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Processus d'apprentissage à distance et téléconférence assistée par ordinateur: essai d'analyse

France Henri

Résumé: L'article analyse le processus d'apprentissage à distance qui peut être engendré par la téléconférence assistée par ordinateur. En s'appuyant sur des principes théoriques proposés par Gavrlel Salomon, l'article analyse le mode de fonctionnement de cette technologie. Les résultats mettent en lumière ses principales caractéristiques communicationnelles qui sont : la participation active des usagers; la construction du contenu par les usagers; le recours au processus de traitement de l'information qui met à contribution certaines habiletés cognitives de l'usager; la socillsation; la décontextualisation du discours et l'objectlvation de la pensée. L'analyse fournit un cadre conceptuel qui contribue au développement d'une compréhension plus profonde du processus d'apprentissage à distance suscité par l'utilisation de la téléconférence assistée par ordinateur,

Abstract: The article presents the distance learning process occuring when using computer-mediated communication. An analysls of the functioning mode of this technology is conducted based on theoretical principals developed by Gavriel Salomon. The results show the main communication characterstcs of the technology, includlng: active participation of the users; construction of the content by the users; activation of certain cognitive skills related to nformation processng; socialization; decontextualisation of the discourse and objectivation of thinking. The analysis provides a conceptual framework for understanding the distance learning process by computer-mediated communication.

QUELQUES CARACTÉRISTIQUES PERTINENTES DE LA TELECONFÉRENCE ASSISTEÉE PAR ORDINATEUR (T.C.A.O.)

La téléconférence assistée par ordinateur (T.C.A.O.) se caractérise par l'échange de messages textuels, individuels ou de groupe, par voie télématique. L'usager communique par T.C.A.O. en rédigeant des messages que l'ordinateur met en mémoire. D'autres usagers peuvent lire ces messages et en rédiger de nouveaux. La plupart des logiciels de T.C.A.O. offrent, outre la téléconférence pour les discussions de groupe, un éventail de fonctions plus ou moins diversifiées: prise du vote et décompte des voix exprimées, évaluation de messages, bottin des usagers, répertoire des téléconférences, recherche par mot clé, branchement à l'intérieur des téléconférences, etc. Ces fonctions sont autant de moyens de traiter l'information transmise par les usagers et mise en mémoire dans l'ordinateur central.

Marquée par l'interactivité, la T.C.A.O. est néanmoins fort différentede la communication interactive en face à face. Elle permet, à certains égards, une interaction plus forte. La pression sociale qui découle de la simple présence physique des personnes se trouve réduite, favorisant une plus grande liberté d'expression et des réactions plus spontanées de la part des participants (Johansen et al., 1979). Ceux-ci ont un contrôle total du délai de réponse et ils peuvent prendre le temps nécessaire pour étudier le contenu des messages et y réfléchir afin de fournir une réponse plus complète.

Pour être efficaces, les discussions de groupe doivent être soumises à certaines conditions. Ces conditions exigent des membres du groupe qu'ils développent des habiletés, des attitudes et une forme de discipline qui ne ont pas nécessairement partie de leurs acquis et du profil de leurs comportements. Certains usagers peuvent avoir de sérieuses réserves à communiquer par écrit: soit qu'ils maîtrisent mal les habiletés d'écriture soit qu'ils n'aient pas une très forte image d'eux-mêmes et qu'ils craignent alors de voir leurs interventions immortalisées dans la mémoire de l'ordinateur. Ecrire semble aussi créer des problèmes aux usagers qui ne s'estiment pas assez scolarises; leur capacité d'échanger peut ainsi être inhibée (Johansen et a1.,1979; Phillips, et Pease, 1985). Selon Shapiro et al. (1987), l'utilisation de la T.C.A.O. exige que les usagers possèdent une certaine aisance lorsqu'ils communiquent par écrit; ils doivent être capables de s'exprimer clairement et maîtriser les habiletés qui se rapportent à la compréhension et à l'analyse de texte. La participation constitue un des plus importants facteurs de succès de la T.C.A.O. Cette technologie ne peut être productive que si les usagers s'engagent à y participer activement et régulièrement; ceci exige une forte motivation de leur part. Si les usagers n'éprouvent pas un réel besoin de communiquer entre eux, la T.C.A.0. risque de ne pas fonctionner (Kerr & Hiltz, 1982; Hiltz, 1983).

Enfin, pour qu'une téléconférence se déroule bien et qu'elle soit efficace, l'intervention d'un animateur choisi parmi les membres du groupe est presque toujours nécessaire. L'animateur doit faire preuve de leadership pour aider le groupe à atteindre ses objectifs. Il doit maîtriser les techniques d'animation spécifiques à la T.C.A.O. et les appliquer aux moments opportuns afin éviter les échanges inutiles ou hors contexte (Johansen et al., 1979; Brochet, 1985).

LA T.C.A.O. ET L'APPRENTISSAGE A DISTANCE EN GROUPE

Les expériences d'utilisation de la T.C.A.O. en formation à distance tendent à démontrer son influence déterminante sur le processus d'apprentissage. La T.C.A.O., parce qu'elle peut se faire en différé, rend possible une meilleure réflexion sur le contenu; l'étudiant peut s'attarder plus longtemps sur un commentaire particulier, revoir à tout moment un aspect de la téléconférence qu'il souhaite mieux comprendre ou qu'il considère plus important. Comparativement aux réunions en face à face, la T.C.A.O. laisse aux usagers un temps d'analyse et engendre une dynamique de participation sans que les "luttes" pour le droit à la parole n'interviennent. Ainsi, les participants réagissent davantage au contenu d'une communication qu'aux attributs physiques de l'auteur du message (âge, apparence physique, statut) (Harasim, 1987).

La T.C.A.O., en permettant des rapporta directs entre les apprenants de même qu'entre les apprenants et les enseignants (ou tuteurs), brise l'isolement, stimule la participation et induit un processus d'apprentissage nettement distinct. Ce processus repose sur la participation et la communication entre les pairs alors que celui qu'engendrent les médias traditionnellement utilises en formation à distance mise presqu'exclusivement sur l'auto-apprentissage. Les observations faites jusqu'à présent montrent que l'interactivité entre les apprenants provoque des effets très positifs sur l'apprentissage. De plus, elle permettent le développement de nouvelles activités d'apprentissage plus stimulantes qui favorisent l'engagement des apprenants face à leur apprentissage (Kaye, 1987; Hiltz, 1986).

On peut faire des hypothèses sur les effets de la participation et de l'interactivité qui caractérisent la T.C.A.O. en s'appuyant sur les recherches portant sur ledéveloppement cognitif. Certains auteurs soutiennent que l'interactivité peut favoriser le développement cognitif en plaçant les personnes dans une situation de dispute. La rencontre de leurs propres concepts cognitifs et de leurs pointa de vue avec ceux des autres crée des conflits cognitifs positifs qui donnent lieu au développement de constructions mentales plus élaborées. Les interactions sociales, en ce sens, seraient essentielles à la croissance cognitive (Clement et Nastasi, 1988).

La T.C.A.O. offre donc aux apprenants la possibilité de discuter, de poser des questions, de résoudre des problèmes en groupe. Or, le groupe constitue un facteur environnemental important dans l'apprentissage. Il représente un lieu privilégié d'interactions entre les participants et contribue à générer une esprit de corps. Le groupe de travail intellectuel (réflexion, décision, formation, résolution de problème) possède son énergie propre et produit des performances supérieures à celles réalisées par un membre moyen du groupe (Hiltz et Turoff, 1982). Le gain s'explique par la somme d'informations disponibles dans le groupe, par une plus grande diversité d'interprétations des faits, par la mise à l'épreuve des idées individuelles. Aussi le groupe libère l'individu de l'insécurité du travail intellectuel et le rend capable de proposer et d'expérimenter des idées nouvelles. Non seulement le groupe arrive-t-il a une performance supérieure, mais les individus participant à un travail de groupe apprennent davantage que les individus à capacités égales travaillant seuls (Mucchielli, 1984). L'osmose sociale, la circulation des idées et un plus grand engagement personnel faciliteraient l'assimilation, la mémorisation et la compréhension.

A partir des travaux sur le rôle des groupes réunis en face à face, certains auteurs font des hypothèses sur les avantages pédagogiques de la communication de groupe et tentent d'observer s'ils se reproduiront avec la T.C.A.O. Il apparaît que le groupe induit une démarche d'apprentissage collective et coopérative, où les savoirs et les expériences de tous les apprenants sont mis à contribution (Shapiro et al, 1987). La T.C.A.O., par sa structure interactive, amène les usagers à aborder l'apprentissage selon un mode coopératif qui valorise le savoir collectif (Meunier et Henri 1987; Harasim et Wolfe, 1988). Le contenu de formation se construit collectivement, par les interventions et les interactions; ainsi, dans l'activité pédagogique de solution collective de problèmes, les solutions possibles émergent des apprenants, alimentant ainsi le contenu et la dynamique d'apprentissage (Henri et Leacop, 1987).

Harasim (1989), comme plusieurs autres auteurs, affirme que l'interactivité est la principale caractéristique de la T.C.A.O. et qu'elle constitue le principal facteur qui influe sur le processus d'apprentissage. La T.C.A.O. modifie la nature des interactions d'apprentissage et en augmente la qualité; elle offre la possibilité d'élaborer un large éventail d'activités d'enseignement et d'apprentissage. Aucun autre média ne permet aux groupes, dont les membres sont disperses, de communiquer de manière interactive par des échanges textuels, asynchrones, sauvegardés sur support informatique. Cette dernière caractéristique de la T.C.A.O. est fondamentale. La sauvegarde des messages textuels offre la possibilité de revoir les échanges sous forme d'imprimés, de les analyser et de les comprendre avec la même rigueur que celle que l'on applique à l'analyse de textes (McCreary, 1989).

L'interaction, selon Harasim (1987), permet à l'étudiant à distance de participer à un processus d'apprentissage "collaboratif" qui se distingue des autres modes d'apprentissage. L'apprentissage collaboratif réserve à l'apprenant un rôle de participant actif, fortement engagé dans la construction des connaissances. L'étudiant construit ses connaissances dans le cadre de discussions avec ses pairs et des experts. Les connaissances, selon cette théorie, émergent du dialogue actif, par la formulation d'idées transmises sous forme textuelle et par la construction d'idées et de concepts à partir des messages élaborés par d'autres apprenants.

Pour qu'il y ait apprentissage collaboratif, comme le souligne Harasim, il faut que les activités d'apprentissage proposent une structure de tâche coopérative, c'est-à-dire qu'elles reposent essentiellement sur la participation active de l'apprenant et sur l'interaction des pairs dans le but d'atteindre un but commun. Harasim fait observer que l'utilisation de la T.C.A.O. dans un cours à distance ne garantit pas automatiquement que les étudiants s'engageront dans un processus d'apprentissage basé sur la collaboration. Certaines variables doivent être prises en compte, entre autres: la nature de la tâche, la matière enseignée, les caractéristiques du groupe et les caractéristiques individuelles des apprenants. Ces variables influent sur la participation et par conséquent, sur l'interaction.

La recherche a permis de développer un corpus assez important de connaissances sur l'utilisation pédagogique de la T.C.A.O. La plupart des écrits que nous avons recensés concluent que la qualité de la participation par T.C.A.O. est supérieure à celle que l'on observe en face à face (Hiltz, 1985; Haile et Richards, 1984; Brochet, 1985; McCreary et Van Duren, 1987, McCreary 1989; Mason, 1989). Toutefois, dans ces écrits, les auteurs ne précisent pas en quoi la participation des apprenants est supérieure ni ne donnent des indications sur la méthode d'analyse des messages qui les amène à tirer une telle conclusion. Quant au processus d'apprentissage, bien qu'il soit longuement décrit, les auteurs ne semblent pas non plus disposer d'outils ou de critères pour en faire une évaluation systématique. Les résultats publiés jusqu'à présent ne nous permettent pas de conclure hors de tout doute que le processus d'apprentissage est véritablement enrichi. Le fait que les étudiants communiquent entre eux, qu'ils prennent part à de nombreux échanges, qu'ils consacrent plus de temps au cours par T.C.A.O. et qu'ils entretiennent des relations égalitaires avec le tuteur. Les résultats ne suffit pas à prouver qu'il y a un enrichissement du processus d'apprentissage.

Sur le plan méthodologique, la recherche sur la T.C.A.O. ne s'est pas encore dotée d'outils rigoureux pour analyser et comprendre le processus d'apprentissage à distance de tel qu'il se révèle dans les téléconférences. Quelques tentatives ont quand même été faites pour mettre au point des méthodes qualitatives d'analyse de contenu. A cet égard, les travaux de Elliset McCreary (1985), de Waugh et al. (1988) proposent des approches méthodologiques intéressantes mais elles demeurent encore incomplètes. Leurs démarches représentent un net effort pour catégoriser les messages, pour clarifier la notion d'interaction, pour préciser le degré d'interactivité entre les messages (lien, absence de lien, faux lien entre les messages) et pour représenter visuellement la structure du contenu d'une téléconférence par des tracés ou des communicogrammes. Néanmoins, ces outils méthodologiques n'ont pas été développes pour décrire le processus d'apprentissage; il aident à saisir la dynamique qui caractérise la communication par T.C.A.O. Il reste donc un travail important à faire pour développer une méthode complète et spécifique qui guiderait l'analyse du contenu des messages afin de mieux comprendre le processus d'apprentissage induit par la T.C.A.O.

En résumé, la recherche sur la TC.A.O. a prouvé que cette technologie convient à l'apprentissage à distance parce qu'elle est bien acceptée par les étudiants et que le taux de participation est suffisamment élevé pourjustifier son utilisation. Les chercheurs doivent maintenant travailler au développement d'outils d'analyse de contenu qui permettent de mettre en lumière de manière précise la richesse que l'on attribue aux messages par T.C.A.O. et au processus d'apprentissage qu'ils induisent. Pour mettre au point ces outils, les chercheurs devront préciser l'impact de cette technologie sur l'apprentissage en décryptant dans le contenu des messages les éléments révélateurs du processus d'apprentissage et les signes de son extériorisation. Comme première étape de ce travail, nous proposons une analyse de la T.C.A.O. pouvant mener au développement d'outils méthodologiques pour décoder le contenu des messages et décrypter le processus d'apprentissage.

L'ANALYSE DE LA T.C.A.O. COMME MEDIA EDUCATIF

L'analyse que nous faisons de la T.C.A.O. comme média éducatif adopte une perspective cognitiviste et elle est guidée par les hypothèses issues de la recherche sur les propriétés éducatives des médias. Le cadre théorique que nous appliquons permet d'analyser le mode de fonctionnement d'un média ou d'une technologie de communication et d'inférer les effets qu'il peut avoir sur l'apprentissage.

Quelques hypothèses issues de la recherche sur l'apprentissage par les médias

Il existe actuellement deux grands courants de recherche sur les médias. Le premier courant tend à démontrer que la principale variable de l'apprentissage par les médias se rapporte au contenu du message; le second propose que le media constitue par lui-même une variable importante du processus d'apprentissage. Selon Clark (1988), qui appartient au premier courant, tous les médias peuvent être placés au même rang quant à leur efficacité pédagogique. Aucun n'aurait de propriété spécifique; les chercheurs qui s'associent à cette école soutiennent que la variable première qui influe sur l'apprentissage, c'est le contenu. En conséquence, il importe que le contenu du message soit bien structuré et adapté à l'apprenant, et que la méthode d'enseignement qui intègre ce contenu, soit efficace. Salomon appartient au second courant. Il propose que les médias en eux-mêmes influent sur l'apprentissage. Selon lui, tous les médias seraient différents et auraient des effets spécifiques tributaires des caractéristiques propres à chacun. La différence entre les médias ne se situerait pas au niveau du contenu du message mais plutôt au niveau des processus cognitifs et psychologiques induits chez l'apprenant. Chaque média déclencherait le recours à des processus d'apprentissages spécifiques. L'apprentissage par les médias ne se limiterait pas uniquement au contenu transmis mais il se doublerait d'acquisitions reliées aux processus mis à contribution par l'apprenant pour extraire l'information transmise par le media et pour la traiter (Salomon, 1981). Ainsi, l'utilisation d'un media entraînerait le développement d'habiletés non visées dans les objectifs d'apprentissage reliés à la présentation du contenu. Cette hypothèse tend à être corroborée par les recherches de Salomon (1974) qui propose que les médias se distinguent par leurs systèmes symboliques et les procédés techniques qu'ils utilisent. Par exemple, dans une recherche sur le film et la télévision, Salomon (1972) montre que les procédés techniques particuliers à ces deux médias mettent à contribution des habiletés spécifiques que l'usager intérioriserait. Par exemple, la technique du "zoom out, zoom in" aurait pour effet de développer la stratégie analytique qui amène l'usager à distinguer les parties d'un tout. Au cours d'une expérience plus récente avec l'ordinateur, Salomon (1988) montre que les procédés informatiques de l'intelligence artificielle inciteraient les élèves à intérioriser une démarche métacognitive.

Salomon explique sa théorie de la manière suivante. Ce sont les systèmes symboliques des médias qui seraient responsables des habiletés que l'usager utilise pour extraire l'information et la traiter. Chaque media aurait une fonction psychologique qui lui est propre et entraînerait des réactions cognitives spécifiques. L'effet d'un média se traduirait par un ensemble des réactions psychologiques et cognitives chez l'usager. Ainsi, l'apprentissage se rapportant au contenu se doublerait d'un autre type d'apprentissage exclusivement tributaire du système symbolique et des procédés techniques du media.

Les systèmes symboliques n'expliquent pas à eux seuls les effets des médias. Bates (198 l), à l'instar de Salomon, fait la distinction entre le système symbolique, le contenu et le mode de présentation pour mieux cerner le mode de fonctionnement d'un media et identifier ses effets. Le contenu réfere à l'ensemble des informations que l'on veut transmettre (faits, idées, concepts, etc.). Le système symbolique est l'ensemble des symboles utilises pour encoder un contenu selon des règles précises. Le mode de présentation du contenu est défini par le style de présentation et le degré de conviction (Salomon, 1981, p. 78). Le style de présentation se rapporte au type de discours utilise (par exemple, ladescription journalistique, l'exposé scientifique ou factuel, la fable, etc.). Le degré de conviction est déterminé par la structuration, la complexité, la concision et la redondance du contenu.

Les médias auraient donc des effets psychologiques et cognitifs dont l'usager est plus ou moins conscient, et ces effets seraient engendres par le mode de fonctionnement des médias. Les médias entraîneraient des apprentissages qui ne sont pas attribuables aux contenus d'information, mais plutôt aux habiletés et aux processus utilisés pour extraire l'information. La tableau 1 présente cette théorie de manière synthétique.

TABLEAU 1
Effets du mode de fonctionnement des médias

Média		Apprentissage
Mode de Fonctionnement	>	Effets du Mode de Fonctionnement
Contenu Système symbolique Mode de présentation	>	Extériorisation d'habiletés cognitives et des processus psychologiques

LE MODE DE FONCTIONNEMENT DE LA T.C.A.0.

Pour tenter de mieux comprendre le processus d'apprentissage induit par la T.C.A.O., il importe d'analyser le mode de fonctionnement de cette technologie. Le but est d'identifier, sur le plan théorique, les habiletés cognitives et les processus psychologiques mis à contribution par l'usager.

L'analyse du mode de fonctionnement de la T.C.A.O. porte sur l'interaction entre les stimuli externes du média (contenu, symbolique et mode de présentation) et les processus internes qui supportent l'apprentissage. Elle s'emploie à identifier les processus et les habiletés qui pourraient être mises à contribution par l'usager au cours des échanges par T.C.A.O. Nous étudions successivement :

- le contenu;
- le système symbolique; et
- le mode de présentation de la T.C.A.O.

Le contenu

Contrairement à ce que nous connaissons des autres médias écrits (comme l'imprimé, le vidéotex et le télétext), la T.C.A.O. place l'usager dans une situation où il construit le contenu avec d'autres usagers. Non seulement doit-il lire des messages mais aussi en rédiger. La lecture passive, c'est-à-dire la nonparticipation à l'élaboration du contenu, ne lui permet pas de contribuer à l'élaboration du contenu.

Dans une situation pédagogique, le contenu des téléconférences n'est pas conçu à l'avance par l'enseignant; il se développe grâce à la participation des apprenants. L'usager-apprenant doit pouvoir comprendre les messages transmis par les autres participants et y repondre de manière pertinente, logique et socialement acceptable. Ainsi, le contenu se bâtit par une série d'interactions entre les participante.

L'élaboration du contenu mise essentiellement sur l'initiative des usagers. Pour être considérés comme participants à une téléconférence, les usagers ne peuvent se cantonner dans un comportement de lecteur passif. Ils doivent témoigner de leur présence et de leur implication dans le processus de construction de contenu en laissant des traces sous forme de messages. C'est alors qu'ils peuvent être perçus et reconnus comme membres d'une téléconférence.

Progressivement, message après message, avec l'apport de tous les participants, le contenu s'élabore. Selon Feenberg (1987) ce procédé fait naître un certain suspens dans les échanges, éveille la curiosité, surprend parfois par l'orientation imprévue des débats, suscite la participation active et stimule la motivation. De plus, pour l'usager, le fait d'être cité et de voir sa pensée reprise dans les messages, ne laisse généralement pas indifférent; c'est en soi une source de gratification et de motivation.

Trois propositions peuvent être inférées à partir des observations sur la manière dont le contenu de la T.C.A.O. s'élabore. Elles portent sur les habiletés cognitives que l'usager doit mettre à contribution pour traiter l'information et sur le processus social qui y est associé.

- Pour participer activement à des échanges par téléconférence, l'usager aurait recours à des habiletés cognitives qui permettent d'organiser et de structurer sa propre pensée, de la traduire sous forme dénoncés verbaux et de la livrer dans les messages textuels.
- Le processus d'écriture collective suppose que l'usager comprenne la pensée des autres, qu'il y réagisse avec pertinence et qu'il fasse avancer les débats de manière logique et cohérente. L'information nouvelle transmise dans les messages doit être traitée en fonction de celle que l'usager possède déjà.
- Participer activement à la construction du contenu présente des exigences non seulement au niveau du traitement de l'information, mais aussi au niveau social. Etre membre actif d'une télécon férence nécessiterait de l'usager une démarche de socialisation pour s'intégrer au groupe et s'y faire accepter. Ce serait une condition de base pour être reçu et entendu par les autres usagers. La dynamique sociale au sein d'un groupe serait aussi un facteur important qui influe sur le contenu.

