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The Effect of Graphic Format and Cognitive Style on the Immediate and Delayed Interpretation of Complex Quantitative Data

J. Thomas Head
David M. Moore

Abstracf: This study examined the effects of graphic format and cognitive style on interptetation of quantitative data and of imagery instructions on recall. One hundred and twenty-three college students answered amount, static, and dynamic questions regarding the same data presented in one of four graphic formats: bar graph. linegraph, line-table chart. and table. The subjects also answered questions about trends and general concepts in the absence of the graphic under immediate and delayed imagery conditions. Subjects performance on the questions was in the order amount > statlc > dynamlc. There was no difference in results for the four graphic formats, but immedlate recall was better than delayed recall. The field independents performed better under the imagery condition and there was an interaction between cognitive style and type of graph. There was a modest correlation between the cognitive style and the scores on the dynamic questions.

Résumé: Les effets d'un format graphique et d'un genre cognitif sur l'interprétatlon des données quantitatives et le rappel des images instructives seront examinés dans cette étude. Cent-vingt trois étudiants universitaires ont répondu aux questlons statiques, dynamiques, et totales en ce qui concerne les données presentées dans un des quatres formats graphiques: une barre graphique, une courbe au trait un diagramme de table et trait, et un graphique. Les sujets ont aussi répondu aux questions concernant les concepts générales et les tendances a l'absence du graphique sous des images de condition immédlates et dilatoires. Ill y avait un ordre spécifique dans la representation des questions des sujets, tel que total > statique > dynamique. On ne voyait aucune difference dans les résultats des quatres formata graphiques; mals le rappel immédiat était meilleur que le rappel dilatoire. Il y avait une amélioration avec les Indépendants spécialisés sutte aux images de condition, et aussi une interaction entre le genre cognitif et le genre graphique. Les résultats ont mis en évidence une modeste corrélation entre le genre cognitif et les marques des questions dynamiques.

The rapid improvements in hardware and software for the production of computer graphics have provided the user with the capability to prepare graphic materials easily and quickly. As a result, graphics for instructional applications have shown a dramatic improvement and are approaching professional quality. The versatility provided by the software has made it possible to present numerical information in a multitude of chart formats. Most software packages allow the users to readily display the same data in a variety of different formata by a few simple keystrokes. However, educators and instructional designers still lack the empirical evidence to assist them in determining

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the "right" type of graphics to use in a given learning situation. The use of graphics in instruction has generally been recommended in the literature (e.g., Miller, 1969; Shostack & Eddy, 1971; Takeuchi & Schmidt, 1980). However, very few studies have been conducted to test the effectiveness of different types of graphics on the interpretation of quantitative data intended by the designer. Washburne (1927) investigated the effects of tabular, and graphic arrangements on recall. This study tested recall of specific amounts, as well as static and dynamic comparisons and rank ordering. Watson and Driver (1983) found that three dimensional graphic plots did not result in greater recall of information than did tabular presentation data.

MacDonald-Ross (1977) indicates that there are three questions to ask when developing quantitative data presentations: 1) What data to present; 2) Which format would be the best; and 3) How to present that format competently. The format of data which is presented is selected from a variety of possibilities. At times data presentation formats are selected with thought and sometimes without any rationale. "One is constrained by the data one is working with, and by the likely impact of the message on the reader. Having a purpose enables the writer to select between those alternatives which are legitimate and workable" (p. 361).

Watson and Driver (1983) state that the important variables to judge the value of a graphic presentation include understanding the data, prior knowledge, comprehension and "degree of appeal to the interest of user." The genera1 advantages of graphics in presentations have also been delineated by Watson and Driver (1983). Some of these advantages include the ability 1) to create interest in the user; 2) to aid in grasping relationships; 3) to save time when viewing masses of data, 4) to provide at a glance a comprehensive view of the relationship between different categories of information; and 5) to assist in analytical thinking. However, there appears to be a lack of research that supports the above claims. Benbasat and Dexter (1986) concluded that tabular reports led to better decision making and graphical reports led to faster decision makingwhen time constraints were low. However, a combined graphical-tabular report was found superior in terms of performance. Winn (1987, p, 192) stresses the importance of 'developing lines of inquiry into the learning strategies students use when working with graphic forms." It is important to discover how and what students learn from graphics. Are some graphics more effective than others? Are some types of information better presented by different graphic formats?