Le systéme symbolique

Un système symbolique est composé d'un ensemble d'éléments (mots, figures, chiffres) que l'on utilise selon des règles et des conventions précises Les systèmes symboliques servent à représenter la réalité. Bates (1981) classe les systèmes symboliques en trois catégories: digital, analogique et iconique. Un système digital est composé d'éléments discontinus et non ambigus qui peuvent être organisés selon des lois précises (l'écrit par exemple); un système analogique comporte des éléments continus, associés à l'émotivité (la musique par exemple); un système iconique utilise essentiellement des représentations picturales La T.C.A.O. n'utilise qu'un seul système symbolique: l'écrit. Pour comprendre les effets que peut entraîner le recours à l'écriture chez l'usager, nous résumons les résultats de récents travaux qui montrent comment l'acte d'écrire peut influencer le développement de la pensée.

Le langage en général, et l'écriture en particulier, ont une fonction instrumentale: ils servent à concrétiser la pensée. Toutefois, le langage écrit n'est pas uniquement un instrument que la pensée utilise pour s'exprimer; bien plus, il joue un rôle important pour faciliter et structurer le développement de la pensée propositionnelle. Sous ce vocable, Bruner (1975 in Glatthorn, 1985) distingue deux notions: 1) la compétence à communiquer qui se traduit par l'habileté à penser et à communiquer au sujet des réalités concrètes, et 2) la compétence analytique qui met en jeu un processus de pensée sur le langage, et des structures propositionnelles sans lien avec le contexte concret.

Le langage écrit joue de toute évidence un rôle important dans le développement de la compétence à communiquer. Dans notre culture, sans la maîtrise du langage écrit, une partie importante de la compétence à communiquer serait évacuée, Il semble que l'acte d'écrire soit également un facteur important dans le développement et l'application de la compétence analytique. L'écriture crée une distance entre le scripteur et la réalité concrète: elle en facilite l'analyse. Cette distance amène le scripteur à reconstruire les connaissances qu'il possède, à planifier sa communication et à structurer son message. En procédant ainsi, le scripteur établit une séparation entre ce qu'il est, et la réalité qu'il veut traduire. Cette démarche d'objectivation est une condition essentielle au développement de la compétence analytique.

Les travaux sur le processus d'écriture reconnaissent que traduire les opérations inhérentes à l'expression des idées sous forme de langage écrit pose d'énormes demandes au niveau des processus cognitifs et que la révision et la correction auxquelles le scripteur a recours de manière continuelle contribuent au développement des habiletés à penser. (Nightingale, 1988).

L'écriture peut faciliter l'émergence de la pensée tacite (Glatthorn, 1985) ou de la connaissance inerte (Bransford, et al. 1986). Il s'agit de ces connaissances que le scripteur possède et qui sont logées dans son esprit sans qu'il ne les utilise lorsqu'il serait logique de le faire. L'acte d'écrire les fait émerger; il entraîne essentiellement une exploration de l'univers mental et la découverte de ce qu'il pense. Cette découverte s'opère parce que, selon Eming (19'77), écrire amène le scripteur à intégrer les connaissances et les informations qu'il possède; l'aide à établir des liens et des rapports entre les idées et permet de revoir et d'évaluer sa pensée.

L'interrelation entre l'acte d'écrire et le fait de penser, laisse supposer qu'il existe aussi un lien entre écrire et apprendre à penser. Glatthorn (1985) écrit, en citant Berthoff (1978), qu' "apprendre à écrire est une façon d'apprendre à penser...penser requiert que l'on sache comment découvrir et utiliser les ressources du langage" (p.67).

En résumé, les recherches sur le processus d'écriture établissent le lien entre l'acte d'écrire et celui de penser; elles tendent aussi à démontrer qu'écrire favorise le développement d'habiletés cognitives (habiletés à penser). Puisque la T.C.A.O. est un media textuel, nous sommes amenée à formuler les propositions suivantes

- la T.C.A.O. peut s'avérer un soutien médiatique qui favorise le développement des habiletés cognitives propres au traitement de l'information parce qu'elle exige de l'étudiant qu'il comprenne et analyse les messages qu'il lit; qu'il apporte des informations nouvelles; qu'il traite celles qu'il possède déjà pour exposer ses idées et défendre son point de vue.
- la T.C.A.O., parce qu'elle garde en mémoire tous les messages, permettrait à l'étudiant, avec l'aide de l'enseignant, d'observer, d'analyser et d'évaluer ses habiletés cognitives; cette application favoriserait le développement de la métacognition.

LQ mode de présentation de la T.C.A.O.

Nous avons dit plus haut que le mode de présentation comporte deux dimensions: le style de présentation et le degré de conviction. Nous verrons ici comment chacune opère dans la communication par T.C.A.O.

Le style de présentation du contenu des téléconférences est qualifié de dialogique. Cette caractéristique peut être exploitée de manière efficace dans une situation d'apprentissage. Paul (1986) montre la valeur pédagogique du dialogique et l'importance de développer la ***pensée*** dialogique. Paul décrit la 'pensée dialogique" comme le processus de questionnement par lequel on remet en cause, de manière spontanée et naturelle les idées qui nous viennent à l'esprit. La pensée dialogique amène à s'interroger sur les croyances et à examiner les différents systèmes logiques qui peuvent être appliques à un même problème. Il soutient qu'on apprend à penser de manière critique et éclairée lorsqu'on remet en question les idées reçues, lorsqu' on cesse de s'identifier avec ses propres conceptions et les croyances qu'on présume justes. Selon Paul, un très grand nombre de personnes ayant atteint l'âge adulte ne sont pas arrivées, au cours de leur développement, à maîtriser ce stade de pensée. Plusieurs continuent à utiliser des théories égocentriques sur les autres et sur le monde. "Nous organisons nos expériences et nous portons des jugements à partir de théories et d'assomptions que nous n'admettrions pas avoir si on nous le demandait" (Paul, p. 132. C'est nous qui traduisons).

Adopter une pensée dialogique, c'est être capable d'explorer des concepts et de découvrir les différents systèmes logiques qui peuvent être appliques à un même problème. Pour développer la pensée dialogique, Paul propose de placer les enfanta dans des situations non menaçantes pour qu'ils découvrent des pointa de vue opposés, pour qu'ils expriment leurs idées par des mots (langage verbal ou langage écrit), qu'ils élaborent des conclusions et qu'ils les justifient. Au cours d'échanges en groupe, l'enseignant peut guider une telle démarche qui, dans un premier temps, vise à aider l'apprenant à découvrir ses propres assomptions et celles des autres, et dans un deuxième temps, ses propres incohérences et celles des autres.

Puisque la T.C.A.O. opère sous forme de dialogue écrit où s'applique l'égalité du droit d'expression, elle pourrait favoriser chez l'usager, le développement d'une pensée dialogique et critique envers ses propres idées et celles des autres.

Le degré de conviction se rapporte aux procédés utilises pour rendre le discourscrédibleetconvaincant. Le degréde conviction de la T.C.A.O. peut être analysé en relation avec la communication verbale face à face. Le contexte physique dans lequel se déroule la communication en face à face constitue en lui-même, un élément majeur de conviction. En plus de la parole, de nombreux codes interviennent dans la communication et la rendent polysémique (le langage corporel, le ton de la voix, le contexte, les signes tacites qui proviennent de l'environnement). Ces codes sont utilisés par le locuteur pour convaincre; ils permettent aussi à l'interlocuteur d'interpréter avec justesse ce qui est communiqué (Feenberg, 1987). La communication écrite est moins complète et moins riche de sens et le message tend à être univoque. La pansée, une fois exprimée sous forme d'écrit, se détache de son auteur et acquiert une certaine objectivité. Tout en gagnant permanence et mobilité, elle y perd en conviction et devient impersonnelle.

On pourrait supposer que la T.C.A.O., parce qu'elle est uniquement textuelle et médiatisée par ordinateur, donne lieu à une communication froide et impersonnelle. Pourtant cela ne semble pas être l'avis des usagers de la T.C.A.O. Au contraire, ils ont l'impression que la T.C.A.O. leur donne un accès direct au processus de pensée des autres participants, sans être distraits par les différents codes de langage qui interviennent dans la communication en face à face ni par les situations compliquées et embarrassantes où sont mêlées les rôles, les statuts, le jeu d'influence et de pouvoir. (Feenberg, 1987). La communication par T.C.A.O. suscite des échanges libres de contraintes sociales et souvent plus intense. Pour pallier les limites de la communication écrite, décontextualisée, l'usager de la T.C.A.O. aura tendance à construire des messages explicites, dans un style direct. Il cherche à traduire efficacement le cheminement de sa pensée et de ses émotions.

En somme, le mode de présentation de la T.C.A.O. adopte un style dialogique dont le degré de conviction exploite avantageusement l'absence de contexte physique. Dans une situation d'apprentissage, le mode de présentation de la T.C.A.O. peut avoir les effets suivants.

- Les interactions dialogiques entre les apprenants, adéquatement encadrées par un enseignant, peuvent favoriser l'émergence d'une pensée dialogique et critique.
- Le degré de conviction du message par T.C.A.O. est tributaire de la capacité de l'apprenant à exploiter l'absence de contexte physique et de son habileté à exprimer ses idées, ses sentiments et ses émotions sous forme textuelle.

Nous pouvons décrire le mode de fonctionnement de la T.C.A.O. de la manière suivante.

- La T.C.A.O. réserve aux usagers la responsabilité de construire le contenu de la communication.
- Le texte écrit est le seul code de langage dont dispose l'usager.
- Les messages textuels se succèdent dans une série d'échanges dialogiques dont le degré de conviction semble inférieur à celui de la communication écrite telle qu'on la conçoit généralement.

Le tableau 2 résume le mode de fonctionnement de la T.C.A.O.

TABLEAU 2
Mode de fonctionnement de la T.C.A.O.

Structure de fonctionnement	Fonctionnement de la T.C.A.O.
Contenu	A construire, en groupe
Système symbolique	Écrit
Mode de présentation	
- style de présentation	Dialogue
- degré de conviction	Variable, selon le but la communication et les habiletés de l'usager

Ainsi décrit, le mode de fonctionnement de la T.C.A.O. permet d'inférer la nature des habiletés mises à contribution par l'usager. Ce sont:

- des habiletés cognitives qui se rapportent au traitement de l'information pour structurer et élaborer les messages;
- des habiletés métacognitives qui se rapportent à l'objectivation de la pensée induite par l'acte d'écrire; et
- des habiletés d'ordre psychologique qui se rapportent à la socialisation et au sentiment d'appartenance au groupe.

Le tableau 3 présente les effets du mode de fonctionnement de la T.C.A.O.

TABLEAU 3
Effets du mode de fonctionnement de la 7YC.A.0.

Structure du fonctionnement >	Fonctionnement de la T.C.A.O. >	Effets Cognitifs	Effets Psychologiques
Contenu	A construire, en groupe	Interactivité cognitive	
Systéme symbolique	Ecrit (décontextualisation)	Objectivation de la pensée Métacognition	Socialisation
Mode de présentation			
- style de présentation	*Dialogue	Interactivité - sociale - cognitive - métacognitive	Appartenance au groupe
- degré de conviction	*Variable, selon le but de la communication et les habiletés de l'usager		

CONCLUSION

L'analyse du mode de fonctionnement de la T.C.A.O. met en lumière les caractéristiques communicationnelles de cette technologie. Ce sont:

- la participation aux échanges;
- l'interactivité par laquelle se construit le contenu;
- le traitement de l'information qui met à contribution certaines habiletés cognitives;
- la socialisation au cours des échanges; et
- la décontextualisation du discours et l'objectivation de la pensée qui peuvent inciter à l'extériorisation de la métacognition.

L'exercice que nous avons entrepris ne procure pas uniquement une meilleure connaissance du mode de fonctionnement de la T.CA.O. Le produit de cette analyse fournit la base pour l'élaboration d'un cadre conceptuel pour nous aider à mieux comprendre le processus d'apprentissage à distance engendré par la T.C.A.O. Il permet également la formulation d'hypothèse sur les facteurs spécifiques à cette technologie peuvent influer sur le processus d'apprentissage à distance.

RÉFÉRENCES

Bates, A. (1981). Efficacité du message et système éducatif. ***Communication,*** 33, p. 25-49.

Bransford, J.D., Sherwocd, R.D., & Sturdevant, T. (1986). Teaching thinking and problem solving. In J.B. Baron & R.J. Sternberg (Eds), ***Teaching thinking skills: Theory and practice.*** New York, NY: W.H. Freeman and Company.

Brochet, M. (1985). ***Effective moderation of computer conferences: Notes and suggestions.*** Computing Support Services. Guelph, ON:University of Guelph.

Clark, R. (1988). Educational direction and responsability in educational technology. In ***Technologie et communication éducatives. Actes du VIe Colloque du C.I.P.TE.*** Québec, Télé-université, p, 21-34.

Clement, D.H., & Nastasi, B.K., (1988). Social and cognitive interactions in educational computer environments. ***American Educational Research Journal,*** 25(l), 87-106.

Ellis, M. L., & McCreary, E. K. (1985). ***The structure of message sequence in computer conferences:*** A ***comparative study.*** Paper presented to the Workshop on Computer Conferencing and Electronic Messaging, University of Guelph, Guelph, Ontario.

Eming, J. (1977). Writing as a mode of learning. ***Composition and Communication, 28,*** 122-128.

Feenberg, A. (1987) Computer conferencingand the humanities. ***Instructional Science, 16,*** 169-186.

Glatthorn, A.A. (1985). Thinking and writing: The elusive but important connection. In R. Link ***(éd.), Essays on the intellect.*** VA: ASCD.

Haile, P. J., & Richards, A. J. (1984). ***Supporting the distance learner with computer teleconferencing.*** Paper presented at the 15th Annual Convocation of the Northeastern Educational Research Association, Ellenville, New York. 27 p.

Harasim, L., (1987). Teaching and learning online: Issues in computer-mediated graduate courses. ***Canadian Journal of Educational Communication,*** 16(2), 117-135.

Harasim, L. (1989). ***Online educution as a new domain.*** In R. Mason, & A. Kaye (Eds), ***Mindweave.*** Oxford: Pergamon Press.

Harasim, L., & Wolfe, R.,(1988). ***Research analysis and evaluation of computer conferencing and networking in education.*** Toronto, ON: OISE, Ontario Ministry of Education.

Henri, F., & Lescop, J.Y. (1987). ***La communication assistée par ordinateur en formation à distance: Vers une stratégie de l'implantation de l'innovation. Notes de recherche.*** Québec: Télé-université, Université du Québec.

Hiltz, ***S.*** R. ***(1983). Online communities: A case study of the office of the*** **future.** Norwood, NJ: Ablex Publishing Corporation.

Hiltz, R., (1985). The virtual classroom: Initial explorations of computer-mediated communication systems as an interactive learning space. NJ: New Jersey Institute of Technology, USA.

Hiltz, R. (1986). The virtual classroom: Using computer-mediated communication for university teaching. ***Journal of Communication, 36,*** 95-104.

Hiltz, S. R., & Turoff, M. (1982). ***The network nation. Human communication via computer,*** 4ième édition. Reading, MA: Addison-Wesley Publishing Compagny.

Johansen, R., Vallée, J., Spangler, K. (1979). ***Electronic meetings: Technical alternatives and social choices.*** Reading, MA: Addison-Wesley Compagny.

Kaye, A. (1987). Introducing computer-mediated communication in a distance educations System. ***Canadian Journal of Educational Communication,*** 16(2), 153-166.

Kerr, E. B., Hiltz, ***S.*** R. (1982). ***Computer-mediated communication systems.*** New York, NY: Academic Press.

Mason, R. (1989). An Evaluation of CoSy on an open university course. In R. Mason, & A. Kaye (Eds), ***Mindweave.*** Oxford: Pergamon Press.

McCreary, E. (1989). ***Eliciting more rigourous cognitive outcomes through analysis of computer-mediated discussion.*** Paper prepared for Improving University Teaching Fifteenth International Conference, Vancouver.

McCreary, E., & Van Duren, J. (1987). Educational applications of computer conferencing. ***Canadian Journal of Educational Communication, 16(2),*** 135-166.

Meunier, C., & Henri, F. (1987). Recherche en télématique et formation à distance. In ***Actes du Premier Congres des Sciences de l'Education de tangue française du Canada,*** Québec.

Muchielli, R. (1984). ***Méthodes actives dans lapédagogie des adultes. Connaissance du probleme, applications pratiques,*** 5ième édition. Paris: Librairie Technique/Entreprise Moderne d'Edition.

Nightingale, P. (1988). Understanding processes and problems in student writing. ***Studies in Higher Education, 13(3), 263-283.***

Paul, R. W. (1986). Dialogical thinking: Critical thought essential to the acquisition of rational knowledge and passions. In J.B. Baron, & R.J. Sternberg (Eds), ***Teaching thinking skills: Theory and practice.*** New York, NY: W. H. Freeman and Compagny.

Phillips, A. F., & Pease, P. (1985). ***Computer conferencing and education: Complementary or contradictory concepts?*** Paper presented at the 35th Annual Conference of the International Communication Association, Honolulu.

Salomon, G. (1972). Can we affect cognitive skills through visual media. ***Audio-Visual Communication Review, 20,*** 201-242.

Salomon, G. (1974). Internalisation of filmic schematic operations in interaction with learner's aptitudes ***Journal of Educational Psychology, 66(4),*** 499-511.

Salomon, G. (1981). La fonction crée l'organe. ***Communications, 33,*** 75-101.

Salomon, G. (1988). AI in reverse: Computer tool that turn cognitive. ***Journal of Educational Computing Research, 4(2)*** 123-139.

Shapiro, H., Moller, M., Nielson, N.C., & Nipper, ***S.*** (1987). ***Third generation distance education and computer conferencing in Denmark.*** Paper presented at the Second Symposium on Computer Conferencing, University of Guelph, Guelph, Ontario.

Waugh, M., Miyake, N., Levin, J., & Cohen, M. (1988). ***Problem solving interactions on electronic networks.*** Paper presented at the Annual Meeting of the AERA. New Orleans.

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The Effects of Progressive Illustrations on Recognition of Paired-Associates

Farough Abed

Abstract: An interactive illustrative form known as progression was used in this study involving recognition of paired-associates items. Each stimulus-response pair was presented either side by side (non-interactively) or as a series of four panels, with the stimulus as the flrst panel. two Intermediate panels, and the response as the last panel. The Intermediate panels represented a gradual visual metamorphosis from the first item to the last. Subjects (244 undergraduates) saw elther non-Interactlve stimuli, or progressive stimuli with all four panels or only three panels. Testing occurred elther immediately or after two weeks. The non-interactive treatment group given the delayed test scored signlficantly lower than all other groups. A theory was proposed concerning progression as an interactive technique whlch provides a visual link that stimulates the viewer to create an associative semantic link. This process facilitates communication by engaging the vlewer In the message.

Résumé: Une illustration interactive et progressive fut utilisé dans cette étude sur la reconnaissance d'items pairés et associés, Chaque paire de stimulus réponse fut présenté soit côte à cote (non-interactif) ou dans une série de quatre panneaux: un premier panneau présentant le stimulus, deux panneaux intermediaires, et un dernier représentaient une métamorphore visuelle graduele du premier polnt au dernier. Des sujets (244 étudiants) ont pu remarquer un stimulus non-interactif, ou un sitmulus progressif avec soit quatre panneaux ou trots panneaux. L'analyse a été réaliseé soit immédiatement après l'experimentation ou deux semaines plus tard, tes résultats obtenus par le groupe ayant reçu le traitement non-interactif furent Inférieurs à ceux des autres groupes. Une théorie fut proposée concernant une progression tel qu'une technique interactive fournissont une liaison visuelle pour stimuler le spectacteur à créer une liaison sémantique associée. Ce processus facilite une communicatilon tout en attirant le spectateur vers le message.

Communication through images is afundamental teachingstrategy which has received a great deal of attention from researchers in educational technology. While specific picture variables have been studied (e.g., color, amount of detail, shading), much of the research todate has proceeded on the assumption that most pictures would function identically in a given setting. The theory proposed here adopte an alternative view, assuming that various types of pictures have different effects on the learner. The main impetus for this type

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of study is the creation of memorable images which will increase the probability that picture information will be retained over a long period of time. Of interest in this regard is interactive imagery.

Studies on interactive imagery and illustration have typically depicted the syntactic form ***subject-verb/preposition-object*** to associate two objects, thereby providing a direct correspondence between the illustration and the objects to be linked. The present theory proposes that learners can benefit equally well from complex interactive illustrations which associate concepts rather than objects. These may be defined as illustrations with two or more symbols, whose meanings do not directly reflect the intended message of the total image; the whole is more than the sum of the parts. Three major points summarize the theory. First, the learner interprets each of the symbols and then associates them in some way to derive the meaning of the message. Second, this indirect correspondence between the message and the given symbols forces the viewer to use past experiences and world knowledge to decipher the connection between the symbols, thereby increasing cognitive activity Third, this intensive cognitive analysis should strengthen the memory trace (Lockhart & Craik, 1990).

In essence, then, complex interactive illustrations engage the learner in a visual problem-solving dialogue by not immediately communicating the message. This encourages the learner to be an active participant in the learning process, rather than a passive receiver of information. Initially capturing the attention of the learner is a crucial step that interactive illustrations are capable of achieving.

In what instructional situations might this type of illustration be useful? Certainly their chief advantage is their ability to influence affective behavior, making them more appropriate for arousing emotion than for conveying factual information. For instance, they might be used to shape the learner's attitude in an introductory unit on drug abuse or illiteracy

A study dealing with one type of complex interactive illustrations is presented here. It points to another major attribute of these visuals, which is the potential for producing a long-term impact on memory Ultimately this is a goal which instructional designers and educators alike must look to in creating and choosing their materials for visual communication.

With regard to paired-associates learning, Bower (1972) speculated the facilitative recall effects seen when subjects engaged in mental interactive imagery were due to a strong associative link derived from the interactive image. Most of his subjects, he stated, linked their nouns in subject-verb-object or subject-preposition-object scenes. This allowed for both a semantic connection and an imaginal one, and Bower considered this mnemonic technique extremely helpful in paired-associates learning.

Levin (1981) pointed out that illustrations (external imagery) led to more consistent positive recall effects than mental images (internal imagery). He stated that, "visual perception and interpretation skills are required in internalizing an illustration, whereas cognitive constructions and elaborations are required in creating imaginal representations of verbal messages" (p. 207). The former cognitive skills he considered to be less subject to individual differences and consequently more reliable for memory than the latter skills. He added that interactive images and illustrations were effective mnemonic strategies, and their use lessened the difference between recall results for mental images and illustrations.

A great deal of research has demonstrated the efficacy of interactive illustrations in paired-associates learning, and as in the mental imagery investigations, much of the interaction represents a syntactic relationship between a subject and an object. This could take the form of a spatial relation (e.g., The wagon is on the roof) or an active relation (e.g., The dog is chasing the bicycle). For instance, Lutz and Lutz (1977) usedstimulifrom the Yellow Pages to determine the effectiveness of interactivity with respect to brand-product pairs in advertising. While some of their interactive illustrations utilized letter accentuation (in which some characteristic of the product was depicted in the lettering of the brand name), the facilitative effects could be attributed mainly to the pictorial interaction items (a syntactic subject-object relationship, such as a messenger with a rocket on his back for ***Rocket Messenger Service).***

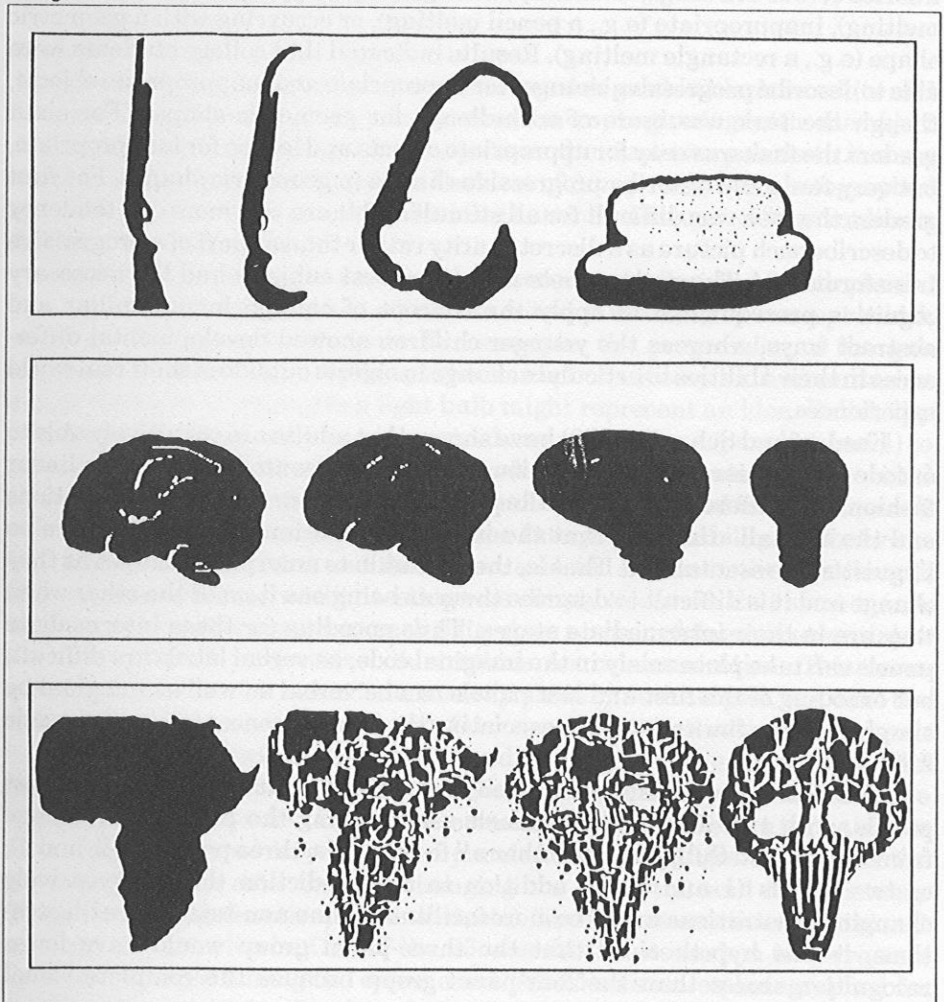
Another interesting study in interactive illustrations emphasized the idea of meaningful vs. non-meaningful interactions. Lippman and Shanahan (1973) used interactive visuals to teach new vocabulary words to elementary school children. In their first experiment they compared three types of letter accentuation with a line drawing condition and a word only condition. Accentuation significantly enhanced recall both immediately and one week after learning, mainly due to the accentuation condition with maximal figural unity; that is, the condition under which some characteristic of the referent was most completely incorporated into the written form of the new vocabulary word. The investigators pointed out, however, that accentuation was not a meaningful form of interaction, a point which led to their second experiment. Familiar noun pairs were presented in one of five forms: written word only; line drawing of response item plus stimulus word; accentuation of one word; verbal presentation of subject-verb/preposition-object sentence; and depiction of this sentence. The last two conditions were considered meaningful interaction conditions, and were found to be more facilitative for recall than accentuation, which in turn proved better than line drawings or written words. Lippman and Shanahan demonstrated that figural unity between the two members of the pair was sufficient to enhance recall, but that a semantic interaction in the form of a subject-verb/preposition-object sentence was even better.

An alternative to a spatial or active interaction is one which might take place on a higher cognitive level requiring the formation of an idea or concept, One study by Abed (unpublished) made use of such an interactive technique in the form of visual puns. These are illustrations that associate two ideas or concepts to create a new meaning, often using a distinctive or witty reference as in a verbal pun. For instance, one visual pun contained the text ***Let my people*** go with the g in go formed by adjoining a hammer and sickle. Comprehension of the visual pun required the association of textual and pictorial information in some new form that was not immediately available to the viewer. In other words, thinking about the visual was necessary for comprehension. Subjects (graduate students) saw either visual puns (interactive illustrations) or non-interactive visuals with equivalent messages. Intermixed with these during the presentation phase were other non-interactive distractor visuals: in Experiment 1 they were non-meaningful messages (pictures of common objects), and in Experiment 2 they were meaningful messages, such as a campaign poster depicting a candidate with a printed name across the top. Both immediate and delayed recognition tests revealed that interactive visual puns facilitated memory significantly more than non-interactive stimuli. However, the type of distractor intermixed with the puns had an effect on memory Long-term recognition memory remained high for visual puns when they were intermixed with non-meaningful distractors, but some decay over time was evident when meaningful distractors were used. This study demonstrated the feasibility of using interactive illustration stimuli for associating other things besides simple concrete nouns, specifically as a mnemonic strategy for concepts requiring higher cognitive levels for comprehension.

A common thread running through all these studies is the use of interactive stimuli in which the interaction occurs in a single illustration. An alternative might be a series of illustrations providing intermediate visuals linking the two pictured items to be associated. Dynamically changing an image of the first item into an image of the second can be achieved in a sequence of three or more visuals. This progressive disclosure of information provides a gradual visual link (or transformation) between the first and last visuals (see Figure 1 for an example on page 23). The two items to be associated are depicted in a series of simultaneously presented visuals which, viewed as a whole, provide the figural unity that Lippman and Shanahan (1973) stated was sufficient for an effective interactive illustration. Choosing two items that are related in some manner (though not necessarily in an obvious one, as in ***dog-***cut) can provide the meaningfulness that they considered necessary to strengthen the mnemonic role of interactive illustrations. This meaning could be conveyed in the syntactic sense through a subject-object relationship. Alternatively it could occur on a higher cognitive level as in the case of visual puns, so that a picture of ***Africa*** progressively changing to a picture of a skull might represent the fate of a continent, or the origin of the oldest human skull. The meaning derived from the picture pair is highly dependent on the individual, and text can be used for the purpose of communicating a specific message to the viewer.

The objective of the present study is to explore the technique of progression as a of interactive illustration. The abundance of research which demonstrates the efficacy of interactive imagery in facilitating memory suggest that showing subjects a progressive visual change between two items to be associated would result in better recognition than simply displaying the two items non-interactively (side by side). The present study is not designed to test the

Figure 1.
Progressive Disclosure of Information.



meaning derived from the visual displays, but merely to test their effectiveness for subsequent recognition.

An historical basis for this type of visual design was provided by the work of Schnall and his associates in the late 1960's and early 1970's. Their work involved the use of visual sequences which showed progressive change in color, position, or shape of the objects represented. Visuals were displayed one at a time rather than simultaneously. Generally the subjects' task required verbalization of the depicted events following presentation of the full sequence, and the results suggested a developmental trend in ability to integrate discrete pictures into a continuous serial change. Of particular interest here was a study by Kasdorf and Schnall (1970), in which the linguistic expression of changes in shape (and other attributes) was measured. Change took place over a series of four drawings, with shape changes being appropriate (e.g., a candle melting), inappropriate (e.g., a pencil melting), or occurring with a geometric shape (e.g., a rectangle melting). Results indicated that college students were able to describe progressive changes for appropriate and inappropriate objects, though the task was more of a challenge for geometric shapes. For sixth graders the task was easy for appropriate objects and less so for inappropriate, but very few could describe progressive change in geometric shapes. For first graders the task was difficult for all stimuli and there was more of a tendency to describe each picture as a discrete entity rather than as part of a progressive transformation. The authors note that the oldest subjects had the necessary cognitive prerequisites to apply the concept of change in unfamiliar and abstract ways, whereas the younger children showed developmental differences in their abilities to articulate change in objects outside of their real world experiences.

Kasdorf and Schnall(l970) have shown that adults are cognitively able to encode and retrieve progressive visual changes presented to them in a linear fashion. The difference between the present series of progressive illustrations and the Schnall stimuli is that the intermediate stimuli used here have no linguistic representations. That is, they are akin to amorphous shapes as they change and it is difficult to describe them as being one item or the other when they are in their intermediate stages. Thus encoding for these intermediate panels can take place solely in the imaginal code, as verbal labels are difficult, but encoding of the first and last panels can be verbal as well as imaginal by simply labeling the items or by associating the two as a concept or in a syntactic form.

The stimuli were designed as easily recognizable items in the first and last panels, with two intermediate panels representing the progressive change from first to last. Subjects saw either all four panels, three panels (1,2, and 4), or two panels (1 and 4). In addition to the prediction that progressively changing illustrations would be more facilitative than non-interactive illustrations, it was hypothesized that the three-panel group would have lower recognition scores than the four-panel group because the complete visual transformation from first to last item was not shown.

METHODOLOGY

Subjects

Two hundred forty-four undergraduates were randomly assigned to one of six treatment groups. The three treatment conditions included two-panel visuals (non-interactive), and three-panel and four-panel visuals (both interactive). Half the subjects in each visual treatment condition were tested immediately after the learning phase and half were tested two weeks later, resulting in six treatment groups. Approximately 40 subjects were assigned to each treatment group. Testing occurred in small groups of 8-11 subjects each (there were four test groups per treatment condition).

Materials

Thirty-two examples of progression were designed in black on white and in equal size. Four separate panels were drawn, beginning with one object which progressively changed its shape over the next two panels to become another object in the fourth panel. Each set of four panels was photographed as a whole with the four panels laid out in a horizontal sequence. The result was 32 black on white slides.

Each pair of items to be associated (pictured in the first and fourth panels) was represented by a phrase which described a meaning or concept which might be derived from the pair. For example, the progression of the gun changing to bread might represent the concept of military vs. humanitarian aid, or the brain changing to a light bulb might represent an idea. Reliability was established by presenting the paired-associates items (panels 1 and 4) to a class of approximately 15 graduate students. The students were provided with a list of the 32 descriptive phrases and they were asked to examine each pair and choose the appropriate descriptor. Interjudge reliability was between 88% and 92% for 25 pairs, and these were selected for use in the experiment. The purpose of this reliability testing was simply to ensure that some meaningful concept could represent each pair, since meaningfulness is essential in the utilization of progressive illustrations for communication. This same meaningful connection was not necessarily made by each subject, nor were the subjects asked what, if any, meaningful connection they made.

At the same time this class also judged the quality of the progression. The judges examined the 32 sets for two reasons. First, panels 1 and 4 needed to be easily recognized. Second, the progression designs werejudged in terms of how the changes occurred in each of the panels, with the judges looking for the presence of jump cuts (images changing too abruptly) and inconsistency (images changing direction, placement, etc). The 25 sets mentioned above met all these design criteria. One of the 25 was chosen at random to serve as a teaching example during the experiment. All 25 sets were photographed for slides twice more, using first panels 1 and 4 and then panels 1, 2, and 4. These two new sets were to serve as example and stimulus items for the two-panel and three-panel treatment groups. Again panels were photographed in a horizontal sequence.

The next phase involved establishing the reliability of the distractor items to be used during testing. Because the test was a four-item multiple-choice format, it was important that the three distractor items in the response not be related in any way to the stimulus items. Eight students were involved with this test. They were shown the stimulus panel and three distractors from each of the 24 stimulus sets, and were asked to identify any distractors which were either semantically or visually related to the stimulus panel. Distractor items were similar in size, placement, and lack of color to the stimulus sets, and were

Figure 2.
Sample Test Item with Stimulus Item on Left and Response or Distractor on Right. Correct Answer is "A".

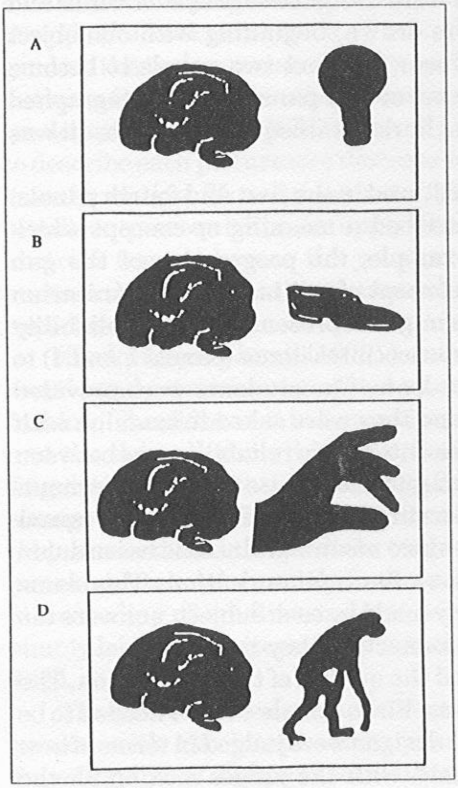
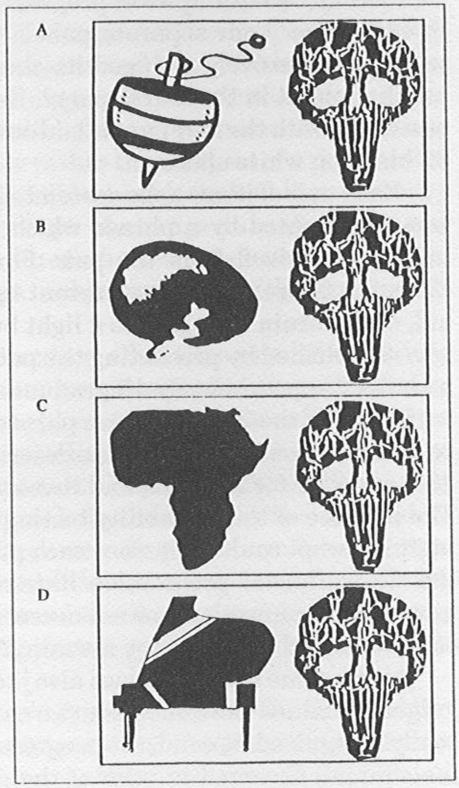


Figure 3.
Sample Test Item with Stimulus Item on Right and Response or Distractor on Left. Correct Answer is "C".



photographed for slides. Examples of distractors for two test items are shown in Figures 2 and 3.

Procedure

In the learning phase all treatment groups were first presented with the example slide. The technique of progression was explained to the experimental groups, and all groups were told that they would see more of the same types of slides. No indication was given of subsequent testing. Slides were shown for 4 seconds each using a Kodak slide projector and a constant screen size for all groups. Also, the same order of stimulus presentation was used for each group.

Testing procedures were identical for all groups. An example of the testing procedure was first given using the example stimulus from the learning phase. During testing stimulus-response pairs were projected onto the screen such that each stimulus item was seen consecutively four times: once with the correct response item and three times with distractors. These were presented one after the other rather than simultaneously. Subjects were instructed to wait for a blank slide following all four pairs before recording their answer on a response sheet (so as to avoid cueing from other subjects and to force subjects to view all choices before deciding). Positioning of the correct response and the distractors in sequence was randomized across test items. Twelve of the stimulus test items were the first panel from the progression sets, while the other 12 were the fourth panel, and these were randomly intermixed. Also a different random order of presentation was used from the one in the learning phase.

RESULTS

The dunn-Bonferroni t statistic was used to test nine planned comparisons. Of interest were the 3-panel vs. the 2-panel scores at each test interval; the 4-panel vs. the 2-panel scores at each teat interval; the 3-panel vs. the 4-panel scores at each test interval; and the immediatevs. the delayed scores for the 2-, 3- and 4-panel conditions. With a significance level of .01 and 238 degrees of freedom, the critical value was 3.17. This was exceeded for three comparisons. Both the 3- and 4-panel delayed scores were significantly higher than the 2-panel delayed score, and the 2-panel immediate score was significantly higher than the 2-panel delayed score.

TABLE 1
Means and Standard Deviations for Recognition Test

	Immediate			Delayed		
	X	SD	N	X	SD	N
2 Panel	22.0	2.7	41	17.7	3.6	39
3 Panel	23.0	1.2	39	21.6	3.6	42
4 Panel	23.4	1.0	43	23.1	1.3	40

DISCUSSION

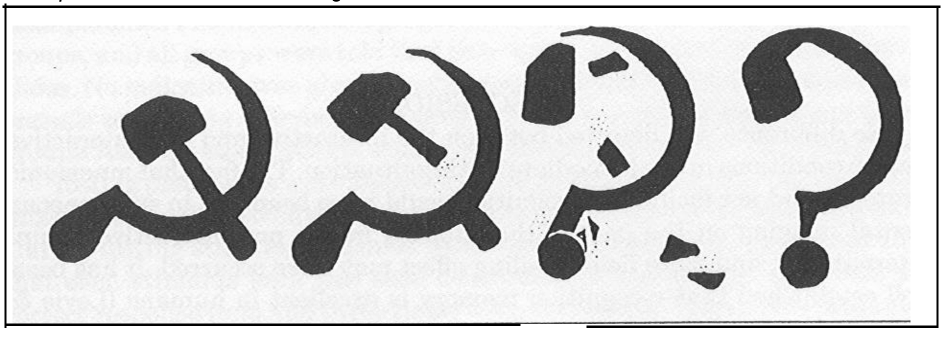
No difference was detected between the interactive and non-interactive picture conditions in the immediate testing situation. The fact that mnemonic strategies did not facilitate recognition could have been due to spontaneous mental imaging on the part of the subjects in the non-interactive group. Alternatively, and more lieu, a ceiling effect may have occurred. It has been well established that recognition memory is excellent in humans (Levie

Hathaway, 1988), and far more test stimuli may have been necessary to perceive any difference between groups in an immediate test situation. A similar result appeared in a study by Jusczyk, Kemler, and Bubis (1975), who tested adults' and children's memory ofverbally presented subject-verb-object sentences. Treatment conditions included verbal presentation only, verbal presentation plus picture, and verbal presentation plus mental imagery instructions. For the adult group no differences in immediate recognition memory could be found, although differences among the various conditions were apparent for free recall.

Given the favorable results of past research on interactive illustrations, it was not surprising that the interactive progression illustrations were facilitative in the delayed recognition of associated pairs of pictures relative to the non-interactive side-by-side displays. What elements rendered the former illustrations more memorable than their counterparts? Two major components make up these progressive illustrations. First, the visual element of the illustrations was unique in its dynamic characteristic. Kasdorf and Schnall (1970) showed that adult subjects were capable of applying the concept of change to abstract events. The changes taking place in the current progressive stimuli were clearly abstract, and the positive results obtained with them suggest that these subjects were also able to visually interpret the progressive changes through the four panels of the illustration. This leads to the second, or semantic, component. What sort of interpretation was applied to the progression stimuli?

One of two types of meaning might be applied to either the progressive or the non-interactive stimuli (assuming that subjects applied any meaningful association at all). The typical spatial or active relationship attributi to noun pairs was unlikely to occur in at least some of the pairs used for this experiment. Certainly a pair such as a communist symbol and a question mark would lend themselves more to the complex idea of the future of communism than to some spatial or active relationship (see Figure 4 for illustration). While it is difficult to ascertain how often these higher levels of cognitive activity are employed without directly questioning the subjects themselves, it is probable

Figure 4.
Example of Four Panel Progression.



that this type of activity occurred at least some of the time. It has been shown that adults spontaneously engage in mental interactive imaging for non-interactive stimulus pairs (Bower, 1972; Paivio, Yuille, & Smythe, 1966). It is possible that the visual link occurring through progression sparks some associative activity on a conceptual level. This hypothesis is explored more fully further on in the discussion, and might be the basis for future research on progressive illustrations.

Referring back to past research, the data from the experiment on visual puns demonstrated that adults were able to benefit from interaction as a mnemonic device even when more difficult cognitive processing was required. ndeed, it is difficult to imagine that all advertisements rely on the simple syntactic formats used in the interactive illustration studies on brand/product pairs in advertising (e.g., Lutz & Lutz, 1977). Surely any number of advertisements can be found that require consumers to associate cognitively complex ideas.

The role of the visual and semantic components of these progressive and non-interactive illustrations might be put into theoretical perspective by considering the dual coding theory. The non-interactive pictures, displayed side by side, required imaginal encoding, and had the potential for verbal encoding as well. Although the illustrations were not accompanied by text, Paivio (1971) has suggested that adults spontaneously attach verbal labels to pictures. Spontaneous interactive imaging might also have occurred either on a syntactic or conceptual level.

The interactive illustrations also provided the opportunity for dual coding since the first and fourth panels were identical to pictures used in the non-interactive condition. The semantic aspect of the two types of visuals did not differ. However, the interactive illustrations had the potential for leading to additional imaginal processing through the intermediate panels, though verbal encoding probably would not have taken place with the middle panels given their metamorphic states. Presumably the key to their facilitation lies in this extra pictorial emphasis provided by a progressively changing visual link.

Levin (1981) described thedifference between theprocessingof images and illustrations by referring to the need for cognitive constructions and elaborations for the former and visual perception and interpretation for the latter. Theoretically, progression bridges the gap between images that must be formulated internally and illustrations that are provided externally The intermediate panels act as a purely visual link between two items, but this link is lacking a semantic component. This external variable acts as a driving mechanism for the internal variable; that is, the viewer is encouraged by the visual link to create some semantic link to strengthen the association on another level. Hence all the skills which Levin refers to are coming into play First visual perception and interpretation must occur (illustration activity), followed by cognitive constructions and elaborations (imagery activity).

For these processes to occur, an interactive illustration is necessary but not sufficient. The illustration must also stimulate the viewer to think about the association being made, as is the case with visual puns and progression. A simple spatial or active relationship is also interactive (and clearly facilitative, as research has shown), but this provides all the necessary information. If everything is immediately available to the learner, then storage can take place with less cognitive activity. Presumably a greater degree of cognitive involvement with information should make that information more accessible later, as Craik and Lockhart (1972) and Lockhart and Craik (1990) have suggested. This is the premise on which advertisers work that makes their profession so successful, and future research could explore this topic by comparing memory capacity given standard interactive illustrations (subject-object) and cognitively complex interactive illustrations.

Theoretically, then, complex interactive illustrations are facilitative because they initially capture the attention and interest of the learner because of their distinctiveness and highly engaging qualities. They maintain this level of attention by actively involving the learner in deciphering the message. This essential step in communicating a visual message must be achieved for ultimate memorability.