Designers and producers of visual materials must also be concerned with a number of considerations including the nature of the instructional task, the teaching and learning strategies to be employed, and the individual characteristics of the learner.

In his research, Witkin (1977) noted that certain individuals relied heavily on the outside environment for perceptual cues even as they conflicted with internal ones. Others were able to separate easily essential information from a surrounding visual field. The two orientations titled field dependence and independence, respectively, exist on a continuum, with individuals found at all points. Field dependent individuals tend not to add structure to visuals and accept the visuals as presented, because they do tend to fuse all segments of a visual field (e.g., a graph) and do not view the visual's components discretely.

Field dependent and independent individuals approach learning in different ways. Goodenough (1976) and Witkin, Moore, Goodenough, and Cox (1977) have reviewed the literature and offered several conclusions about learning and cognitive style. First, field independent individuals, being more analytic in approach, tend to *act* upon a stimulus complex, analyzing it when it is organized, structuring it when it lacks organization. In many instructional situations, the ability to analyze and structure aids in learning. The field dependent learner, however, takes a more passive approach, accepting the field as given, experiencing it in a more global, diffuse manner. This passive approach means that field dependent individuals tend to notice those cues in a stimulus field which strand out or are more salient. When the stimulus is arranged so that the salient cues are also relevant, then the field dependent person may experience little difficulty. In fact, if a learning task is clear, well-structured, and low in complexity, then there maybe no significant differences in learning by the two orientations. Field dependence is important because it involves perceptual and problem-solving abilities, structuring a stimulus field, breaking up or disembedding such a field, suppressing irrelevant information, and dealing with high information load, all of which are relevant in the interpretation of data in the graphic format. More specifically, it is of interest to determine if any of the various graphic formats help or hinder those individuals who are classified as field-dependent. These students may have difficulty processing complex visual information (i.e., as in a graphic format) unless it is presented in such a way as to compensate for specific processing deficiencies related to field-dependence (Head & Moore, 1989).

Head and Moore (1989) investigated the effects on interpretation of presenting numerical data in four different graphic formats: bar graph, line graph, table and line-table. Three types of quantitative recall were tested: questions dealing with specific amount, static, and dynamic comparisons (Washburne, 1927). Their results indicated that both main effects, type of graph and type of question, were significant, however, no interaction was present. This initial study was designed to be part of a continuing series of studies which increased the number of data points for each successive experiment. The rationale for increasing the amount of data was based on the prediction that as the number of data points become very large, the table charts would be ineffective and there would be interactions between the type of graph, type of question, and the amount of data presented. This would especially be predicted when subjects had time limitations, and for the questions which asked about changes in magnitude or general trends in the data. Both of these conditions would provide a better approximation to conditions in a classroom or business meeting.

Therefore, the purpose of this study was to determine if increasing the amount of data in different graphic formats, i.e., linegraphs, bar graphs, table, and line-table charts, affects the interpretation of quantitative information. The effects of these formats were tested by asking three types of questions: amount, static, and dynamic regarding the data presented. In addition, both immediate and delayed recall of relationships in the data were measured by asking questions in the absence of the stimuli. It was also of interest to determine if there was an interaction between graphic format and type of question and to determine whether cognitive style field dependence (FD), field independence (FI) interacted with the ability of the subjects to recall information in any particular chart format. This study was a ***partial replication and expansion*** of the study by Head and Moore (1989). The present study increased the amount of data presented by a factor of two and introduced the comparison of immediate and delayed recall in the absence of the graphic stimuli over the previous study.

More specifically, it was of interest to determine if there is any correlation between the various graphic formats and those individuals who are classified as field-dependent or field-independent. Field dependent students may have difficulty processing complex visual information (i.e., as a graphic format) unless it is presented in such a way as to compensate for specific processing deficiencies related to field-dependence.

The specific research questions generated for this study are as follows:

1) What is the effect of different chart formats on the interpretation of numerical data?
2) Is there any interaction between the type of graph and the type of questions asked?
3) What is the effect of increasing the amount of numerical data presented?
4) What is the effect of cognitive style on interpretation of numerical data presented in different chart-graph formats?

METHODOLOGY

Subjects

The subjects of this study were 123 college students enrolled in professional education classes or introductory educational psychology classes in a large, land grant university in the United States. The subjects were given the ***Group Embedded Figures Test*** (GEFT) (Witkin, Oltman, Raskin & Karp, 1971). The measure of field dependence used in this study was the Group Embedded Figures Test (GEFT), (Witkin, Oltman, Raskin, & Karp, 1971). It is avariation of the original Embedded Figures Test (EFT) which can be administered to groups rather than individually. Like the original EFT, the GEFT requires subjects to find a simple geometric figure embedded within a complex one. The GEFT consists of 25 such figures. It is divided into sections of 7, 9, and 9 items, with time limits of 2, 5, and 5 minutes respectively. The first section is for practice only and is not scored. The number of simple figures traced correctly on the second and third parts makes up the raw score which can range from 0 to 18. The more figures found and correctly traced, the more independent the subject is assumed to be. Since the manual for this test does not indicate recommended classifications for field dependence and dependence, the authors used the following system. Approximately the top 40 percent of subjects (15-18 were classified as field-independent, the lowest 40 percent of subjects (0-ll) were classified as field-dependent and middle 20 percent subjects (12-14) were classified as neutral. Several secondary analyses using the above classification of field dependence were also conducted.

Procedures

The subjects were randomly assigned to one of four treatments which were presented fictitious data in four different graphic formats: 1) bar graph, 2) line graph, 3) table, and 4) line-table chart. The data used to prepare the graphic stimuli were the same for all four treatments and were adapted from the Head and Moore (1989) study (see figures 1 and 2 for examples). The graphs and charts presented in this study contained twice the data points in comparison to the four types of graphs used in the 1989 study. These more complex graphs contained data at the maximum readability level for projected graphs.

The subjects were given a fictitious narrative and then shown a specific graphic stimuli, e.g., line graph on a 35mm color slide. Each treatment group was given questions on the content of the graphs and charts. There were four types of questions:

Figure 1.
Black and White Version of the Bar Chart Used as a Stimulus Slide.