Another important aspect of this theory deals with the reliability issue. Levin (1981) pointed out that illustrations are more reliable for memory than images. Progression, like visual puns, provides the reliability of an illustration, but also allows for the unique aspect of individuality that makes imagining a successful mnemonic technique. A learner's memory is enhanced by his or her own experiences.

One illustration approach which has considered these criteria is the transformation approach (see Levin, Anglin, & Carney, 1987 for more details), studied mainly in prose-learning situations. Transformations provide a mnemonic strategy for learning a large amount of factual information by creating both an interactive visual and auditory association between familiar and unfamiliar bits of information. The focus is on connecting critical features. As Levin et al. pointed out, this type of illustration is singular in its omission from traditional textbooks.

Progressive illustrations can make an impact in educational settings simply because of their memorability. They have the capacity for achieving an affective change, which is useful for some content. For instance, in a lecture or chapter dealing with environmental issues a smokestack could progressively transform into a tree to stress the need for environmental regulation of industries. While this visual would not contain the specific content, it could provide supportive emotional appeal. Similarly, progressive illustrations could be used for factual content. Indeed, ***Sesame Street*** has used the technique of progression to associate letters with words, as in b progressively changing to ***ball.***

The arrival of the new information age has ushered in new tools and technologies that are rapidly redefining the way learning and communication occur. For example, hypermedia could provide the basis for using progressive illustrations to drive a point. Referring back to the ecological example, the students could be prompted to click continuously on the image of a smokestack in order to watch it gradually change to a tree to make a point regarding clean air. Alternatively progression might be used in animation graphics where the learner would select a symbol representing some issue (i.e., a smoke stack) and through animation the image would change to a contrasting symbol (i.e., tree).

A final point should be made with reference to the hypothesis that the 3-panel progression group would have poorer scores than the 4-panel progression group. Fleming and Levie (1978) discussed a perception principle called closure, in which the viewer completes stimulus figures which are open or incomplete. They provide evidence of the viewer's ability to perform this task, but indicate also that unfamiliar or ambiguous stimuli may prove difficult. The present stimuli were indeed unfamiliar, but the lack of difference between scores for the two progression groups suggests that subjects were able to provide the necessary closure anyway even without all the cues. Even a partial transformation was better than none at all.

REFERENCES

Abed, F. Visual puns as interactive images: their effect on recognition memory, Unpublished manuscript, Indiana University, Bloomington, IN 47405.

Bower, G.H. (1972). Mental imagery and associative learning. In L.W. Gregg (Ed.), ***Cognition in learning and memory*** (pp. 51-88). New York, NY: John Wiley and Sons, Inc.

Craik, F.I.M., & Lockhart, R.S. (1972). Levels of processing: A framework for memory research. ***Journal of Verbal Learning and Verbal Behavior,*** 11, 671-684.

Fleming, M., & Levie, W.H. (1978). ***Instructional message design.*** Englewood Cliffs, NJ: Educational Technology Publications.

Jusczyk, P.W., Kemler, D.G., & Bubis, E.A. (1975). Adevelopmental comparison of two types of visual mnemonics. ***Journal of Experimental Child Psychology, 20, 327-340.***

Kasdorf, C.A., & Schnall, M. (1970). Developmental differences in the integration of picture series: Effects of variations in object-attribute relationships. ***Human Development, 13,*** 188-200.

Levie, W.H., & Hathaway, S.N. (1988). Picture recognition memory: A review of research and theory. ***Journal of Visual Verbal languaging, 8, 6-45.***

Levin, J.R. (1981). On functions of pictures in prose. In F.J. Pirozzolo, & M. C. Wittrock (Eds.), ***Neuropsychological and cognitiveprocesses in reading*** (pp. 203-228). New York, NY: Academic Press.

Levin, J.R. Anglin, G.J., & Carney, R.N. (1987). On empirically validating functions of pictures in prose. In D.M. Willows & H.A. Houghton (Eds.), ***The Psychology of illustration: Basic research*** (pp. 51-85). N.Y.: Springer-Verlag.

Lippman, M.Z., & Shanahan, M.W. (1973). Pictorial facilitation of paired-associate learning: Implications for vocabulary training. ***Journal of Educational Psychology, 64,216-222.***

Lockhart, R.S., & Craik, F.I.M. (1990). Levels of processing: A retrospective commentary on a framework for memory research. ***Canodian Journal of Psychology, 44,*** 87-112.

Lutz, K.A., & Lutz, R.J. (1977). Effects of interactive imagery on learning: Application to advertising. ***Journal of Applied Psychology, 62, 493-498.***

Pavio, A. (197 1). ***Imagery and verbal process.*** NY: Holt.

Pavio, A., Yuille, J.C., & Smythe, P.C. (1966). Stimulus and response abstractness, imagery and meaningfulness, and reported mediators in paired-associate learning. ***Canadian Journal of Psychology, 20, 362-377.***

APPENDIX

Stimulus Pairs

1. Africa-Skull
2. Table-Spider
3. Fig leaf-Trousers
4. Watering can-Elephant
5. Dog-Bowling pin
6. Shark-Sailboat
7. Globe-Beagan/Gorbachov
a. Heart-Bomb
9. Communist symbol-Question mark
10. Treble clef-Violin
11. Elephant and donkey-Mickey Mouse
12. Book-Computer
13. Gun-Bread
14. Jet-Butterfly
15. Smoke stack-Tree
16. Crane-Dinasaur
17. Turtle-Car
18. Bat-Umbrella
19. Food-Television
20. Cat-owl
21. Peace sign-Nazi
22. Globe-headphone
23. Brain-Bulb
24. Soccer-Italy

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Computer-Mediated Communication and Shared Learning

Dennis J. Dicks

Abstract: Despite decades of development, user-friendliness still presents a constraint on the diffusion of computer-mediated communication (CMC). Research indicates that CMC systems are generally not capable of structuring interaction to a degree appropriate for goal-directed behaviour. thus limiting their usefulness in collaborative work or teaching. This paper reviews a variety of techniques which have been developed to get groups of people to communicate effectively: cooperatlve learning. team building, groupware, computer supported cooperatlve work, decision support systems, and organizational design. Some of these approaches have achieved modest success in moderating computer exchanges-for example, in using AI to direct interaction. However. this paper suggests that future research could be productively guided by the growing literature on "shared learning": the concept that organizations can be designed in such a way that they "learn" from past experience. Recent research on this outgrowth of the application of "learning curves" in production engineering is used to suggest ways in which AI mlght be used to improve the utility of CMC.

Resume: En dépit des années de développement, la convivialite continue de limiter la diffusion des systèmes de communication assistés par ordlnateur. La recherche indique que ces systemes ne donnent pas à l'interaction une structure suffisante pour supporter la collaboration sur les buts communs -comme, par exemple — à l'apprentissage, ou au travail cooperatif. Cet article présente quelques techniques qu'on a utilisées jusqu'à ici pour promouvoir la communication dans les groupes: apprentissage cooperative travail en groupes, 'groupware,' 'CSCW," 'decislon support systems." "organizatlonal deslgn." Bien que ces techniques ont produit des résultats modestes, on suggère ici que la recherche doit être guider par la literature crossainte sur "shared learning" : l'idée qu'on peut dessiner les organkations tel qu'elles aprennent de leur expérience collective. Selon l'auteur, les concepts de "shared learning' peuvent informer l'application de IA pour améliorer les systemes de communication assistes par ordinateur,

Recent research on "computer-mediated communications" continues to draw attention to the problem of making these systems more user-friendly. As Melone points out, user-satisfaction has been examined for nearly two decades, directly, or indirectly as an indicator of system effectiveness (Melone, 1990). Clearly, if users do not feel comfortable with the technology, or do not accept it as a substitute for more established forms of interaction, computer mediated communication may remain a fringe activity. While technical aspects of system quality cannot be ignored, the more difficult challenge is to satisfy users' socio-emotive needs.

These concerns echo those expressed two decades ago over teleconferencing, concerns which generated a vast body of literature. Not surprisingly, current conclusions are starting to resemble earlier ones: for example, that users are happier with mediated communications when they already know the people at the other end, and can work on a common task (Hiltz & Johnson, 1990; cp. Hough & Panko, 1977, Ch. VII and pp.176-178).

A new twist is that the inability of mediated communications to replicate face-to-face interaction is now seen as an advantage rather than a significant failure. Since computers do not transmit the non-verbal cues associated with status, coercion, and so on, it is argued that they remove constraints on a free exchange of ideas (Boyd, 1989). This may be true; but at what point does free-for-all become chaos? Communicating by computer can produce very boring exchanges, reflecting a lack of direction and resolution (Keisler, Siegel & McGuire, 1984; Mason, 1987). While a "level playing field" might occasionally allow revolutionary ideas to surface from unexpected corners, most of the time communication can only procede when the participants share some beliefs, values, and sense of purpose. This is particularly important when communication has an identified goal, such as learning, or working on a common task. Indeed, Boyd quickly adds that even the most democratic exchanges between individuals depend upon a set of rules. And the rules will probably have to be clearer and stronger if the exchanges are to be collaborative and goal directed.

Giving some direction to mediated communication means achieving a delicate balance: no control tends to produce unsatisfying, unproductive interaction; strict control tends to stultify it (Keisler, Siegel & McGuire, 1984, p.1130). Belief that this delicate balance can be attained has stimulated a number of different and heretofore unrelated lines of research. Each is based on the assumption that there is some way of helping groups of people to communicate more effectively

Cooperative Learning

Some of the earliest academic efforts at coordinating the activities of groups of people arose in the context of "cooperative learning." Dewey and Piaget saw interaction with peers playing a key part in expanding cognitive experience (Abrami et al., 1990, p.22). In recent attempts to balance the excessive emphasis on the individual in twentieth century psychology, researchers have begun to explore the benefits of learning in groups. There is some evidence that learning in a cooperative environment, rather than in isolation, improves attitudes, raises the level of achievement, and is more efficient. These benefits may be greatest in more open-ended activities, for learning in groups appears to generate more divergent thinking and more creative problem solvingbehaviour. Similar advantages have been found when cooperation is effected by linking individuals via computers (see literature review by Johnson Johnson, 1989).

These studies have made an important contribution to what we know about the conditions favouring cooperative effort. Two key factors are feedback and accountability. Feedback includes overt rewards, which seem to have the greatest impact on learning when they are based on group rather than individual performance. It also includes the more covert support provided as the participants discuss, explain and elaborate the learning process. For these effects to occur, it seems necessary that each group member understand the collective goal, have some role in the common activity, and feel accountable for it (see review by Slavin, 1989).

Groups thus seem to work well together when their members depend on one another. Interdepence can be encouraged by common goals, rewards, resources, tasks, roles and threats (Abrami et al., 1990). It seems obvious that interdependence will be established more readily if the group members are more "compatible" in some sense. One dimension of compatibility which has been explored in this context is intellectual ability. Groups composed of individuals of similar ability do not necessarily perform well. Generally, groups appear to perform better when their members have something to learn from one another (Nicholson, 1991).

Team Building

Group members appear to learn most from one another when they share symbol systems, and when there is an optimal overlap of their abilities and roles, in industrial (Cohen & Levinthal, 1990, pp. 133-34) as wellaseducational contexts. This type of evidence has led to the development of a number of strategies for building and strengthening teamwork. Broadly speaking, these strategies address three different facets of team building: selecting team members who will work well together; providing training and practice in cooperative behaviour for established teams; and creating conditions (such as reward structure, better communications) to facilitate cooperation in day-to-day activities.

Obviously, the selection strategy is limited to the rare situations where new working groups are being formed. Though innovative methods of organizing work are starting to gain credibility in North America, existing practice tends to restrict the freedom of managers to re-organize the workforce. Similarly, the training approach is limited to situations where the group membership is known in advance, and the members have the time and inclination to participate in planned learning programs. This might be the case in industrial settings where strategy entails cooperation between circumscribed units, such as Marketing and Manufacturing. However, even in such settings, the actual pattern of communications may not follow the theoretical plan prescribed by corporate structure; the key communications may in fact be spontaneous and unofficial. In this case, and certainly in the case of electronic mail or groupware systems, the only alternative available is to provide the conditions which will make spontaneous communications more cooperative and effective. One way of doing this is to facilitate communication by means of a networkof electronic tools: Groupware or Decision Support Systems. Another is to manipulate the factors which contribute to good Organizational Design. Relevant research in these domains is treated in the following sections.

Groupware / Cooperative Work

One approach to group communications has grown out of the practical need to make effective use of networked computing systems. Formalized as "Computer Supported Cooperative Work" (CSCW), this approach has focussed on the development of electronic tools to facilitate collaboration within offices, or across offices dispersed in space or time. These tools encompass collaborative dialogue; document development, production and control; shared research resources, such as libraries, dictionaries, and information on procedures and techniques; project management; and computer-based instruction. They might be embodied in a dedicated environment, such as the special input and output consoles and software of Stanford's "Augmentation Research Center" (Engelbart & Lehtman, 1988); or in portable "groupware" (Opper, 1988) designed to be used on any suitable network, especially PC LAN's. Obviously, groupware has a greater potential for widespread use than dedicated hardware.

Current groupware can at best provide "passive" coordination of individuals using the same electronic medium towards some common end. In other words, groupware supplies the tools (eg. file sharing, agenda setting, etc.), typically with an Artificial Intelligence component, which the users can choose to employ to coordinate their activities (e.g., writing a common document, setting up a meeting). ***Information Lens*** from MIT helps users filter, sort, and set priorities for messages arriving via electronic mail. To do this, its AI component casts these messages into "frames"and uses rules to organize them (Crowston and Malone, 1988). Given the limited power of current natural language parsers, this approach does not achieve any greater coordination of communication than the application of memo forms in the paper domain. There seems to be very little progress on the much more difficult task of building "active" coordination into the technology.

Other experimental forms of groupware seem to be headed in this direction. For example, ***SuperSync*** attempts to facilitate group interaction by predicting how pairs of individuals will get along. It gathers answers to questions like 'You will most probably obtain the best advice from whom?" to draw up "sociograms" which can be used to select groups which will function effectively However, Supersync does not have any of the communication-facilitating functions one expects in groupware (Opper, 1988). Here again, AI is used for "passive" coordination, since it is applied before the group members begin to interact.

Groupware will only advance to "active coordination," or real communication-management, when its AI functions take into account some of the results of other approaches to group interaction.

Decision Support Systems

One of these other approaches is the design of Decision Support Systems which are intended to improve decision-making by providing electronic access to databases, analytic and statistical tools, modelling techniques and so on. This technology is becoming much more important with the growing use of Management Information Systems, which will tend to decentralize not only access to information that is critical to an organization's operations, but also the ability to change this information and act on it. Optimizing the operations of these systems is obviously crucial to corporate survival.

Decision-making is very much a directed behaviour, with a limited set of goals and means available. Much of the early literature focussed on highly rational models of decision-making, such as expectancy theory, involving the weighing of probabilities ofvarious events and outcomes. More recent research (Mitchell & Beach, 1990, p.2) indicates that most business decisions involve choosing whether or not to pursue one available course of action (rather than a choice among competing options); and that the criteria tend to be qualitative (sustaining the organization's strategy) rather than quantitative (profit maximizing).

Another trend has been to consider decision-making as a group behaviour rather than the act of the isolated executive. This is consistent with the decentralizing tendency of MIS and with the fact that decisions increasingly involve the assessment of large amounts of quantitative and qualitative information, as noted above.

A third trend is to try to transplant to computer conferencing methods of structuring communication which have been developed for decision-making in face-to-face situations. A good example of this is Archer's development of the Computer Conferencing Nominal Asynchronous approach, which attempts to balance creativity and control. Creativity is encouraged by the Nominal Group technique for eliciting responses from all participants. Control is imposed by filtering contributions through a moderator (Archer, 1989).

Not surprisingly, these trends have come together in work on Group Decision Support Systems, which allow several users simultaneous access to the relevant information and analytic tools. In what is probably the most advanced form of this technology to date, the PLEXSYS Planning System, up to 4 dozen people can be linked electronically to one another and to an elaborate collection of databases, statistical tools and analytic models (Nunaker, et al, 1988). PLEXSYS uses a combination of knowledge representation techniques and semantic inheritance networks to direct the use of these planning tools. On-screen "frames" are used to reduce the vast complexity of databases and analytic processes available to manageable steps, allowing the user to construct concepts and query the system in an interactive fashion.

Tests of PLEXSYS with 40 brain-storming groups confirm some findings in the computer-communications literature and contradict others. As in other studies, the anonymity of mediated messaging encouraged participation and minimized "group think."It also tended to increase tension by allowingblunter comments and prolonging misunderstandings. In contrast, groups using PLEXSYS generated more comments than those meeting face-to-face; and they expressed more satisfaction with their sessions and more confidence in their outcomes than typical computer-conferees. Nunaker and colleagues attributed the superior performance of PLEXSYS to the facts that they used real decision makers dealing with real problems; that they used larger groups (optimally, 8-22 people, rather than 2-5); and that the hardware and software had been "matured" by eight years of development.

In spite of its relative success, PLEXSYS has two significant limitations as a prototype for directive systems of mediated-communication. First, it is obviously a dedicated rather than portable system, with conference facilities, supporting hardware, and software for up to 48 people. Secondly, use of the system provides for face-to-face meetings whenever desired. Indeed, the physical facilities include rooms for face-to-face meetings, and never really isolate the users from one another. Nunaker et al. attribute some of the success of PLEXSYS to the opportunities to use face-to-face meetings for resolving misunderstandings, and so on.

Consequently, PLEXSYS is perhaps best considered an idealized model, a simulation of what might be achieved, rather than production prototype. Its electronic hardware can be emulated by more diffuse networks. Its software imposes a "frame" approach on brain-storming, a rather open-ended task. The claims that it is very user-friendly and successful need to be examined further. Most importantly, the role of face-to-face communication in this success needs to be investigated carefully, as this finding tends to confirm the suggestion, from research over two decades, that mediated commmunication by itself cannot fill all needs for interaction.

Organizational Design

Hiltz and Johnson have concluded that computer-mediated communication will be more successful in an environment which has at least some structure, tailored to the nature of the group of users (Hiltz &Johnson, 1990). 'lb add some substance to their conclusion, they refer to the work of Daft and Engel on organizational design, work that is interesting for two reasons.

First, Daft and Engel examine the design of organizations in terms of their ability to process information @aft & Engel, 1986). Organizations exist to reduce uncertainty and equivocality in their operating environments. Drawingon previous research (e.g., Daft & Weick, 1984; Tushman and Nadler, 1977), they isolate a number of binary variables which describe the nature of operating environments, types of information required to master them, types of organization and types of business strategy. They combine these variables in a series of 2x2 matrices to create a model of organizational design. Figure 1 (see following page) summarizes the model.

The premise of this model is that organizations process information in order to deal with uncertainty (lack of data) and equivocality (ambiguous data). In general terms, the model proposes that organizations deal with these problems in different ways, depending on the degree to which tasks are variable, and analysable; and on the degree to which corporate departments are functionally different and interdependent. Organizations can respond to these types of situations by varying the amount and the richness of information that is exchanged among departments. In practice, this means tinkering with the "structural mechanisms" and technologies which coordinate and control the organization's internal and external communication, drawing appropriately from a range of different communications modes. Daft and model

Figure 1.
*A Summary of Daft and Engel's Model of Organizational Design**

EQUIVOCALITY	UNCERTAINTY: LOW	UNCERTAINTY: HIGH
HIGH	*Craft Technology* unanalysable environment low task variety differentiated departments low interdependence rich media low information flow (occasional face-to-face, telephone	*Nonroutine Technology* unanalysable environment high task variety differentiated departments high interdependence rich media high information flow (frequent face-to-face, special reports)
LOW	*Routine Technology* analysable environment low task variety undifferentiated departments low interdependence thin media low information flow (formal rules, bulletins)	*Engineering Technology* analysable environment high task variety undifferentiated departments high interdependence thin media high information flow (data bases, MIS, formal plans)

*Their model is greatly simplified here by collapsing four 2x2 matrices (see Daft & Engel, 1986). The larger boxes indicate communications environments; the smaller ones indicate communications modes.

gives general advice on how to carry out such tinkering, but they suggest that their real contribution is to point out that the main problem is not lack of information, but the ambiguity of that which is available. The next section provides an example of the application of this model to an actual situation.

Shared Learning

A second reason that Daft and Engel's work is interesting is that it provides a link to another approach to organizational design: the work on learning curves. Originating in industrial engineering, this large body of literature deals with the observation that the performance of production units in manufacturing tends to improve with time, generally following the shape of the classical learning curve. Until recently, the research has focussed postfacto on the shape of the curve, rather than on the factors which might affect its shape, or the question of how learning occurs, if at all.

In a paper on what he calls "shared learning, "Adler uses Daft and Engel's uncertainty/equivocality matrix to try to explain, in terms of information flows, how an organization improves its performance over time and space (Adler, 1990). This is a case-study of the evolution of the design and manufacture of a high-tech product, in which a firm has detected and remedied problems with the flow of critical information among its functional units. Improvements mainly involved changing who talked to whom, what about and when. In Adler's terms, these improvements were based upon a clearer perception of the differentiation and interdependence among the functional units. For example, the firm created "centres of competence" to recognize and reinforce creativity at branch plants, with rich internal communications but restricted links with other units On the other hand, the firm reacted to the interdependence of design and manufacturing functions by increasing the richness and volume of communication between the formal units.

Broadly speaking, the firm had to replace some of its formal rules, which defined its structure in hierarchical terms, with more informal guidelines prescribing a timely flow of information. This was accomplished not by changing telecommunications links but by physically moving people: by setting up new sub-units for liaison, by creating new "'start-up" teams, and by job rotation. These types of practice are already well established in Japanese firms, which have evolved into what can be called "learning machines" (Dicks, 1986). Adler's contribution is to link the cognitive and structural aspects of corporate learning within an analytic framework which might be generalizable to any group of people with common goals.

In another empirical study, Cohen and Levinthal investigate the capacity of organization to learn. "Absortive capacity" they define as ".. .the ability of a firm to recognize the value of new, external information, assimilate it and apply it to commercial ends..." (Cohen & Levinthal, 1990). A key finding is that corporate learning depends upon a firm having an adequate technological base, and a workforce capable of developing it. In their terms, this means that members of the workforce should possess a balanced mixture of shared and unique abilities; and they should be intimately familiar with the formal and informal communications channels which underly the firm's operations (pp. 148; 133-135).

Design Of Computer-Mediated Communications Systems

Returning to the perceived need for imposing more strucure on computer-mediated communications (Boyd, 1989, Hiltz & Johnson, 1990), we can learn a little from this diverse body of research on group interaction. For one thing, there is further reinforcement for the old finding that face-to-face interaction fulfils a crucial role in successful communication, in establishing an initial foundation of trust and in resolving misunderstandings. It is nonetheless conceivable that future mediation systems will sufficiently replicate face-to-face conditions so that people will not have to meet in real space and time.