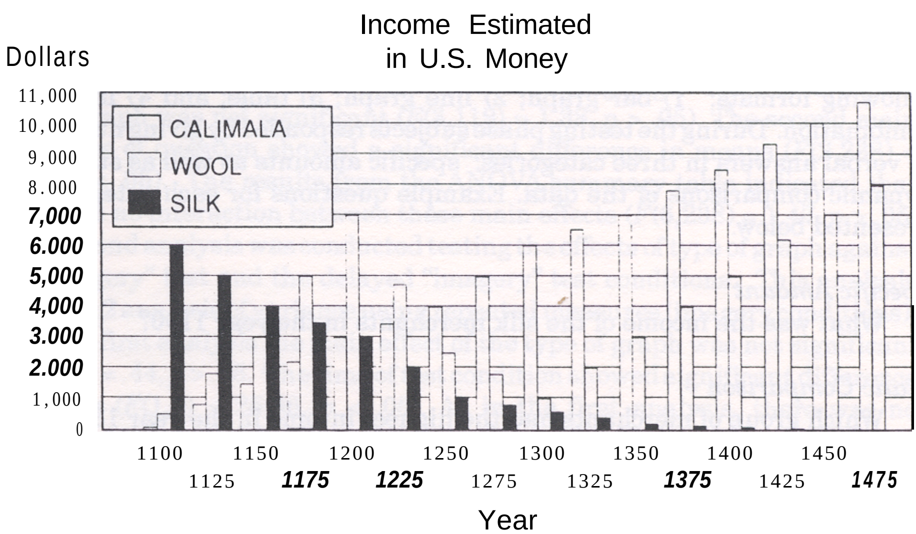
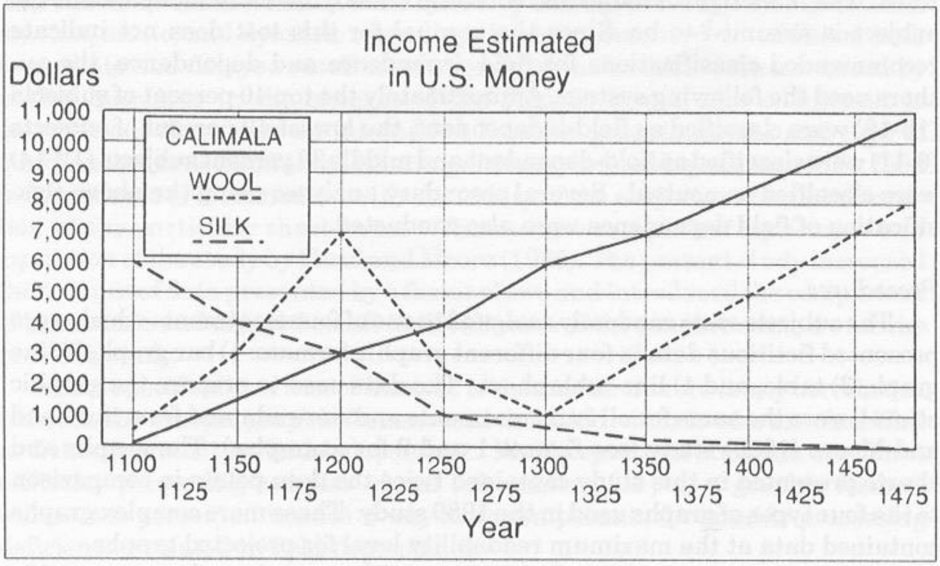


Figure 2.
Black and White Version of the Bar Chart Used as a Stimulus Slide.



1) Specific amount, e.g., how much, how many? 2) Static comparisons, e.g., which? 3) Dynamic comparisons, e.g., which increased (decreased) most rapidly? and 4) Imagery, which asked about trends and general concepts. All students in the treatment groups answered the same 56 questions (14 each in the above four categories).

The subjects were randomly assigned to one of four treatments which presented fictitious data in graphic form to alleviate any effect of prior knowledge. The fictitious data dealt with various European merchants income during the middle ages. The four treatments presented the same data in the following formats: 1) bar graph; 2) line graph; 3) table; and 4) line-table combination. During the testing phase subjects responded by giving numerical or verbal answers in three categories: specific amounts as well as static and dynamic comparisons of the data. Example questions for each category are presented below.

Specific Amount

What was the income of the silk merchants in the year 1100?

Static Comparison

Which group of merchants had the highest income in the year 1350?

Dynamic Comparison

Which group of merchants had the greatest increase in income between the years 1100 and 1200?

Imagery

Which group of merchants showed a sharp increase in income, then showed a sharp decrease, and finally recovered in the latter years of the time period described in this experiment?

In Part 1 of the experiment, all subjects were presented 42 questions (amount, static, and dynamic comparisons) with 7 seconds to respond to each question while looking at the treatment slide.

In Part 2, the subjects were then instructed to study the graphic on the screen for 60 seconds and form a mental image of the stimulus. The subjects were then asked 14 "imagery" questions about trends and general concepts with 7 seconds to respond to each question in the absence of the treatment slide. In the Delayed conditions, subjects were tested one week later using the same imagery questions without viewing the graphic.