The work of Daft and Engel at least provides a starting point for deciding under what conditions "thin" communications media, such as asynchronous electronic mail, aresufficient; and what conditions "rich" media, such as broad-band data supplemented by live video and high quality sound, are necessary, The model sketched in Figure 1 may be useful when one has the time to design the relationships between parts of an formal organization, such as a business firm or government bureau. In these cases, the rewards and sanctions required to get the system working are also at hand. However, these tools may not be available when one is designing the links between parts of a research consortium or a university, organizations which are expected to be less formal, less predictable. In these latter cases, effective communication is perhaps even more important, but it is difficult to see how Daft and Engel's criteria can be applied to spontaneously arising interactions- unless by a clever application of Artificial Intelligence!

As we have seen above, AI has been applied in rather limited ways to keeping track of what users are communicating about, or deciding 'a priori'how well team members will get along. Using AI to decide who should communicate with whom, when, and by what combination of media would probably be more productive, and certainly more of a challenge. An AI system in this case would have to develop profiles of communicators, based on their communications environment in Daft and Engel's terms, their role in the goal-seeking activity their repertoireofskills and knowledge. Perhaps such a system would also take a less mechanistic approach (see Mitchell & Beach, 1990) and so include their vocabulary of images as well. AI would thus serve as a real-time mediator perhaps only in an advisory role, recommending when communications should occur, in what direction, and by what types of channels.

In designing such a system, we might want to start with three general attributes (Silver, 1988; in his case, for DSS systems). These are Restrictive*ness, Guidance and Focus.* Restrictiveness refers to the fact that a communications system, particularly one which is to serve goal-directed behavior, must reflect some choices among all possible alternatives. As a simple example, access must be restricted to a useful subset of all possible communicators. Further, only some members of this subset might be allowed to access certain data; or to perform certain kinds of operations, such as modelling. Guidance refers to help the system may provide its users in taking the next step: who to communicate with, which information to consult in making a decision, and so on. Focus refers to the degree to which a system is tailored to a specific use. For example, an MIS is highly focussed, since certain people have certain types of access, and their communications must maintain a high degree of precision. Similarly, a system designed to allow researchers to communicate about a particular problem might be highly focussed, with features designed to facilitate certain tasks but not others. On the other hand, a brain-storming system might have a very loose design. As a rule, the greater a system's focus, the more restrictive it will be and the less the need for guidance; and conversely, an unfocussed system will present more alternatives for action, and hence should provide more guidance for its users.

The real challenge is to create a mediating system which can respond to varying communications scenarios with an appropriate balance of these attributes. In the literature, there is enough knowledge about the conditions which promote effective cooperation, and about how to measure them, to begin facing this challenge. We know that interdependence is a key factor in the effective functioning of groups, and that Daft and Engel's model gives us some way of dealing with this variable. We also know that an appropriate balance of shared and unique abilities is a key factor. Finally, we know that effective organizations exhibit a balance of what has been called "loose" and "tight" coupling (Cameron, 1986; Weick, 1976). This might best be explained in an example: an effective organization should have the creativity and flexibilty created by "loose coupling" among its units in order to envision new business opportunities; and, at the same time, enough "tight coupling" in order to build new production facilities and pay the bills on time.

In Cameron's terms, an appropriate balance of loose and tight coupling is one of the key paradoxes which characterize effective organizations. Tolerating the co-existence of opposites is a necessary feature of working in groups. Further, "paradoxes are paradoxical" : empirical evidence indicates highly effective organizations (at least in higher education) can perform ". . .in contradictory ways to satisfy contradictory expectations." (Cameron, 1986). This suggests that an AI system for mediating computer-mediated communications in such a way as to promote group learning will have to embody enough fuzziness to live with and perhaps even promote these paradoxes.

REFERENCES

Abrami, P. C., Chambers, B., d'Appolonia, S., de Simone, C., Wagner, D., Poulsen, C., Glashan, A., & Farrel, M. (1990), ***Using cooperative learning, centre for the study of classroom processes.*** Montreal: Concordia University, Department of Education.

Adler, P. S. (1990, August), Shared learning. ***Management Science, 36(8), 938-955.***

Archer, N. I? (1989), Improving idea generation during decision making in small group computer conferences. ***Canadian Journal of Educational Communication,*** 18(2), 111-124.

Boyd, G. M. (1989), Appropriate uses of computer-mediated communication systems for education; conferencing 'R-Places'. ***Educational Technology and Training International, 27(3),*** 271-275.

Cameron, K. S. (1986, May), Effectiveness as paradox: consensus and conflict inconception of organizational effectivenss. ***Management Science, 539-553.***

Cohen, W. M. &, Levinthal, D. A. (1990), Absorptive capacity: a new perspective on learning and innovation. ***Administrative Science Quarterly 35,*** 128152.

Crowston, K., & Malone, T. W. (1988, December), Intelligent software agents. ***Byte, 267-274.***

Daft, R. L., & Engel, R. H. (1986, May), Organizational information requirements, media richness and structural design. ***Management Science,*** 32(5), 554-571.

Daft, R. L., & Weick, K. E. (1984), Toward a model of organizations as interpretation systems. ***Academic Managment Review, 9,284-295.***

Dicks, D. J. (1986), From ships to chips: Manpower policy for structural change in Japan. ***Aspects of Educational Technology, XIX,*** 37-51.

Engelbart, D., & Lehtman, H. (1988, December), Working together. ***Byte, 245-*** 256.

Hiltz, S. R. , & Johnson, K. (1990), User satisfaction with computer-mediated communication systems. ***Management*** Science, 36(6), June, 739-764.

Hough, R.W. , & Panko, P.R. (1977), ***Teleconferencing Systems: A state-of-the-art survey and preliminary analysis.*** Stanford Research Institute.

Johnson, D. W., &Johnson, R. T. (1989), ***Cooperation and competition: Theory and research.*** Edina, MN: Interaction Book Company.

Keisler, S. Siegel, J., & McGuire, T W. (1984, October), Social psychological aspects of computer-mediated communication. ***American Psychologist,*** 39(10), 1123-1134.

Mason, R. (1987), Computer conferencing: its contribution to self-directed learning. ***Proceedings of the Second Guelph Symposium on Computer Conferencing,*** University of Guelph, 33-39.

Melone, N. P. (199, January), A theoretical assessment of the user-satisfaction construct in information systems research. ***Management Science,*** 36(l), 76-93.

Mitchell, T. R. , & Beach, L. R. (1990), "...Do I love thee? Let me count..." Toward an understanding of intuitive and automatic decision making. ***Organizational Behavior and Human Decision Processes, 47,*** l-20.

Nicholson, P. A. (1991), The effect of reward structure and group ability composition on a problem solving simulation in an interactive video environment. Doctoral Research Proposal, Educational Technology Program, Concordia University, Montreal.

Nunamaker, J. F., Applegate, L. M., & Konsynski, B. R. (1988), Computer-aided deliberation: Model managment and group decision support. ***Operas tions Research, 36(6), 826-848.***

Opper, S. (1988, December), A Groupware Toolbox. ***Byte,*** 275-281.

Silver, M. S. (1988), Descriptive analysis for computer-based decision support. ***Operations Research, 36(6),*** 904-916.

Slavin, R. E. (1989), Research on cooperative learning: an international perspective. ***Scandinavian Journal of Educational Research, 33(4),*** 231-243.

Tushman, M. L., & Nadler, D.A. (1977, July), Information processing as an integrating concept in organizational design. ***Academic Management Review, 613-624.***

Weick, K. E. (1976, March), Educational organizations as loosely coupled systems. ***Administrative Science Quarterly, 21,*** 1-19.

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The SSF Model: Structuring the Functions of the Sound Attribute

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Abstract: Prescribing instruction that utilizes the specific attributes of educational technologies has met with criticism and limited success. A contributing factor may be an insufficient depth of understanding of the attributes themselves. Given the current state of affairs, it seems reasonable to expect more negative criticism and poor results when designing instruction for the sound attribute. A better understanding of the sound attribute may be gained and a subsequent improvement of the educational materials realized when the functions and structure of the sound attribute are prescribed for sound- image sequences. The purpose of this paper is to present the perceived problem and offer the Structured Sound Functions (SSF) Model as a possible conceptual solution.

Resume: l'enseignement utilisant les technologies pédagogiques et leurs attributs précis a fait face à une critique et un succès limité. Une compréhension insuffisante des attributs eux-mêmes est un facteur qui contribue à cette critique. Les choses étant ce qu'elles sont, on peut s'attendre encore à des critiques négatives et des résultats médiocres quant a l'enseignement utilisant l'attribut du son. Une meilleure compréhension du son peut être atteint et une amélioration du materiel éducatif peut etre realisée lorsque la structure et les fonctions de l'attribut sont considerées dans la conception de séquences audio-visuelles. La résolution d'un probleme à l'aide du modèle Structured Sound Functions (SSF) est presente dans cet article.

BACKGROUND

Educational technologies (e.g., hypermedia, desktop and conventional video) can be made to possess attributes (e.g., interactivity, multiple windowing, zooming, sound) that may differentially affect learning (Greenfïeld, 1984; Clark, 1983; Salomon & Gardner, 1986). Matching these attributes with assessed needs, learning objectives and instructional strategies have enabled instructional message and user interface designers to prescribe instruction that utilizes the particular attributes of the technology required to achieve objectives (Reiser & Gagne, 1983; Richey, 1986). However, simply prescribing instruction that merely utilizes particular attributes of a technology has met with criticism and limited success, including: Video zooming (Salomon, 1979);

interactivity and differentiated presentations (Hannafin, 1989); learner control (Merrill, 1988); CAI (Dede & Swigger, 1988) and LOGO combinatorial and knowledge-transfer attributes (Pea & Kurland, 1984); hypermedia (Conklin, 1987); and the attribute of embedding generative fact- and concept-level cognitive strategies (Barba & Merchant, 1990), to mention a few. It appears that an insufficient depth of understanding of some of these attributes may be at least partly responsible for ineffective or inefficient instructional communication (Clark, 1983; Hartson & Mix, 1990; Lepper, 1985; Salomon & Clark, 1977; Salomon & Gardner, 1986).

Given the current state of affairs, it seems reasonable to expect more negative criticism and poor results when designing instruction for the sound attribute. The purpose of this paper is to address the non-use and mis-use of the sound attribute and present the Structured Sound Functions (SSF) Model (Mann, 1990) to improve sound attribute research and scriptwriting guidelines in educational technology.

VISUAL PREFERENCE

Owing to a preponderence of visually-minded theoreticians and practitioners, designing instructional sound for simulations video and desktopvideo has often been slighted in both practice and research (Buxton, 1987; Doane, 1980; Gorbman, 1976; Nickerson, 1986; Seidman, 1986). For example, only three of the 100 software development contracts tendered for Ontario's Grant Eligible Microcomputer System (G.E.M.S.) made extensive use of the sound function (Gaudino, 1986). Moreover, complex instructional messaging has caused confusion in some important computer interfaces, the most serious instance occurring at the Three Mile Island plant where over sixty different warning systems were activated (Buxton, 1987; Nickerson, 1986). One explanation for the proliferation of silent courseware has been that younger children may not understand sound-image relationships (Greenfield, 1984). Another explanation was that it just doesn't seem 'right' for users to have to listen to their computers speak to them (Mel et al, 1988). In these instances and others, opportunites may have been missed because the sound attribute was not included in the message design of the user interface.

Semiology

Some theorists and practitioners (Bordwell & Thompson, 1979; Doane, 1980; Gorbman, 1976; Prendergast, 1977; Seidman, 1986; Spottiswoode, 1950) have suggested that semiological frameworks should organize content. Although there are obvious physical differences between video, CAL and multimedia technologies, they share several psychological and physical characteristics (Lepper, 1985; Salomon & Gardner, 1986). Among their psychological characteristics, educational and informational messages can be encoded in symbolic forms which subsequently require skill for their decoding (Salomon, 1979; Smith, 1988). Moreover, multimedia may expand the number of symbol systems to represent meaning, bringing to bear a wider range of semiotic functions that may influence how a reader acquires meaning from text (Havelock, 1988; Olson, 1988; Beinking, 1987) or from graphics (Marcus, 1987). In this light, the analogies of research on the cognitive and social effects of conventional video to those of CAL and hypermedia have been useful (Lepper, 1985; Salomon & Gardner, 1986). On their own, however, combined, chained, arranged and organized symbol schemes are too descriptive and too complex for most sound analysis and production users (Gianetti, 1985).

Formative Research in ETV

Coldevin's (1981) several content organization categories were meant to improve learningusingmediabystructuringtheeducationalcontent throughout the production. But they do not attend to sound in sound-image relationships. Similarly, the story-spine has been considered by some (Goldman, 1983; Field, 1982; Boot, 1979) to be an indispensable instrument for theatrical and made-for-TV scriptwriting. But its usefulness in treating the story using sound has been left unspecified.

The Children's Television Workshop used instructional goal-areas as a method for structuring visual and verbal content (Palmer, 1969; Lesser, 1972; Mielke, 1968; Schramm, 1972). Their methodology, however, neglects to consider procedures for selecting and combining their sound strategies (goal-areas) with the purposes or functions (Point of View POV], character's past, etc.) for the sound in the image-sound relationships.

The idea that television acts more like an ear than an eye and that its participation is aural not visual (M. McLuhan, 1967; S. McLuhan, 1978), carries the correct attitude for approaching the visual preference or bias problem in educational technology. However, this notion was only part of his larger vision of post-literacy in a futuristic global village, and is not readily adaptable to designing sound for television. Even Aristotle (see the ***Poetica*** in McKeon, 1941) alluded to theatrical structure but ignored sound per se in his discussion of plot development using sound (i.e., the structure, dialogue, and music).

Image Decoration

Some design guidelines for the conventional technologies appear to be dependent on visual cues rather than story structure; or only allude to the psychological components of sound. Zettl (1973) replaced Pudovkin's (1960) synchronistic-asynchronistic dichotomy with the more literal source connected-disconnected film categories. Millerson (1979) presented four types of audio-visual relationships and is generally correct in stating that 'the trick is to use sound selectively if you want the scene to carry conviction, rather than try to include all typical background noises" (p. 367, Millerson, 1979). He has suggested that the image's impact in video and film may be due to its accompanying audio, the effect of image and sound can be cumulative, and the sound and image together may imply a further idea. But like many others, these re-orientations of sound in technology can be attributed to a camera-oriented dominance in the terminology (Doane, 1980; Seidman, 1986).

Some theorists (Daiute, 1985; Malone, 1981) have suggested that captivating computer-sound must somehow decorate, enhance, create fantasy, reward, or represent that which would have otherwise been leas effectively communicated as text or numbers, Others (Alkin, 1973; Rosenbaum, 1978; Gorbman, 1976) have stated that captivating images cannot hold learners' attention for long if the aural sense is not suitably stimulated. Finally, there are those (Buxton, 1987; Paine, 1981; Ragsdale, 1988) who believe that learners who are regularly bombarded by ever-deepening visual information (hi-res graphics, video capture), may need heightened sound effects in their instructional messages if only to perceive them at all. In all these cases, supporting the image is presumed because the overall design of the program or production is purposeless or structureless and will, as it usually goes, require some measure of redundancy from the audio channel to impact on a weak informational or emotional message.

Redundancy

Audio visual redundancy, however, can be boring (Brown, 1985), distracting (Gecsei, 1986) or both (Field, 1982; Goldman, 1983). While it is apparent that the redundancy of information (Schoderbek, Schoderbek & Kefelas, 1985) may contribute to message retention, and that auditory and visual modality design may increase human capacity over either mode separately (Craik, 1979), the increase is often evident only when the bimodal information is related, not redundant (Fleming, 1987; Grimes, 1990). So, although reaction seems to be growing against the exinclusion of sound in educational technologies, the prevailing attitude of many message designers still seems to be that sound is the poor relation in the sound-image relationship and should only be permitted as much consideration, effort and facilities as can be spared after the visual requirements of the production are satisfied (Altman, 1980; Blattner et al, 1989; Buxton, 1987; Buxton et al, 1989). This 'poor relation' attitude is evident in conventional video technology, where the problem of achieving high quality sound has been avoided by suggesting that either the image supplied most of the information, or that the presence of the image makes the sound less critical (Alkin, 1973; Altman, 1980; Zettl, 1973). Without sufficient attention to the function or purpose and the structure of the sound attribute, there's little reason to expect that results of encoding and decoding educational messages from the sound attribute of these educational technologies will be any more successful than they have been for other attributes

In situations where it is assumed that text, graphics and video samples supply most of the information or that the presence of the image makes the sound less critical, it seems that unifunctional sound or unstructured sound has been the norm, not the exception, and unstructured sound is considered to be undesirable because its primary purpose is only to support the image. A deeper understanding of sound design may be gained and a subsequent improvement of educational audio-visual materials realized when the functions and structure of the sound attribute are prescribed for sound-image sequences.

THE SSF MODEL: STRUCTURING THE FUNCTIONS OF THE SOUND ATTRIBUTE

The Structured Sound Functions (SSF) Model is a generic educational message design tool for structuring sound in sound-image sequences. Several functions can be structured offering a more equitable treatment of the sound attribute. Three activities seem to be implicit in structuring sound functions into a sound-image relationship: Creating functions, structuring the functions and scriptwriting. First, sound functions must be chosen for each sound-image relationship.

Creating Functions for the Sound Attribute

The function of the sound attribute is a characteristic that prescribes or describes its purpose within the sound-image relationship (Alten, 1981; Gorbman, 1976; Zuckerman, 1949). Evidently, functional aesthetic distinctions are rarely drawn between meanings inherent in the stated and implied message in the image, and in the stated and implied sound.

Unifunctional sound tends to demonstrate a lack of creativity and innovativeness in the courseware design. The two most common types of unifunctional sound are conditioned reflex sound and hackneyed sound. Conditioned reflex sound relies on stimulus-response (S-R) associations and S-R chains. The S-R associations and chains provide networks of associations to support generalizations beyond the immediate control of individual stimuli (Hannafm & Rieber, 1990). Reinforcement schedules can have differential effects on both how associations are made and how behaviour is shaped as well as on the durability of conditioned responses (Reynolds, 1968). Hackneyed sound is a corollary of the conditioned reflex design. Hackneyed sound is the application of another designer's sound idea to one's own program or production; colloquially referred to as a spin-off or sound bite (Brown, 1985; Goldman, 1983) depending on how heavily the user borrows from the original idea.

Creating sound functions for a sound-image sequence means writing one or more sound functions on the function sheet (Figure 1). In this case, it also means the additional task of encoding utterances that represent one or more sound functions into the sequence. Together, the implied sound functions can prescribe what the sound should imply within a sound-image relationship.

Analyzing or creating functions of sound for a sound-image sequence means writing a description or prescription for what the sound does or should

Figure 1.
The Functions of Sound.

The Functions of Sound (Speech, Sfx, Music)
For Segment: ______________________________

Step 1: *What do the* images Show (e.g., Point moving along a line.. .)

Step 2: *What does the Sound State* (e.g., Silent)

Step 3: *What do the* images imply (e.g., Something will happen to the point or line)

THEN: ***What the SOUND SHOULD /MPLY about the Atmosphere, Feeling,*** or ***Mood (e.g.,*** Video-game style sfx, music)

OR: ***What the SOUND SHOULD IMPLY about the Point(s) of View (e.g.,*** Objective POV – a situation analysis; Performer POV – focus favours the point Subjective POV – usually contrast to other POVs)

OR: ***What the SOUND SHOULD IMPLY about Future or Past Events*** (Temporal Speech Coding – e.g., "Meanwhile the position of point Q has changed" Or – "Don't forget to.. .l' Or – OK, now watch for.. .")

OR: ***What the SOUND SHOULD IMPLY about the Locale(s)*** (e.g., A congested situation – multiple voices; becomes clearer – one grows dominant)

OR: ***What the SOUND SHOULD IMPLY about the Character's Past*** (e.g., Character's Personal Past/Private Past/Public Past-Or, just back story on the present visual situation -why it looks this way, and where it was before)

OR: ***What the SOUND SHOULD IMPLY about the Character IN the Character*** (The exceptions to this behaviour. Quirky, paradoxical and unpredictable conditions. In simulations – why it looks this way and where it was before)

imply about an atmosphere, a feeling, or the mood; one of three points of view a future or past event; a locale; a character's past; or a character's personality. These functions may be conceptualized as possible prescriptions for character, place, time or subject matter in a sound-image relationship.

Atmosphere / Feelings / Mood

The Atmosphere/Feeling/Mood Sound Function (Alten, 1981; Seidman, 1986; Zuckerman, 1949), traditionally has been the most overused function of sound. When an ***Atmosphere/Feeling/Mood Sound Function*** is created, it must imply either more or something else about the referent other than what has already been stated or implied about atmosphere, a feeling, or mood by the image.

Point Of View (POV) Sound Function

Informational Sound Functions (Alten, 1981; Zuckerman, 1949) can add new concepts, ideas or facts to the program or production. ***Objective, Subjective or Performer POV Sound Functions*** (Lee & Misiorowski, 1978) can be prescribed as a function of character. A ***Subjective POV Sound Function*** may use a character voice-over. An ***Objective POV Sound Function*** may use a narrator voice-over, and a ***Performer POV Sound Function*** may use some combination of subjective and objective sounds. When an ***Objective, Subjective or Performer POV Sound Function*** is created, it must imply another point of view or more about the point of view than what has already been stated or implied about the referent by the image.

Temporal (Future/ Past Events) Sound Function

The Temporal Sound Function (Brown, 1985; Gecsei, 1986; Gianetti, 1985; Field, 1982; Lee & Misiorowski, 1978; Root, 1979; Samuels, 1984) may be conceptualized as the visual equivalent of a scriptwriter's "gimmick." When a ***Temporal Sound Function*** is created, then it must imply more or something other about the referent than what has already been stated or implied about the future or past in the image. Unlike the ***Character's Post Sound Function,*** the ***Temporal Sound Function*** informs the learner about a past event unrelated to the history associated with the Character or gimmick (e.g., a metaphorical occurrence as in a dream).

Locale Sound Function

The Locale Sound Function (Alten, 1981; Zuckerman, 1949) seems to play one of the most necessary informational roles in a sound-image relationship. Most often, the ***Locale Sound Function*** is used realistically as appropriate background speech, music, or sound effect. Typically, familiar sounds are produced to establish a place for a referent. When the Locale Sound Function is created, then it must imply more or something else about the referent than what has already been stated or implied about it in the image or sound.

Character's Personal, Private, or Public Past/Future Sound Function

Three types of sound function related to a Character's Past or future are presented: Personal, private and public. When the ***Character's Professional Past or Future Sound Function*** (Brown, 1985; Gecsei, 1986; Gianetti, 1985; Field, 1982; Lee & Misiorowski, 1978; Root, 1979; Samuels, 1984) is created for a referent, then the character's professional past implies (without overtly stating it) what the character has been doing for a living; his roles in the corporation, history of relationships with co-workers, and so forth. When the ***Character's Personal Past or Future Sound Function*** is created, then the character's personal past or future implies (without overtly stating it) the nature of his/her marital history, history of educational background, job, and socioeconomic history. When the ***Character's Private Past or Future Sound Function*** is created, then the character's private past or future propels the character through the story. The private past implies the need for fame, money, stability of the marriage, peculiar tendencies, and flaws of character or personality.