Analysis

A two-way analysis of variance was used in which the independent variables were type of graphic and type of questions. The design was a 4 x 3 design based upon a mixed model and used a combination of between and within subjects methods (all subjects would respond to all types of questions). A second analysis was conducted using a two-factor repeated measure ANOVA to investigate effects of the types of graphs vs. the "imagery" questions (Part and the delayed "imagery" questions. The dependent variable was the test score which measures the interpretation of the quantitative data presentation.

RESULTS

A 4 x 3 analysis of variance with repeated measures was used to test the research questions concerning the type of graph and type of questions. The main effect means are found in Table 1 (see following page). The F ratio for the type of graph was not significant ($F(3,119) = 1.38$, $p > .05$). The second main effect type of question showed a significant difference in means 98.96, $p < .05$). The results from the ANOVA summary table indicated that there was no interaction between these main effects ($F(6,238) = 1.47$, $p > .05$.

A second analysis was conducted testing the effects of type of graph against the "imagery" test and the delayed "imagery" test conditions. This analysis used a 4 x 2 analysis ofvariance usingrepeated measures (imagery conditions). As in the first analysis the main effect of the type of graph was not significant ($F(3,101) = .44, p > .05$. The time of test condition showedsignificant difference in means ($F(1,3) = 25.36$, $p < .05$). As in the first analysis, there was no significant interaction between themaineffects ($F(3,l01) = 1.67$, $p > .05$). Table 2 (see following page) presents the mean scores of this analysis.

An additional analysis was conducted to determine if there was a difference in the earlier 1988 results (Head and Moore, 1989) and the present study

TABLE 1
Means by Type of Question and Graph

Type of Graph	Type of Question: Amount	Static	Dynamic	MEAN
Line	13.583	12.583	11.250	12.472
Bar	13.154	12.410	11.513	12.359
Table	13.792	13.000	11.708	12.833
Line-Table	13.611	12.417	10.806	12.278
MEAN	13.496	12.561	11.293	12.450

TABLE 2
Means by Imagery Questions and Type of Graph

Type of Graph	Imagery: Part 2	Delay	MEAN
Line	11.864	11 .000	11.432
Bar	12.074	10.185	11.130
Table	12.000	11.500	11.750
Line-Table	12.219	10.438	11.328
MEAN	12.057	10.733	11.395

across the dynamic question form. Using a one way ANOVA, the F ratio indicated that the 1988 results were significantly higher for the line-table condition ($F(1,58) = 33.61, p < .05$). Figure 3 (see followingpage) illustrates the difference of the means for the 1988 and 1989 study.

A series of two-way factorial analyses of variance were conducted. One used cognitive style and type of graph as independent variables with the "imagery questions" as the dependent variable. The main effect for cognitive style was significant $F(2,111) = 4.87, p < .01$ with an interaction between cognitivestyleand type of graph $F(6,lll) = 2.31, p < .05$. See Table 3 for means.

Figure 3.
Percentages of Correct Responses for the Line-Table Chart Comparing 1988 and 1989 Experiments as a Function of Type of Question.