When the ***Character's Personal, Private or Public Past/Future Sound Function*** is created, then it must imply more or something other about the referent than what has already been stated or implied about his/her past in the image. Unlike the ***Character-In-The-Character Sound Function*** (Goldman, 1983; Root, 1979; Zuckerman, 1949), this function does not plumb the depths of the character's psyche. This function tries to answer specific questions in relation to the message design or plot.

Character-In-The-Character Sound Function

The Character-In-The-Character Sound Function refers to the subtext, story spine or tragic flaw in the character. The ***Character-In-The-Character*** sound should be used to depict a certain recurring aspect of the character's behaviour, certain aspects of the character's (moral) character or his or her peculiar personality (mask) is intentionally prescribed ambiguously (e.g., self-effacing music that presents a multi-faceted personality of the character). When the ***Character-In-The-Character Sound Function*** is prescribed, the person's character (i.e., his or her habits) or their persona (i.e., his or her worldly mask) is created. This character or persona must imply more or something other about the referent than what has already been stated or implied about him/her in the image.

Specific questions in relation to the subtext of the plot are best answered by implication using ***Character-In-The-Character Sound Function:*** What does he really want? Who/what's really stopping him/her from getting what she or she wants? The intention behind prescibing this sound function is to generate a controversy with the other sound functions (i.e., ***POV, Locale, Character's Past,*** etc.) working in the sound design.

In conclusion, unstructured sound is undesirable because it is often distracting (Gecsei, 1986), boring (Brown, 1985) or both (Field, 1982; Goldman, 1983). In education, boredom can be a formidable problem often treated with improved motivational messaging (Fleming, 1987; Keller, 1983; Malone, 1981) or with procedural facilitations (Scardamalia et al, 1989); while distraction is anathema to the learning process, and may be prevented with attention-focusing events of instruction (Gagne & Briggs, 1979; Hannafin, 1989). Six functions of the sound attribute can provide a subtext or within sound-image sequences. However, these sound functions still require a structure to prescribe the duration of the function in the sound-image relationship. Structuring sound substrategies is a second activity in structuring sound functions into a sound-image relationship.

Structuring The Functions Of The Sound Attribute

A sound structure is a combination of strategies working together with one or more functions. A "strategy" is a schema for mediating an intended message or expression. The strategies that comprise a sound structure refers to the plot (McKeon, 1941), the content organization category (Coldevin, 1981), the goal-area (Palmer, 1969; Lesser, 1972; Mielke, 1968; Schramm, 1972), the code (Salomon, 1979; Smith, 1988), or the story-spine (Goldman, 1983; Field, 1982; Root, 1979). Sound strategies and substrategies help the designer or script-writer to prescribe where, how, and for which function exactly each component of the message fits into or "works" in the overall scheme of each scene or sequence of scenes. Structures place appropriate sound functions next to every image sequence to create the preferred symbol scheme for a referent. Figure 2 (page 54) shows the six sound strategies and fifteen substrategies that can be used to produce or evaluate the structure of the sound in a sound-image sequence.

In this context, structuring the sound functions for a sound-image sequence means writing the sound strategies on the Structured Function Sheet for each created function. Structuring sound functions means describing or prescribing from among six levels of informational intervention with the image; from either of two roles for an emotional strategy; from a flexible pacing strategy, a continuous or discontinuous rhythm strategy; a spaced, massed, or summarized review strategy; and a convergent or divergent delivery strategy

The Informational Sound Strategy

Four substrategies comprise the ***Informational Sound Strategies*** (Alten, 1981; Brown, 1985; Buxton, 1987; Field, 1982; Gaver, 1989; Gecsei, 1986; Goldman, 1983; Zuckerman, 1949). ***Cueing, Counterpointing, Dominating,*** and ***Undermining*** can be placed along a relationship-to-image continuum. All four substrategies may be used throughout the sound design in combination with other substrategies. A fifth substrategy is not considered here and not included in the SSF Model. It prescribes sound information that supports or merely accompanies the image, making that information unnecessarily redundant, and subsequently promoting the visual preference or bias.

Audio segues, headliners, flashforwards or gimmicks are some examples of the ***Cueing Informational Sound Substrategy*** where the chosen sound function foreshadows the visual action. The ***Countepointing Informational Sound Substrategy*** has been used to create a visual cast-against-type characters by providing aesthetic meaning. The ***Dominating Informational Sound***

Figure 2.
Sheet for Structuring Sound Functions.

Structuring the Sound Functions (Speech, Sfx, Music) for Segment:

The Informational Strategy:

☐ **Cues The Image**	☐ **Dominates the Image**
How?	How?
How Often?	How Often?
Where?	Where?
☐ **Counterpoints The Image**	☐ **Undermines the Image**
How?	How?
How Often?	How Often?
Where?	Where?

The Emotional Strategy:

☐ **Punctuates an Emotional Highlight**	☐ **Defines Intensity of Action**
How?	How?
How Often?	How Often?
Where?	Where?

The Pacing Strategy:

☐ **Slow-Paced**	☐ **Fast Paced**
How?	How?
How Often?	How Often?
Where?	Where?

The Rhythm Strategy:

☐ **Discontinuous Rhythm**	☐ **Continuous Rhythm**
How?	How?
How Often?	How Often?
Where?	Where?

The Review Strategy:

☐ **Massed Review**	☐ **Spaced Review**
How?	How?
How Often?	How Often?
Where?	Where?
☐ **Summarized Review**	
How?	
How Often?	
Where?	

The Delivery Strategy:

☐ **Divergent Delivery**	☐ **Convergent Delivery**
How?	How?
How Often?	How Often?
Where?	Where?

Substrategy rarely appears in video simulations and multimedia. If it did occur more often it may alleviate the current audio-visual redundancy affecting educational courseware (i.e., identical informational and emotional strategies using verbal, visual and graphic organizers). However, at its rare best, this substrategy untypifies a predictable or hackneyed emotional interlude (e.g., injects silence where music would bridge two scenes or where the attention to image is lost briefly). The *Undermining Informational Sound Substrategy* is considered to be an ironic or sarcastic use of informational sound in that its effect "sends up" the meaning in the image.

The Emotional Sound Strategy

The sound attribute is often prescribed with either ***of*** two ***Emotional Sound Strategies*** (Alten, 1981; Brown, 1985; Field, 1982; Gecsei, 1986; Goldman, 1983; Lapper, 1985; Seidman, 1986; Zuckerman, 1949). Invideoand computer application, the visual action may be a gimmick. Strategically placed, ***Defining Visual Action Intensity Sound Substrategy*** prescribes how, where, and how often the chosen sound function should punctuate the visual action. A sound or its absence may create depth by creating suspense or interest in the sound-image relationship. Restraint through the sparing use of silence or room noise may imply suspense or interest in the story or message. ***Punctuating an Emotional Highlight Sound Substrategy*** may create depth by implying suspense or interest with two or more sound functions in a sound-image relationship (e.g., electroacoustically-produced sound designs may create deeper-felt emotions in the learner).

The Pacing Strategy

Since the 1930's, pacing has been used effectively in many conventional applications of sound to image (i.e., in artistic, education, and entertainment environments). Motion picture writers and editors have operationalized the importance of "the dialogue cutting point" for making smooth, unnoticeable cuts when cuttingfrom onespeaker to another in a scene (Salt, 1976). The two ***Pacing Sound Substrategies*** (Coldevin, 1981; Lesser, 1972; Mielke, 1968; Palmer, 1969; Salomon, 1979; Schramm, 1972) prescribe how fast, where, and how often the chosen sound function occurs in the production. Sound pacing can be placed along the designer's continuum Fast or Slow occurring in contrast to one another.

The Rhythm Strategy

TwoRhythm Sound Strategies (Brown, 1985; Coldevin, 1981; Field, 1982; Palmer, 1969; Root, 1979; Salomon, 1979; Schramm, 1972) prescribe the periodicity for each chosen sound function in a script or sound mix. A Continuous Rhythm Substrategy places uninterrupted sound ***Review*** or ***Summarized Review)*** or interrupted sound at regular intervals (Spaced Review) throughout the sound design. A ***Discontinuous Rhythm Substrategy*** places uninterrupted sound or interrupted sound at regular intervals throughout the program or production.

Review Sound Strategy

When one or more of the ***Review Strategies*** (Coldevin, 1981; Palmer, 1969; Salomon, 1979; Schramm, 1972) have been chosen for a particular sound function, then each strategy should show the size and the extent to which the designer or learner wants to manipulate the reality suggested by the image by writing how, where or how often each sound function will be ***Massed, Spaced,*** or ***Summarized*** (Coldevin, 1981; Palmer, 1969; Salomon, 1979; Schramm, 1972). The three review substrategies prescribe the nature of a particular function's recurrence in a sound-image relationship.

Corporate video productions tend to use a Summarized Review Substrategy to reinforce behaviour modification role modelling techniques. Similarly, most "Sesame Street" episodes often repeat "this program has been brought to you by the letter M"; broadcast TV news programmes utilize a Summarized Review Substrategy in recapping the main news stories. Exemplary software using sound as a reviewing technique tend to mass the speech or music into "sound bites."

The Delivery Sound Strategy

Convergent or Divergent Delivery Substrategies (Davis, Alexander & Yellon, 1981) are usually considered to fall along a continuum. Their visual counterparts have been implemented in education to prescribe instructional events or learning activites. The application of convergent or divergent delivery methods to sound designing is most appropriate when applied in this context.

In a Convergent Delivery Substrategy (Coldevin, 1981) the designer or learner presents the questions and supplies the answers; favouring one side over another. Brown (1985) states that in a dramatic script with a convergent delivery, catharsis is reached through the ultimate confrontation of two opposing forces. In a Divergent Delivery Substrategy (Coldevin, 1981) the designer or learner supplies their own answers to controversial questions presented by the medium. Two or more diverging points of view emerge but are presented equally for scrutiny. It is important to retain this dichotomous or scholastic presentation format, wherein no attempt is made to editorialize nor to show favour.

In summation, structuring skills are relatively common dramatic devices that, in many cases, are learned in many creative writing and production courses under various synonyms. Structuring the sound functions for a sound-image sequence means writing the sound strategies on the Structured Function Sheet for each created function. Together, the implied sound substratgeies can prescribe how, where, and how often the speech act should be placed within a sound-image relationship. Implicit in this task is an ability to choose from among fifteen possible substrategies, as well as the ability to decide how, where, and how often each substrategy should be applied in the sound-image relationship. In this light, modifying the structured functions of the sound attribute for conventional and multimedia deisgn may take as much or more time, effort and resources as encoding its educational messages. Scriptwriting is the third activity before applying available sound resources to the technology.

Scriptwriting

Scriptwriting involves simply using the information from the structured function sheets as a guideline for placing the utterances music or sfx in the sequence. Then, different versions of the scripting format (e.g., using stated sound, implied sound categories or "text" and "subtext" categories) will encourage proper allocation of speech, music or sound effects resources. Figure 3 shows a typical multi-column script sheet. Notice that the six functions have been filled-in along the top of the form. The spaces under these columns can then be used to determine the approximate location and quantity of each structured sound function in a sequence, scene or keystroke.

This multi-column scripting sheet is an adapted animation-style layout with the addition of functions in each column instead of the conventional number of the tape tracks, voice overs and instruments. Together with the

Figure 3.
Multi-Column Scripting Sheet.

Scripting Structured Sound Functions
For Segment:

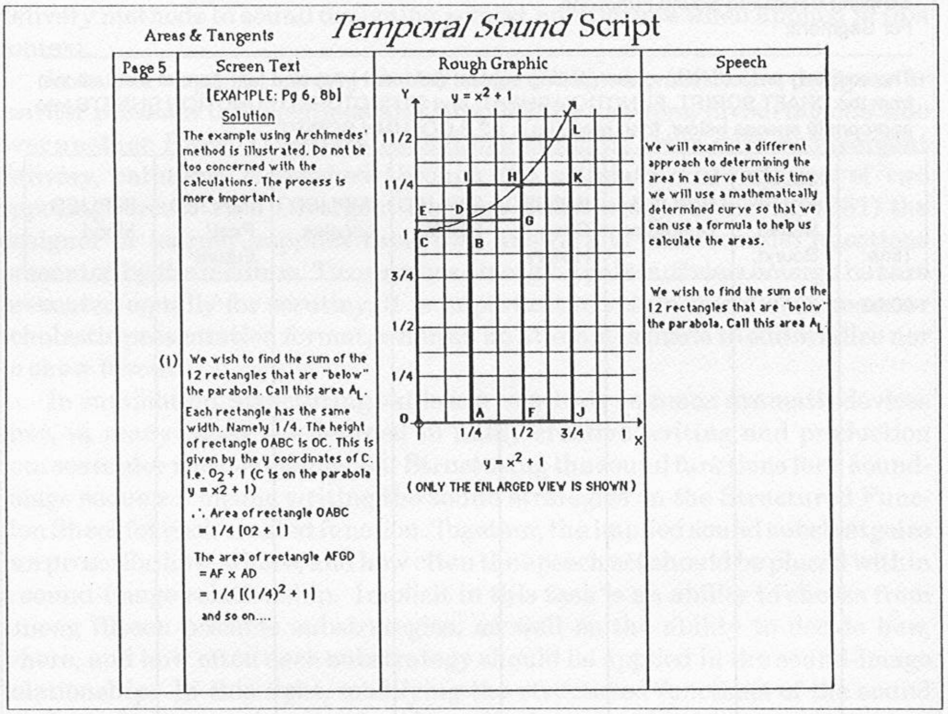
The scripting procedure involves plotting subtext (informal info) and text (formal instructions) from the DRAFT SCRIPT, FUNCTION SHEET, and STRUCTURED FUNCTION SHEETS into appropriate spaces below, then rewriting a 1,2,3-COLUMN SCRIPT.

Time:	stated Picture stated Sound:	IMPUED Character	IMPLIED Case History	IMPUED POWS	IMPUED Locales	IMPUED Past/ Future	IMPUED Mood
00:00							

Structure Sheet, the multi-column script should encourages quick stroming sessions using any of the sound functions in various combinations with analog or digitized video. Next, progressively more detailed versions of the script can be written by collapsing the columns down to three, two or one column depending on the technology used. Figure 4 shows a collapsed script version.

Figure 4 shows a collapsed script page for an introductory calculus unit using only the *Temporal (Past and Future) Sound Function* (Mann, 1990). This function has been structured with a *Moderately-Slow, Spaced, Discontinuous, Counterpointing* and *Convergent* instructional strategy (Mann, 1990). An important aspect in creating these collapsed versions of the script is that a psychological distinction is maintained: Between the picture and the sound; between the stated sound and the implied sound; and between the text and the subtext.

Figure 4.
A "Collapsed" Script Page for a Temporal Sound Function.



CONCLUSION

Although attribute research suggests *modus tollens* that sound may only produce equivalent learning, a review of the interdisciplinary literature is promising (Mann, 1990). The review has two interdisciplinary focii. First, there is an extensive literature base surrounding the long history of the impositions of literacy on unofficial oral forms (Havelock, 1988; Olson, 1988). Second, there is a substantial literature base in communications, education, human factors and instructional psychology on the impact of dialogue and music to film (Cavlcanti, 1939; Eisenstein, Pudovkin & Alexandrov, 1949), to instructional film and video (Zuckerman, 1949) and to computer programs (Buxton et al, 1989; Fiedorowicz & Trites, 1985).

An Educational Communications Model

This paper presented the SSF Model to improve sound attribute research and scriptwriting guidelines in educational technology At first glance, this sound design model may be seen tobeonly workable for conventional dramatic entertainment, not for educational media. However, the model is partially based on principles adapted from educational films and television. The framework for four of the six sound functions and two of the six strategies that contribute to structuring a sound function were adapted from an analysis of instructional films (Zuckerman, 1949). The Review Rhythm and Pacing Strategies are based on the scripting guidelines of the Children's Television Workshop (Schramm, 1972). The balance of the variables and their systemic development is a mix of communications research and the author's research and experience.

For educational purposes, then, the SSF Model should be implemented as a subsystem of instructional designand is therefore dependent on other factors in the ID system- (e.g., a needs assessment, learner characteristics or mental models, etc). Structuring the functions of a sound attribute is a personal and situation-specific activity which requires an understanding of the external conditions of learning (Gagne & Briggs, 1979), the learners' characteristics or mental models (Johnson-L.&d, 1988), as well as the designers' preferences or biases (Bowers, 1988; Ragsdale, 1988; Winograd and Flores, 1986). Ongoing research and practical advice is required on the effects and interactions of these functions and structures on intentional and incidental learning.

The Media Mix Perspective

Educational communication-mediated by current technology requires decisions about bath the intended message and how the impact of the technology shapes that message. Although the SSF Model may be applied to any media mix with an audio capability, itsapplication should be selective and fully integrated with current theory and exemplary practice, Furthermore, current multimedia permit differentiated presentations, as well as adaptive and non-linear interaction that increase the variety of design possibilites. Use of these integrated technologies may require more complex levels of learner or designer control that challenge the user interface designer. The fullest utilization of these and other technological capacities (e.g., control ofinstruction, interactivity) requires a media mix perspective towards the attributes of communication technology in favour of a perspective that chooses one medium or attribute of one medium over another.

From a media mix perspective, conventional divisions between the media (e.g., computer, video and film) may be less useful than a clearer definition of the structured function of the communication attribute (e.g., a brief convergent speech-counterpoint& subjective point of view). Moreover, conventional classifications of particular media (e.g., between tutorial, simulation or drill-and-practice programs) are lost in the speed and quality of transitions between these classifications. A media mix perspective, then, does not differentiate among sound designing activities for computer, video and film; nor does it restrict sound designing activities to particular classifications of use of one or more media. In designing sound with images, a media mix perspective advocates the application of the structured functions of the sound within media mix sequences.

Sound and Learner-Control

Throughout the planning and authoring of media mixing activities, sound must become an integrated part of the design of the program, not just a feature of it (Grimes, 1990; Lepper, 1985; Mann, 1990). Adding sound to currently silent programs may require a new definition or description about what will and will not constitute a sequence. Adding sound will also require new decisions about which functions (i.e., a Locale, Mood, etc.) the sound (i.e., music, speech and/or effects) will contribute to a sound-picture sequence. Morever, adding sound will then require decisions about how, where and how often the functions should occur throughout the sequence and throughout the entire program. Before and throughout media mixing activities, a psychological distinction should be maintained between the images and the sound, between the stated and implied sound, and between text and subtext; particularly when rapid changes are being made without being physically included in the script.

Timing and Duration

Optimal timing and duration of sound cannot in itself affect changes in human processing, attitude and performance. The design of communication and educational mixed media messages should supplant or activate cognitive strategies, aim to change attitudes or to improve skill-based or problem solving performance. In this way, sound design (i.e., speech music and effects) can make a viable contribution to the mixed media perspective.

Other sound design issues requiring elaboration include: How sound and image should occur simultaneously; whether or not sound should have an on/off switch and volume control; and whether or not it should be playable from a repeatable keystroke or clickable icon. Subsequent mixed media research should continue to aim at supplanting and activating cognitive strategies, changing attitudes and at improving problem solving levels using the SSF Model.

REFERENCES

Alkin, E.G.M. (1973). ***Sound with vision: Sound techniques for television and film.*** London: Butterworths.

Alten, S. R. (1981). ***Audio in media.*** Belmont, CA: Wadsworth Publishing.

Altman, C. (1980). Introduction. ***Yale French Studies, 60,*** 3-15.

Barba, R. H., & Merchant, L. J. (1990). The effects of embedding generative cognitive strategies in science software. ***Journal of Computers in Mathematics and Science Teaching,*** 10(l), 59-65.

Blattner, M., Sumikawa, D., & Greenberg, R. (1989). Earcons and icons: Their structure and common design principles. ***Human-Computer Interaction. 4, 67-94.***

Bordwell, D., & Thompson, K. (1979). ***Sound in the cinema. Film art: An introduction.*** Reading, MS: Addison-Wesley

Bowers, C. A. (1988). ***The cultural dimensions of educational computing: Understanding the non-neutrality of technology. New*** York: Teachers College, Columbia University Press.

Brown, J. (1985, January). ***Scriptwriting for television, radio, and film.*** Paper presented at a creative writing seminar for the Department of English, Concordia University.

Buxton, W. (1987). The audio channel. In R. M. Baecker, & W. A. S. Buxton (Eds.), ***Readings in human computer interaction: A multidisciplinary approach*** (pp. 393-399). Morgan Kaufman Associates.

Buxton, W., Bly, S.A., Frysinger, S.P., Lunney, D., Mansur, D.L., & Mezrich, J.J. (1989). Introduction to this special issue on nonspeech audio. ***Human Computer Interaction,*** 4, 67-94. Los Altos, CA: Morgan Kaufmann.

Cavalcanti, A. (1939). Sound in films. ***Films,*** 1(l), 25-39.

Clark, R. E. (1983). Reconsidering research on learning from media. ***Review of Educational Research, 53(4), 445-459.***

Coldevin, G. (1981). Experimental research in television message design: implications for ETV. ***Programmed Learning & Educational Technology,*** 18(2), 86-99.

Conklin, J. (1987). Hypertext: An introduction. ***IEEE Computer, 9,*** 17-41.

Craik, F. I. M. (1979). Human memory. ***Annual Review of Psychology, 30, 63-*** 102.

Crecine, J. (1986). The next generation of personal computers. ***Science, 23*** (l), 935-943.

Davis, R., Alexander, L., & Yellon, S. (1981). ***Learning system design: An approach to the improvement of instruction.*** New York, NY: McGraw Hill.

Daiute, C. (1985). Writing ***and computers.*** Reading, MS: Addison Wesley Company

Dede, C. & Swigger, K. (1988). The evolution of instructional design: Principles for intelligent computer assisted instruction. ***Journal of Instructional Development,*** 11(l), 15-21.

Doane, M.A. (1980). The voice in the cinema: The articulation of body and space. ***Yale French Studies, 60, 33-50.***

Eisentein, S. M., Pudovkin, V., & Alexandrov, G. V. (1949). ***Statement on the sound film. Film form.*** New York, NY: Harcourt Brace.

Fiedorowicz, C., & Trites, R. (1985). Autoskill: Component reading subskills program. (Computer program). The Ontario Ministry of Education, Toronto.

Field, ***S.*** (1982). ***Screenplay; The foundations of screenwriting. New*** York, NY: Dell Trade.

Fleming, M. L. (1987). Displays and communication. In R.M. Gagne (Ed.), ***Instructional technology: Foundations*** (pp. 223-260). Hillsdale, NJ: Lawrence Erlbaum Associates.

Gagne, R., & Briggs, L. (1979). ***Principles of instructional design.*** (2nd ed.) New York, NY: Holt, Rinehart and Winston.

Gaudino, V. (1986). The use of speech and sound in software developed for the G.E.M.S. ***In CALM Development, 2(6), 6-9.***

Gecsei, T. (1986, September). ***Advanced scriptwritingforfilm.*** Paper presented at a scriptwriting seminar for the Department of Communications Studies, Concordia University

Gianetti, L. (1985). ***Understanding movies.*** Englewood, NJ: Prentice Hall

Goldman, W. (1973). ***Adventures in the screen trade. New*** York, NY: Warner Books.

Gorbman, C. (1983). Teaching the soundtrack. ***Quarterly Review of Film Studies, 1(4),446-452.***

Greenfield, P. M. (1984). ***Mind and media: The effects of television, videogames and computers.*** Cambridge, MS: Harvard University Press.

Grimes, T. (1990). Audio-video correspondence and its role in attention and memory. ***Educational Technology Research and Development Journal,*** 38(3), 15-26.

Hannafin, M. (1989). Interaction strategies and emerging instructional technologies: Psychological perspectives. ***Canadian Journal of Educational Communication, 18&3),*** 167-179.

Hannafin, M. J., & Rieber, L. P. (1990). Psychological foundations of instructional design for emerging computer-based instructional technologies: Part I. ***Educational Technology Research and Development Journal, 37(4).*** 91-101.

Hartson, R., & Mix, D. (1990). Human-computer interface development: Concepts and systems for its management. ***ACM Computing Surveys,*** 12(l), Entire issue.

Havelock, E. (1988). The coming of literate communication to western culture. In E. Kintgen, B. Kroll & M. Rose (Eds.), ***Perspectives on literacy*** (pp. 127-134). IL: Southern Illinois University Press.

Johnson-Laird, N. (1988). ***The computer and the mind: An introduction to cognitive science.*** Cambridge, MS: Harvard University Press.

Keller, J.M. (1983). Motivational design of instruction. In C. M. Reigeluth (Ed.), ***Instructional design theories and models: An overview of their current*** status (pp. 386-434). Hillsdale, NJ: Lawrence Erlbaum Associates.

Lee, R., & Misiorowski, R. (1978). ***Script models: A handbook for the media writer.*** New York, NY Hastings House.

Lepper, M. R. (1985). Microcomputers in education: Motivational and social issues. ***American Psychologist,*** 40(l), 1-18.

Lesser, G. (1972). Assumptions behind the production and writing methods in sesame street. In W .Schramm (Ed.), ***Quality instructional television.*** Hillsdale, NJ: Lawrence Erlbaum Associates.

Malone, T. W. (1981). Toward a theory of intrinsically motivating instruction, ***Cognitive Science, 4, 333-369.***

Mann, B. L. (1990). ***Designing the audio channel for computer-based calculus.*** (Research Report No. 1071: lb Enhance The Quality Of Selected Mathematics Courseware By Incorporating Recent Technological Advances). Toronto: Ontario Institute for Studies in Education. Department of Measurement, Evaluation and Computer Applications.

Marcus, A. (1987). Graphic design for computer graphics. In R. M. Baecker & W. A. S. Buxton (Eds.), ***Readings in human computer interaction: A multidisciplinary approach*** (pp. 320-326). Morgan Kaufman Associates.

McKeon, R. (1941). De poetica. In R. McKeon (Ed.) ***The basic works of Aristotle*** 1447.1-1462.15. New York, NY: Random House.

McLuhan, M. (1964). ***Understandingmedia: Theextensionsofman.*** New York, NY: McGraw Hill.

McLuhan, ***S.*** (1978). ***McLuhan: The man and his message. ACBC*** documentary by Stephane McLuhan. Hosted by Tom Wolfe. Broadcast January, 1979.

Mel, B. W., Omohundro, S.M., Robison, A. D., Skiena, A. D. Thearling, K. H., Young, L. T., & Wofram, S. (1988). Tablet: Personal computer in the year ***2000. Communications of the ACM, 31(9), 639-646.***

Merrill, D. M. (1988). Applying component display theory to the design of courseware. In D. H. Jonnassen (Ed.), ***Instructional designs for microcomputer courseware.*** (pp. 61-96). Hillsdale, NJ: Lawrence Erlbaum Associates.

Mielke, K. (1968). Asking the right ETV questions. ***Educational Broadcasting Review, 2(6),*** 54-61.

Millerson, G. (1979). ***The technique of television production.*** London: Focal Press.

Nickerson, R.S. (1986) ***Using Computers: Human factors in information systems.*** Cambridge, MS: MIT Press.

Olson, D. R. (1988). From utterance to text. In E. Kintgen, B. Kroll, &M. Rose (Eds.), ***Perspectives on literacy*** (pp. 175-189). Illinois: Southern Illinois University Press.

Paine, F. (1981). Sound design and Walter Murch. ***University Film Association Journal,*** 15-20.

Palmer, E. (1969). Research at the Children's Television Workshop. ***Educuc-tional Broadcasting Review, 3(5), 43-48.***

Pea, R. D., & Kurland, D. M. (1984). On the cognitive benefits of learning computer programming. New ***Ideas in Psychology, 2(2),*** 137-168.

Prendergast, R. (1977). ***Film music: A neglected*** art. New York, NY: Norton.

Pudovkin, VI. (1960). ***Asynchronism as aprinciple of sound film.*** Film Technique and Film Acting, London: Vision Press Ltd.

Ragsdale, R. ***G.*** (1988). ***Permissible computing in education: Values, assumptions, and needs.*** New York, NY: Praeger Books.

Reinking, D. (1987). Computers, reading and a new technology of print. In D. Reinking (Ed.), ***Reading and computers: Issues for theory and practice (3-*** 23). New York: Teachers College Press.

Reiser, R.A., & Gagne, R. M. (1983). ***Selecting media for instruction.*** NJ: Educational Technology Publications.

Reynolds, ***G.*** (1968). ***A primer of operant conditioning.*** Glenview, IL: Scott, Foresman.

Richey, R. (1986). The ***theoretical and conceptual bases of instructional design.*** New York, NY: Kogan Page.

Root, W. (1979). ***Writing the script: A practical guide for films and television.*** New York, NY: Holt, Rinehart, and Winston.

Rosenbaum, J. (1978). Sound thinking. ***Film Comment, 14, 5.***

Salomon, ***G.*** (1979). ***Interaction of media, Cognition and learning, New*** York, NY: Jossey Bass Inc.

Salomon, G., & Clark, R. (1977). Reexamining the methodology of research on media and technology in education. ***Review of Educational Research, 47,*** (l), 99-120.

Salomon, G., & Gardner, H., (1986). The computer as educator: Lessons from television research. ***Educational Researcher,*** 15(10), 13-19.

Samuels, A. (1984, September). ***Scriptwriting for television.*** Paper presented at a scriptwriting seminar in the Department of Communications Studies, Concordia University, Montreal Canada.

Salt, B. (1976). Film style and technology in the thirties. ***Film Quarterly, 30,*** 12-24.

Scardamalia, M., Bereiter, C., McLean, R. S., Swallow, J., & Woodruff, E. (1989). Computer-supported intentional learningenvcironments. ***Journal of Educational Computing Research,*** 5(l), 51-68.

Schramm, W. (1972). ***Quality instructional television.*** Honolulu, HI: University of Hawaii Press.

Schoderbek, P. P., Schoderbek, C. G., & Kefelas, A. ***G.*** (1985). ***Management systems: Conceptual considerations*** (3rd ed). Plano, TX: Business Publications Inc.

Seidman, S.A., (1986). On the contributions of music to media productions. ***Educational and Communication Technology Journal, 29*** (1). 49-61.

Smith, D. (1988). Institutional contexts for interactive learning-media. ***Programmed Learning And Educational Technology,*** London: England.

Spottiswoode, R. (1950). ***A grammar of the film: An analysis of film technique.*** Berkeley, CA: University of California Press.

Weis, E. & Belton, J., eds. (1985). *Film sound*. New York: Columbia University Press.

Winograd, T., & Flores, F. (1986). ***Understanding computers and cognition.*** Norwood, N.J: Ablex.

Zettl, H. (1973). ***Sight, sound and motion: Applied mediaaesthetics.*** San Diego, CA: University of California Press.

Zuckerman, J. (1949). ***Music in motion pictures: A review of the literature with implications for instructional films.*** PA: Pennsylvania State College, Instructional Film Research Program.

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REVIEW OF CANADIAN STUDIES

The Canadian Studies and Special Projects Directorate of the Secretary of State has commissioned Dr. David R. Cameron, Professor of Political Science at the University of Toronto, to undertake a review of the current state of Canadian studies in Canada, in collaboration with the Association for Canadian Studies.

Dr. Cameron has extensive experience both in government and education. He served as Dean of Arts and Science at Trent University, and as Vice-President of lnstitutional Relations at the University of Toronto. He was Assistant Sccretary to the Federal-Provincial Relations Office, Deputy Minister of Intergovernmental Affairs, Province of Ontario and most recently Special Advisor to the Premier of Ontario on Constitutional Reform, as well as Ontario Representative to the Government of Quebec. Dr. Cameron has a special interest in the field of Canadian studies and is currently a member of the Editorial Board of the ***Journal of Canadian Studies/Revue d'etudes canadiennes.***

The eighteen-month review, begun in June 1991, will result in a major report providing an historical overview of the field of Canadian studies since the ground breaking report ***To Know Ourselves: The Report of the Commission on Canadian Studies*** (prepared by T.H.B. Symons and published in 1975 by the Association of Universities and Colleges of Canada), as well as ***Reflections on the Symons Report, The State Of Canadian Studies*** in 1980 (prepared by James E. Page and published by the Secretary of State) and ***Some Questions Of Balance*** (prepared by T.H.B. Symons and James E. Page and published by the AUCC in 1984).

There is a need for a review of the field of Canadian studies at this time. This study will be of critical importance to practitioners and others active in both the field of Canadian studies andeducation, as well as to policy makers. It will assess achievements. underdeveloped areas and opportunities in the field, review the current state of Canadian studies domestically, taking into account the international context, and offer suggestions for potential future directions for the field

LA SITUATION DES ÉTUDES CANADIENNES : UN BILAN

La Direction des études canadiennes du Secrétariat d'État du Canada a chargé David R. Cameron, professor de science politique a l'université de Toronto, de fair une étude sur la situation des etudes canadiennes au Canada, en collaboration avec l'Association détudes canadiennes.

M. Cameron a une vaste expérience autant dans la fonction publique que dans le domaine de l'éducation. Il a été doyen de la faculté des arts et sciences a l'université de Trent et vice-président des relations institutionnelles a l'universite de Toronto. Il a également occupe les postes de secrétaire-adjoint au Bureau des relations federales-provinciales, et de sous-ministre aux Affaires intergouvernementales de l'Ontario et, tout recemment, celui de conseiller spécial du premier ministre de l'Ontario en matibre constitutionnelle ainsi que représentant de l'Ontario aupres du gouverumeut du Quebec. David Cameron s'intéresse particulierement aux études canadiennes et est membre du comite de rédaciton de la ***Revue d'études canadiennes/Journal Of Canadian Studies.***

Cette etude d'envergure s'échelonnera sur une periode de dix-huit mois a partir de juin 1991 et aboutira a un rapport qui fera le bilan de la situation des etudes canadiennes depuis la parution de Se ***connaitre: Le Rapport de la Commission sur les études canadiennes (rédigé par T.H.B. symons et publié en 1975 par l'Association des miversités et collèges du Canada).*** Réflexions sur le Rapport Symons: L'état des études canadiennes en 1980 (rédigé par James E. Page et publié par le Secretariat d'Etat) et de Où ***trouver t'équilibre*** (redigé par T.H.B. Symons et James E. Page et publie par l'AUCC en 1984).

Cette étude critique de la situatio des études canadiennes répond a un besoin msera un outil des plus utiles pour tous ceux et celles qui oeuvrent dans la sphere des études canadiennes, de l'éducation, ou qui travaillent a l'élaboration de politiques. Le rapport fera le bilan des acquis et des faiblesses dans ce domaine, dressera un tableau de la situation des études canadiennes au pays en tenant compte du contexte international et proposera de nouvelles avenues pour l'avenir.

An Overview of the Uses of Computer-Based Assessment and Diagnosis

Lauran H. Sandals

Abstract: This paper presents an overview of the applications of computer based assessment and diagnosis for both educational and psychologlcal placement and Interventions. The paper includes a review and brlef history of computer testing and the antecedents that led to the current acceptance of this medlum as an assessment tool. A rationale for the use of Computer Based Assessment (CBA) and its potentlal advantages in relationship to our current testing practice is also dlscussed. The four generations of (CBA) are presented with a discussion of the strengths and weaknesses of each stage and concludes with some of the issues regarding the construct validity of computer based assessment Instruments vis a vls conventlonal testing practlce.

Résumé: Cet article présente une vue d'ensemble des applications diagnostiques et évaluatives basées sur l'informatique pour le placement et l'intervention pédagogique et psychologique. Après un bref historique du testing par ordinateur, l'article discute des raisons qui ont amené les intervenants à utiliser l'ordinateur en tant qu'outil d'évaluation. tes bases théoriques sur lesquellessont basées l'utilisation du "Computer Based Assessment" (CBA) sont présentées ainsi que les avantages que l'on en retire dans la pratique. De plus, quatre générations de CBA sont discutées au regard de leurs qualités et leurs faiblesses. Enfln, en conclusion, la validité du construit des Instruments d'évaluation informatique est considerée et comparée aux pratiques de testlng conventionnelles.

INTRODUCTION

Testing has been with us since the beginning of recorded history. The Chinese used formal assessment procedures by 1115 years B.C. (Dubois, 1970) in deciding which individuals should be assigned different positions in the Chinese civil service. Throughout time scientists, psychologista, educational diagnosticians, and teachers have looked for better ways than their own feelings to assess an individual's potential in order to provide better educational interventions or treatment programmes. Today a student's ability to enter post-secondary training programmes or different career paths is often determined by national, provincial and state-wide examinations that assess

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and rank students on their knowledge of a variety of subjects that are reported to be necessary for post-secondary success. Thus the wide acceptance of tests by society in general has brought us to a time where norm or criterion referenced tests are used: a) to diagnose learning needs; b) to determine eligibility for special programmes; c) to formatively monitor progress; d) to summatively assess student achievement; and e) to assess a student's personality In the past most of these tests were administrated individually by a trained psychologist or educational diagnostician who presented many of the questions verbally or by demonstrating an individual task which the examinee had to replicate or modify or in large group paper and pencil formats with printed booklets.

Society has always tried to improve on the efficiency of such assessment tasks, however, in the 1930's Pressey developed an early testing machine which Skinner revamped in the 1950's into an early commercial success with his original teaching machines that were to test students. These evolved into the earliest instructional-based teaching machines through the use of linear programming techniques. Our continuing acceptance regarding the application of technology and machines in order to lessen an individual's workload has lead through history to the development and use of such things as gears, tractors, and assembly line robots to carry out many tasks that were originally carried out totally by human brawn and brain power. Since becoming an accepted tool in universities and colleges in the mid-1960's computers have become the focus of research in prototype systems that could make use of the computer as an assessment tool that would free the educator or psychologist from certain aspects of the testing environment that could be done as well as or better by a machine. This would leave the psychologist or educator free to work on an individual basis with the client or student in ways which a computer could not. The major limitation regarding this increased use of technology as an assessment tool usually centred on the costs of the machine and the limitations of the programming languages in addition to the problems with either highly graphic material or the need for verbal instruction. However, rapidly emerging technologies are now taking the computer from the research labs and prototype case situations to schools. Many highly optimistic projections for computers in the early 1970's (Knights, Richardson & McNarry, 1973) and the 1980's (Colbourn & Mcleod, 1983) for their widespread use in assessment and diagnosis by the mid to late 1980's will now actually take place in the mid-1990's.

Thus the onset of these technological enhancements and their related psychometric capabilities have now brought us to a point in time where there are some wide uses of certain computer-based assessment and diagnostic packages by the psychology profession. These developments are just being introduced to the education profession at large with specific applications being targeted towards Special Education.

Rational for Computer Based Assessment

Almost all measurements of human performance have to come to grips with the concept of error in assessment. In most instruments there is some variability that is unknown or unpredicted. There are errors such as the different meanings that different individuals make on the interpretation of the same word or phrase. There is human error in the scoring or interpretation of grouped or individual tests. Thus in current assessment practice either through better standardized test procedures, item analysis or statistical tests we are constantly trying to reduce the amount of error one produces in making predictions based on test instruments. In 1985 Poteet and Eaves edited a special issue of ***Diagnostique*** entitled "Perspectives in Special Education Assessment." In Table 1 the author has presented a summary of their 10 major concerns regarding common errors in current assessment practice. Some of these concerns relate to such practical issues as who makes the assessment decision about which instruments are used in the school division. Other issues involve such things as human error in the administration and/or scoring of the test. Many of the issues raised regarding error are more related to common sense. The use of a computer administered version of the same test could

TABLE 1
*Common Errors in Current Assessment Practice**

1, Instruments to be used in the assessment process are often stipulated by administrators of the School system.
2. Educational diagnosticians regularly use instruments for purposes other than those for which they have been validated.
3. Related to Number 2 above is the practice of taking the recommended uses of an instrument at face value.
4. Educational diagnosticians sometimes become caught up in a "drive up window" mentality that leads to the selection of "quick and dirty" instruments.
5. The band wagon effect too often plays a part in instrument selection.
6. During data collection, practitioners can and do commit a number of errors.
7. In Special Education the use of individually administered Instruments is considered the "sine qua non" of assessment practice.
6. Although it seems too elementary to mention, not enough attention is paid to standardized administration rules.
9. Of the mistakes that are made during the use of assessment instruments, perhaps the most common of all is the scoring error.
10. Interpretation of assessment results is considered by many educational diagnosticians to be their most onerous task.

*Note: Adapted from Poteet and Eaves (Eds.). (1964-1965), Perspectives in Special Education Assessment [Special Issue] Diagnostique, 10, 1-4.

possibly compound the error with much more rapidity This may occur due to the fact that a testee may make several mistakes that can not be changed even if they know they are wrong and in the case of an adaptive test the following questions are individualized from prior responses. In addition the diagnostician or psychologist may not review the computer test before continuing on with the computer scoring and possible scale value interpretations and thus report data from a possibly invalid test situation.

Advantages of Computer Based Assessment (CBA)

Many individuals feel that there is a distinct advantage in using the microcomputer as assessment and diagnostic tools for both psychologists, and educational diagnosticians because of the perceived errors in contemporary assessment techniques and the potential overall cost savings. Some of these advantages are adapted and summarized by the author from Poteet and Eaves (1985) in Table 2Aand also by Bunderson, Inouye, and Olsen (1989) in Table 2B (see page 71).

Many of these advantages relate to computers in education in general but many others relate to such issues as item response theory and the practical comparison of test results using paper and pencil administrations vs. the computer vis a vis comparative scores, time on task, cost justification and human time.

These advantages are particularly apparent when one looks at the potential use of these computer based tests from a psychologist's perspective, especially for an individual who may be in private practice. These advantages tend to deal with issues that may not be particularly of interest to educators and diagnosticians in the public school system but at the same time they provide a valid rationale for their continuing use as described by Jackson in (1986) for the American Psychological Association (APA) Scientific affairs office on the use of Computer Based Personality Testing (See Table 3, page 72).

Thus the numerous problems and error in current contemporary assessment practices when compared with the advantages of computer based assessment leads one to believe that the future for computer based assessment is assured. The major impediments to this evolutionary continuum of developments in (CBA) is only limited by (a) the costs of hardware and software, adequate research expertise in the development of these instruments, and (c) the training and professional development of psychologists and educational diagnosticians in the availability and effective use of the (CBA) instruments. The next section will overview the four generations of (CBA) and the relevant issues regarding the construct validity of these automated assessments.

TABLE 2A
*Advantages of Microcomputers and Item Response Theory**

1. They nearly eliminate error in deriving scores.
2. They reduce scoring time by up to 70% or 80%.
3. They provide a simple mechanism for storing and retrieving valuable information.
4. They have intrinsic motivation for the testee.
5. They have the ability to provide immediate feedback to the examinee.
6. They have the speed to handle the evaluation of tests and their items (reliability, item difficulty, biserial cor relations, etc.)
7. They have the ease to store data and to retrieve it when it has to be recalled.
8. They have the capabilities to detect aberrant response patterns,
9. They have the capabilities to provide ongoing group analysis of the test and item bias.
10. They have the capability to evaluate translations of measurement scales to different languages,
11. They have the capability to tailor the test to individual needs.

*(Eaves, 1984-l985, pp. 28-30)

TABLE 2B
Advantages of Computerized Tests and Computerized Adaptive Tests over Paper Based Testing

1. They have enhanced control in presenting item displays. Greater standardization of test administration.
2. They offer improved test security.
3. They can enrich display information.
4. They can provide equivalent scores with reduced testing time.
5. They can improve the obtaining and coding of responses.
6. They can reduce measurement error.
7. They have the ability to measure response latencies for items and components.
8. They provide improved scoring and reporting.
9. They can be automated for individually administered tests.
10. They can obtain records at a central site.
11. They have the ability to construct tests and create items by computer.
12. They have immediate test scoring and feedback.
13. They can provide an increased variety of testing formats. different languages.

**(Bunderson, Inouye & Olsen 1989)

AN OVERVIEW OF THE FOUR GENERATIONS OF COMPUTER BASED ASSESSMENT

In 1990 Bunderson, Inouye and Olsen presented a definitive chapter on the Four Generations of computerized educational measurement. In this part of the paper a brief summary of the major themes of each of these four generations or stages will be presented in order to provide some continuum of the events that have influenced contemporary computer based assessment strategies. The four generations are: 1) Computer Testing (CT); 2) Computer-Adaptive Testing (CAT); 3) Continuous Measurement (CM); and 4) Intelligent Measurement

TABLE 3
*Advantages of Computerized Testing for Personality Testing**

1. It is quite economical particularly in the saving of expensive professional time.
2. Training technical assistants to supervise administration permits considerable savings.
3. The reduction of time between administration and interpretation speeds up feedback to the patient.
4. Virtually all clerical errors are eliminated.
5. There is a considerable gain in reliability of interpretation by using pre-set rules consistently.
6. There is considerable potential for the systematic gathering of normative information as data recording is cheap and accurate.
7. Complex (i.e., non-linear) scoring procedures are much more feasible in the computer environment.
6. Proper human factors concerns will permit a move to special populations some of which are unserviced by the testing field.