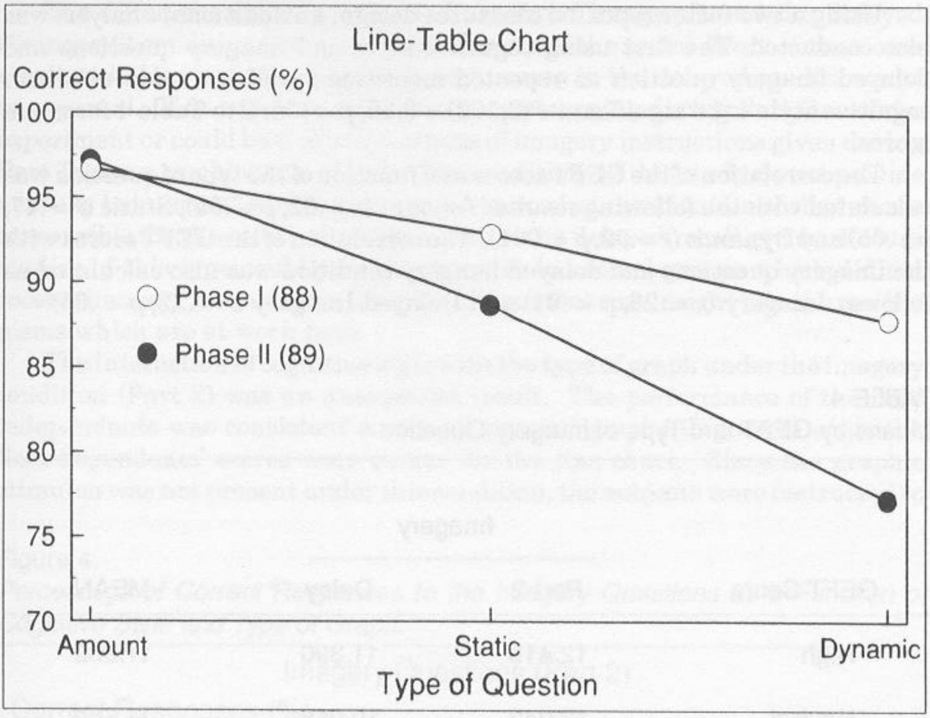


TABLE 3
Means by GEFT and Type of Graph

	GEFT Score			
Type of Graph	High	Neutral	Low	MEAN
Line	12.417	12.600	10.286	11.833
Bar	12.118	12.333	12.062	12.128
Table	12.545	12.000	11.333	12.000
Line-Table	12.600	11.583	12.357	12.167
MEAN	12.380	12.000	11.739	12.057

However, a second analysis using cognitive style and type of graph as independent variables with the scores on Part 1 as the dependent measure, found no significance for any of the variables with no interaction found.

Using a two-factor repeated measures design, an additional analysis was also conducted. The first using cognitive style and imagery questions and delayed imagery question as repeated measures found the main effect for cognitive style to be significant $F(2,102) = 3.36, p < .05$. See Table 4 for mean scores.

The correlation of the GEFT scores as a function of the type of question was calculated with the following results: Amount ($r = .02$, $p > .05$), Static ($r = .17$, $p > ,05$) and Dynamic ($r = .32$, $p < .001$). The correlation of the GEFT scores with the imagery questions and delayed imagery condition was also calculated as follows: Imagery ($r = .26$, $p < .01$) and Delayed Imagery ($r = .22, p < .05$).

TABLE 4
Means by GEFT and Type of Imagery Question

	Imagery		
GEFT Score	Part 2	Delay	MEAN
High	12.415	11.390	11.902
Neutral	12.042	10.958	11.500
Low	11.700	9.925	10.812
MEAN	12.057	10,733	11.395