* (Jackson, 1986)

Computer Testing (CT). This is where an existing paper, pencil or other conventional tests are transferred to the computer mainly for the technological advantages of the computer but with the original test and
ing almost identical to the non-computer version. Many research studies have been carried out contrasting the equivalence of paper and pencil vs. computerized tests and these are presented in detail by Bunderson, Inouye and Olsen (1989). Suffice it to say that one variable addressed the issue of the type of test (such as Free Response tests, computerized personality tests, aptitude tests, achievement tests, coding skills tests, graphics tests, multiple page tests) vis a vis research results that presented data in three categories (computer tests scores higher than paper administrated, computer teats scores lower than paper administrated and no significant differences between (CT) and paper and pencil tests). The main characteristics of this type of system are computer controlled administration; rapid scoring and reporting, new display and response types; mass storage for displays and item banks; network communications and the utilization of classical test theory.

Computer-Adaptive Testing (CAT). In this situation the major characteristics are all of those in (CT), however, there is a process of adaption throughout the administration of the test. In this computer environment the computer continually checks the testee's responses in order to adapt the presentation of the next item based on the preceding response, or series of responses, or overall response patterns of prior groups of responses. The computer uses floating point arithmetic and high speed processors in order to calibrate all the parameters in making the selection of the next item or group of items. The adaption can take one or more of three possible examples (adapting item presentation, adapting item presentation times and adapting the content or composition of the item and subsequently adapting the overall test length based on the prior adaptions). It should be noted that the test lengths may be longer but in many cases the (CAT) may present a shorter test if the program assumes the testee either has mastery of a particular set of concepts through a high percentage of correct responses early on in the interaction, or if the testee receives a high percentage of failures early on in the presentation of items. In general the characteristics of (CAT) include all of those in (CT) plus fast floating point calculations for adaptive algorithms that have its theoretical psychometric routes in the field of item response theory and the computer systems that provide item test banks for a multitude ofscience and mathematics tests.

Continuous Measurement (CM). In (CM) the tests use a form of continuous measurement that is embedded in the curriculum in order to measure the changes in the students knowledge and thus to alter instructional interactions accordingly. Measurements include an item, clusters of items, and other exercises and related independent work either on or off the computer. These systems are usually used in what has been typically termed as a "mastery learning" environment where criterion referenced tests are indexed to an individual's educational or behavioural objectives. The curriculum within this type of assessment and measurement usually includes: 1) a course ofobjectives laid out to help the learner attain certain educational goals; and 2) a way of charting an individual's growth through the system either with or without the computer, but more than likely analogous to the previously defined computer managed learning (CML) strategies. The general characteristics of this system includes all of those in (CT) and (CAT) plus the features found in a criterion referenced, computer managed mastery system. The psychometric characteristics includes those of (CAT) and item response theory in addition to clearly stated objectives and the presentation of learning profiles in making computer based assessment decisions. It should be noted that in the area of special education much of the literature on (CM) is reported as Curriculum Based Measurement and the bulk of the research at the elementary and secondary levels has been carried out and reported by Fuchs & Fuchs (1986,1987,1988, 1989).

Intelligent Measurement (IM). Intelligent measurement makes use of most of the general concepts that are presented in CT, CAT, and CM with the significant addition of "knowledge based capability". This type of test is most likely using "artificial intelligence" based concepts in the development of a diagnostic/assessment system that some individuals term expert systems.

Thus (IM) systems are basically the computer based assessments most researchers were hoping that would evolve over the last 25 years of research since we were trying to provide a computer system that could diagnose and assess many educational and psychological concepts as reliably as trained educational diagnosticians and psychologists. One of the biggest differences between (IM) and the preceding three generations is that many different interpretations can be analyzed of a response or series of responses well past that of simple (CAT) measures, Some of these measures have to factor in a summative knowledge base built on the intuitive and subjective experiences of hundreds of educational diagnosticians and psychologists who make every-day use of the manually prepared version of the assessment instrument. Usually the (IM) system will provide the professional with the ability to: a) score complex responses or a series of items; b) to provide interpretations including narrative ones based on a student's or client's profiles on one or more tests; and c) provide advice on either the educational or psychological interventions which the teacher or psychologist may or may not agree with. Thus in general (IM) provides all of the features of the preceding three generations plus knowledge based expert systems. Within (IM) the system uses the knowledge of a number of experts for the scoring, profile interpretations, teaching expertise, possible psychological interventions plus the vast knowledge base of similarly assessed individuals who may be at the same stage in their educational or psychological development.

Thus these four generations of computers have progressed to the point where one supersedes the others. Many important contemporary research projects and relevant commercial projects use one or all four of the previously discussed systems either (CT), (CAT), (CM) or (IM). Because of certain limitations (CT) may be more than adequate in assessing certain achievement skills in a formative setting in education while for another individual (IM) may be necessary for the presentation, scoring and interpretation of a psychologically based personality test.

Whenever an educator or psychologist tries to develop a new form of an old test or to modify an existing one the issue of test reliability and validity comes into question.

Many of the issues regarding the equivalence and comparative nature of the conventional and computer based forms and the generalizability of the results have been addressed by (Greaud and Green, 1986) and (Olsen, Maynes, Slawson and Ho, 1989). In an article "Psychoeducational Testing and the Personal Computer" (Fifield, 1989) presents a strong case for a critical review of either modified or new computer based tests in the area of Technical adequacy under the topics of: 1) reliability; 2) fidelity of administration; 3) alternate forms reliability ; 4) validity; 5) concurrent validity; 6) content validity; 7) external validity; and 8) social validity He makes a strong case regarding the changing role these reliability and validity techniques have in (CBA) and that we have to reconsider how these measures can be applied or even generalized in comparison to our conventional instruments and test procedures. The next part of this paper will discuss the area where the greatest possible changes occur namely in the area of the tests construct validity.

CONSTRUCT VALIDITY OF COMPUTER BASED TESTS

One of the major issues in the field of computer based testing and assessment has to deal with the issue of does a conventional test change when it is reformatted for a computer based presentation even if all of the items and the test itself appear to be identical. One researcher (Green, 1988) addressed these issues primarily in his interpretation whether the construct validity of the test changed from a conventional paper pencil administration to one where it is administered totally on the computer. Some of the main issues addressed had to deal with the following characteristics which may affect the construct validity of the computer based administration. They are: a) Passive omitting b) Back tracking; c) Screen capacity; d) Graphics; e) Responding; f) Time limits: and g) Adaptive tests and related dimensionality. If even one on the topics to be addressed changes when a test is administered with a computer then the tests' prior norms and validity may have to be re- established in its new format.

Passive omitting. On a paper pencil test a respondent can pass on one or two items (for example items two and three) and then he or she can respond to item four and then item five. In fact a respondent can review the whole test before they go back to start answering and filling in responses to questions. In a computer based test (CBT) this cannot be done unless another choice command or control function keys are provided to allow for a "skip"or "next'item" pass etc. Even if this "skip" and "return" function is allowed it places the examinee in a different mental set and it also requires a breakdown of attention to the task on hand (responding to the cognitive nature of the material being evaluated) to mentally rearranging response patterns through different keyboard manipulations.

Back tracking. This occurs when an item has been previously skipped or passed as in passive omitting above or when a student answers a later question (item 10 for example) and now realises that he or she had made a mistake in a prior item (item 3 for example) and that the answer cannot be changed or can only be changed by further mechanical manipulations of the keyboard and the related user software.

Screen capacity. Prior research by human factor specialists (Sandals 1987) state that approximately 64% of the computer screen should be blank when information is presented in a learning or testing situation. Thus there is a chance that some items such as those that include a lot of reading comprehension may not fit on one screen and actually may take up two or three screens before a response can be made. In the paper version all of the information may be included on an 8-1/2 x 11 page.

Graphics. Some of the same issues raised in C above also relates to the size of the screen. Unless the user is using a screen with high resolution colour graphics (such as super VGA) or digitally stored images or laser discs or CD-ROMS then there will be difficulty in presenting many graphics in the same resolution as the original in the printed test booklet. The technology is available to make the reproduction almost 100% accurate, the limitation is the related high costs for many educational institutions on affording this sophisticated state of the art hardware and software.

Responding. The response in our computer based test usually consists of pressing a key and in most cases this is faster than transferring an answer to an answer sheet and thus this can cause a difference in scores with highly speeded components on tests that may cause vigilance error in the filling in of the answer sheets as reported by (Sandals, 1970). Thus responding may be faster and more accurate through a keyboard, mouse, a light pen, and also the computer may not accept an incorrect answer if it is not in a proper field and thus, as a consequence feedback is given. However, feedback for a misplaced response cannot be provided in a paper pencil test. Thus the whole process of responding may affect the overall test score and the construct validity especially in a speeded test.

Time limits. In most grouped test situations a time limit is given in order to allow a teacher or tester control of the testing situation for the norm of the group. However, in the case of the computer the question is raised whether the customary time limits should be abandoned unless the test has a speeded component which is central to the construct validity of the instrument. Thus the construct validity may change if the computer administration does not have the time limit of the paper pencil version.

Adaptive testing and dimensionality. The major construct validity problem with computer adapted tests (CAT) is that the computer constantly changes the test and the item selections based on the prior response or the prior group of responses. Thus passive omitting is not possible, neither is back tracking or the changing of a prior response. In (CAT) a test item or pattern cannot be changed once an item response has been made or skipped. In addition, the dimensionality and content validity may change since usually no two students get the same test. Thus the usual criterion referenced test decisions can be made but norm referenced comparisons become impossible to report with traditional reporting methods. Two students may go through the exam with one taking only half as many items as another with the items that are actually the same being in the 20% range. The usual interpretation of test results may change since a direct item to item comparison may not take place only the domaincanbecrossvalidated. It may become more difficult to compare student performance when the domain being tested is in Language Arts and Social Studies in comparison to Math and Science where the concepts are more hierarchical and well defined. Thus once a conventional test is placed in a (CAT) mode the construct validity may change significantly as does the content validity and probably most of the reliability of the original test.

Thus these construct validity issues really question whether the computer administration of a conventional test is really measuring the same the original and if not, new norms have to be provided in addition to the new interpretation of the results from the (CBT or CAT).

CONCLUSIONS

This paper has presented an overview of the role computer based assessment and diagnosis has played in both educational and psychological environments. Many who made great predictions in the early 1970s for computer based testing were over optimistic on both the acceptance, funds, research and availability of the hardware and software for the mid 1980s. It is only now that we are seeing the reduction in costs and the research in psychometric theory and expert systems that are needed to make wide ranging applications of computer based assessment and diagnosis a reality. The advent of interactive cd's and CD-ROM's are now going to allow us to provide verbal instructions and graphics and pictures that provide a realistic alternative to conventional individualized assessment instruments. Again the whole issue of the use and misuse of computers in education will come into play if those in power make some of the same mistakes that computers educators did from 19751983. In addition, if the concerns outlined in Table 1 are readdressed then there are many potential benefits for society in general in the use of computer based assessment and diagnosis.

REFERENCES

Bunderson, C., Inouye, D., & Olsen, J. (1989). The four generations of computerized education measurement. In Robert Linn (Ed.), Educational measurement, (3rd edition), 367-407. NY: American Council of Education/ MacMillan.

Colbourn,M. J., &McLeod, J. (1983). The potential and feasibility of computer-guided educational diagnosis. In R.E.A. Mason (Ed.), ***Information processing,*** 83. North-Holland: Elsevier Science Publishers.

Dubois, PH. (1970). A history of psychological testing. Boston: Allyn & Bacon.

Eaves, C. R. (1984-1985). Educational assessment in the United States, ***Diagnostique 10, 5-39.***

Fifield, M. B. (1989) Psychoeducational testing and the personal computer. ***Journal of Special Education Technology, 9(3),*** 136-143.

Fuchs, L. S., & Fuchs, D. (1986). Effects of systematic formative evaluation on student achievement:Ameta-analysis. ***Exceptional Children, 53,199-208.***

Fuchs, L. S. (1987). Curriculum-basedmeasurementfor instructional program development. ***Teaching Exceptional Children,*** 20(l), 42-44.

Fuchs, L. S. (1988). Developing computer-managed instruction on teacher's implementation of systematic monitoring programs and student achievement. ***Journal of Educational Research, 81,294-304.***

Fuchs, L. S., & Fuchs, D. (1989). Enhancing curriculum-based measurement through computer applications: Review of research and practice. ***School Psychology Review, 18, 318-327.***

Greaud, V., & Green, B.F. (1986) Equivalence of conventional and computer presentation of speed teats. ***Applied Psychological Measurement, 10, 23-24.***

Green, B. F. (1988). Construct validity of computer-based tests. In H. Wainer, & H.I. Braun (Eds.), ***Test validity.*** Hillsdale, N.J.: Erlbaum.

Jackson, D. N. (1986). ***Computer based personality testing.*** Washington D.C.: APA.

Knights, R. M., Richardson, D. H., & McNarry, L. D. (1973) Automated vs clinical administration of the Peabody Picture Vocabulary Test and the Coloured Progressive Matrices. ***American Board of Mental Deficiency, 78,*** 223-225.

Olsen, J. B., Maynes, D. D., Slawson, D., & Ho, K. (1989). Comparisons of paper-administered, computer-administered and computerized adaptive achievement tests. ***Journal of Educational Computing Research, 5(3),*** 311-326.

Poteet, J. A., & Eaves, R. C. (Eds.). (1984-1985). Monograph: Perspectives in special education assessment [Special Issue]. ***Diugnostique,*** 10(1-4).

Sandals, L. H. (1970). ***Vigilance errors on a search examination.*** Unpublished masters thesis, Xavier University, Cincinnati.

Sandals, L. H. (1987). The role of screen design graphics, colour and sound in computer based learning. How much is too much or too little. ***Proceedings of the International Conference on Computer Assisted Learning in Post Secondary Education.*** (pgs. 189-196). Calgary, Alberta, Canada: University of Calgary.

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Book Reviews

Mary Kennedy, Editor

The Design, Development and Evaluation of Instructional Software by Michael J. Hannafin and Kyle L. Peck. New York: Macmillan Publishing Co., 1988.

Reviewed by L.F. (Len) Proctor

Purpose of the Book

This book suggests that the quantity and quality of software must be improved if computers are to have a positive impact on the field of education. In Hannafin's and Peck's view, it is the teacher's skill, knowledge of design and commitment to quality that are the most important factors in the creation of high-quality, computer-based instruction. As a result, they have emphasized the instructional design process and not the hardware or software used in lesson creation. Novice authors who use the recommendations and suggestions outlined in this publication to guide their software development will avoid many of the pitfalls often associated with low-quality computer-baaed instruction.

Structure of the Book

This book contains seven sections which have been subdivided into twenty two chapters. Each chapter contains a list of objectives, an extensive reference list, suggestions for related reading and review exercises. The review exercises have been designed to reinforce the concepts and principles presented in the body of each chapter.

The first three sections provide a pedagogical basis for the development of computer-based instruction. Section One contains a brief overview of CAI and a description of the characteristics ofeffective CAI. Section Two presents a discussion of how to combine the strengths of teachers and computers to produce powerful teaching systems. Next is a description of a generic instructional design model which in turn serves as a general organizer for the remainder of the text. A good ID model is important because the success or failure of any CAI lesson depends more on the design of the lesson than on any other single element in the authoring process. Section Three completes the treatment of the pedagogical basis for the development of CBI by providing a structure for assessing the viability of CAI as a solution to an educational problem, a method of task analysis, and a strategy for the construction of learning objectives.

The mechanics of developing and producing computer-based instruction begins in Section Four. Section Four covers the topics of flowcharting, branching, mode selection (e.g., tutorial), frame layout, emphasis options (e.g., type size), interactivity, and student response management. Section Five focusses on the differences between print-based lessons and computer-based lessons. This section describes some of the languages available for CBI lesson creation, lesson organization and how to collect learner response data. Section Six completes the description of the instructional design model by detailing how to carry out the evaluation and revision of each component of the development process. This section is particularly valuable because the evaluation criteria presented here apply equally well to internally and externally developed CAI instruction.

The last section of the book considers both the present and possible future status of computer-based instruction. Section Seven describes peripherals that may be added to the system, interactive multi-media, intelligent CAI, and the emergence of computer networks. The book concludes with a discussion of factors currently influencing the role of CAI, a glossary of terms, author and subject indexes, and a list of recommended readings to guide authors in extending their study of the topics presented.

Critique

For the beginning author, the planning, organizing and production of CAI resources can become a very complex task. The mere act of trying to decide where to begin can often lead to confusion. Hannafin's and Peck's book succeeds in reducing the complexity of the authoring process to manageable limits. It is well organized, clearly written and substantially referenced. While the instructional design model presented is not as extensive as models found in other sources, the essential elements of the design process have been extracted and customized in order to accommodate the needs of a beginning author. The book provides a good framework for making lesson design decisions. Hannafin and Peck assume that novice CBI authors are competent teachers and knowledgeable, experienced computer users. For those authors who do not have these entry level skills, they offer an alternative. They suggest that the user who has little or no programming expertise or design experience could use prestructured templates to create computer-based instruction.

For the novice author who is willing to adopt a linear "programmed" learning approach to CAI development this would probably be all right. But, for authors who wish to use more complex interactions or make use of student tracking capabilities to control lesson presentation elements, there is no substitute for knowing about variables, functions and program control structures. Second, a basic knowledge of the instructional design process would be of help to any author who finds it pedagogically desirable to deviate from the lesson plan presented in a prestructured template.

The suggestions and recommendations made by Hannafin and Peck for implementing learner control, the use of navigation aids, screen design, and the management of student responses are well defined and presented. Howaver, the guidelines given for presenting feedback to students are minimal. They only mention that "feedback frames are used to provide students with the correctness, incorrectness or quality of their responses," Only one example of incorrect response feedback was given. Confirmation, correct response, explanatory and bug-related examples of feedback could have also been given. This is one topic the authors could have treated in greater depth.

One of the most useful chapters in the book is the chapter on evaluating CAI lessons. Hannafin and Peck define evaluation as an ". . .ongoing process used to determine whether lesson objectives have been met, to identify the reasons for the observed performance, and to identify those portions of a lesson where modifications are required." They have chosen not to stress elaborate statistical methods for gathering empirical evidence. Instead, they have developed a series of checklists which serve as systematic guides to gathering informal, anecdotal types of data. Each checklist highlights a series of key points to be considered in the evaluation of the lesson. For example, in the area of instructional adequacy Hannafm and Peck ask: "Are the directions for lesson control clearly stated?" In this case, while the directions are not numerically quantified, it is easy to see that if students have trouble navigating through the lesson they may become easily discouraged or frustrated with the lesson.

This example highlights one problem inherent in summarizing data from this type of evaluation procedure. Even though the lesson may crash in certain circumstances, it may still ‘pass" its evaluation. The problem here is that highly rated assessment, despite a fatal flaw such as "crashing," may mislead the evaluator into drawing positive conclusions about the lesson. To avoid this potentially disastrous outcome, Hannafin and Peck recommend the use of a combination of assessment criteria and fatal flaw criteria for anecdotal methods of CAI lesson evaluation. When both these components are considered concurrently, evaluators are less likely to become the victims of their own evaluation system.

In conclusion, I suggest that this book would be a good starting point for anyone who is seriously considering the development of computer-based instruction. It is not an authoring system specific handbook; it is a generic lesson authoring guide. It does not deal extensively with topics such as intelligent CAI systems, but it does offer a masterful introduction to frame-based approaches to CBI. Perhaps other topics such as adaptive instructional designs, expert systems and artificial intelligence will be included in a revised edition or a future companion publication.

REVIEWER

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Evaluating Open and Distance Learning by Mary Thorpe. Mississauga, ON: Copp, Clark, Pitman, 1988. ISBN O-582-90119-7 (CDN $29.95)

Reviewed by Mary F. Kennedy

According to the author, this book is written for the practitioner — not the evaluation practitioner, but the practitioner in the field of open/distance learning. Unlike most books on evaluation, it does not include an historical overview of evaluation theory and design. Rather it goes to the heart of the matter — evaluation as a practice.

Evaluating Open and Distance Learning is divided into three sections. Part One: ***Open Learning and Distance Education*** presents two brief chapters on evaluation, defining the term and setting the focus on who uses and/or ultimately benefits from evaluation. Thorpe makes a case for learner collaboration and a team approach. A really nice feature of Chapter Two is the inclusion of five case studies, all selected on the basis of interest and application to the potential audience.

Part ***Two: Evaluation in Practice*** contains four chapters on learner self-evaluation, tuition or tutoring, counselling, and course or learning materials. Each chapter provides an overview of evaluation activity in relation to that specific component of open and distance learning. The activities, and Thorpe's suggestions regarding implementing evaluation, draw on data from past completed evaluations. There appears to be, on cursory reading, an over-reliance on Open University data, but, as Thorpe explains, there is little evidence that evaluation is being implemented elsewhere in open and distance education settings. Numerous samples of evaluation checklists, survey instruments, and interview guides are included in these chapters, providing the reader with a flavour of the type of evaluation activity undertaken.

Part Three: ***The Process of Data Collection*** includes two chapters and a conclusion. As the author indicates, the purpose of this section is not to provide a how-to manual, but to focus on the application of these methods to open and distance learning. Thorpe reiterates the view that learners and practitioners should define the type of evaluation they want, since evaluation should be undertaken for the development of learning and the enrichment of learning experiences.

The introductory chapter of this section - Chapter Seven - is the weakest of the book. The problem lies in the scope of material included. Entitled Planning and Data Collection, it is supposedly presented within the context of the social organization of evaluation, but this concept gets lost early on in the nitty-gritty of topics such as chairing meetings, and keeping minutes and ensuring equality of contribution from evaluation team members. In addition there is unevenness of treatment of the various data collection techniques, and so little information on them as to render the treatment meaningless.

Chapter Eight, the final chapter, focuses on the social implications of evaluation, an area Thorpe claims is underemphasized in most evaluation texts. On that point there is no argument. She draws together the elements of this rather complex social process called evaluation, and while not as prescriptive as in earlier sections, the organization and presentation of the information is helpful to the reader who is interested in looking beyond the doing of evaluation activity to the implementation of practices based on evaluation findings.

Her conclusion, while brief, deals with the issue of quality control and she makes the plea for moving beyond the attainment of an acceptable standard of program implementation, the aim of most quality control policies, toward excellence.

Evaluating Open and Distance Learning is a good book for its intended audience. Little understanding of or background in evaluation is required to implement evaluation activity on the scale recommended by the author and the book would certainly provide basic guidance in getting started. One would have to accept the notion, of course, that any type of evaluation is an improvement over no evaluation.

The book has certain bonus features which would make it popular with the novice evaluator. The organization is appealing, and the discrete chapters on each major component to be considered in the evaluation of open and distance education provides the reader with an idea of the scope of course evaluations. Each chapter is followed by a short but good selection of further readings which Thorpe considerately annotates for the reader. The focus of evaluation activity is not research-based; rather, the emphasis is always practical. Formative evaluation is the thrust, for the purpose of course or program monitoring, modication and improvement.

In summary, for the clearly defined audience of open and distance education practitioners this book is ideal as an easy-reading, non-threatening introduction to evaluation, and many practitioners in that field would fit the category of novice evaluator. For those already versed in program evaluation, the book has little to offer.

REVIEWER

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