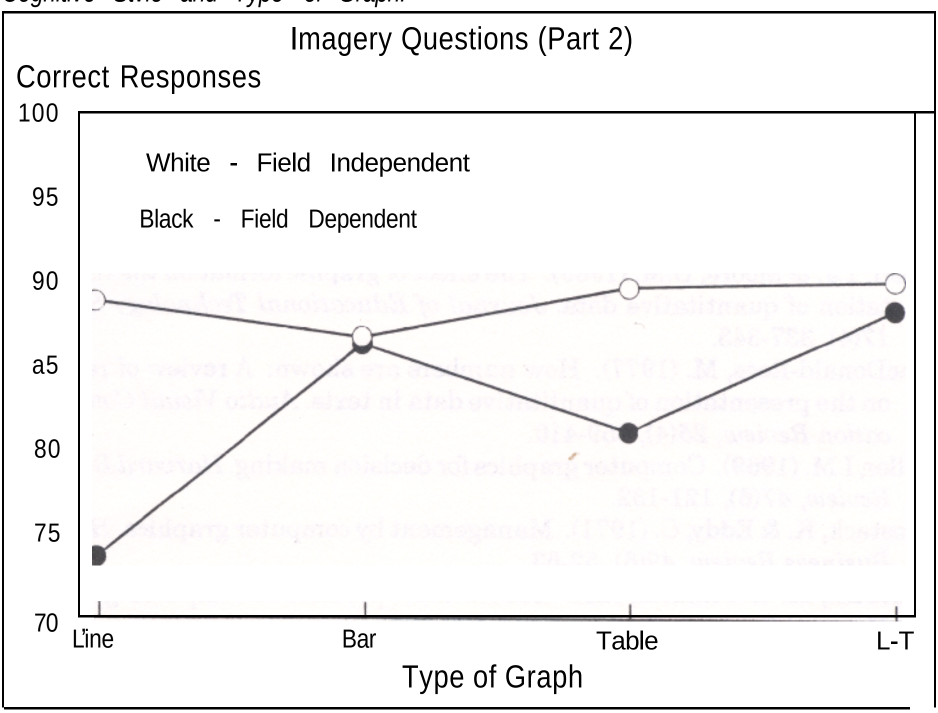
DISCUSSION

One of the main purposes of this study, which was an extension of a previous study by Head and Moore (1989), was to determine the effects of increased data complexity on the interpretation of quantitative data. The earlier study indicated that there was a significant effect for the type of graph. Increasing the amount of data did eliminate the main effect of type of graph found in the previous work. This was due primarily to the decreased performance of subjects in the table condition which resulted in no differences between the various chart types. Additional data obviously adversely affected the interpretation of graphic data used in this study The main effect for type of question was a predicted result because the amount, static, and dynamic questions obviously differ in difficulty in the order found in this study and in the earlier study

The difference in the scores for Part Two ("imagery") and the Delayed ("imagery") condition was predicted because of the usual effect of time on a recall task. However, the relatively high scores in the delayed condition was unexpected. This result could be due to overlearning during Part One of the experiment or could be due to the effects of imagery instructions given during Part Two or a combination of both. The conditions of this study do not provide a means to interpret which of these effects or what combination of the two are responsible for the relatively high scores in the delayed recall group. Future studies of this type could provide appropriate control groups which did not receive imagery instructions. This would provide some insight into the mechanisms which are at work here.

The interaction of cognitive style with the type of graph under the imagery condition (Part was an unexpected result. The performance of the field independents was consistent across all types of graphs (Figure 4) while the field dependents' scores were poorer for the line chart. Since the graphic stimulus was not present under this condition, the subjects were instructed to

Figure 4.
Percentage of Correct Responses to the Imagery Questions as a Function of Cognitive Stvle and Type of Graph.



form a mental image of the stimulus as a strategy which would aid them during the response stage. One possible explanation for the poorer performance of the field dependents would be based on these subjects lower ability to perform well under imagery instructions in this type of task. The low performance for the field dependents in the line chart condition needs further study to determine whether this type of graph presents unique problems for subjects with this cognitive style. This is of particular interest because the line chart should produce the highest scores for the types of questions asked in the imagery condition.

The correlation of GEFT scores with the type of question was in the order: dynamic > static > amount. This trend can be explained by the increasing difficulty of the task presented by the dynamic questions when compared to static or amount questions. The field dependents should not have any particular difficulty with the relatively easy questions in the amount or static categories, but would be expected to have more difficulty with the dynamic questions which do present a more demanding perceptual and cognitive task.

One other result which was of interest was the difference of the scores on the dynamic questions for the line-table condition as a function of data complexity (cf. Head & Moore, 1989 study). The group viewing the more complex graph (twice the data available) had lower scores, which is a predicted result given the difficulty of interpreting the dynamic questions.

REFERENCES

Benbasat, I. & Dexter,A.S. (1986). An investigation of the effectiveness of color and graphical information presentation under varying time constraints. *MIS* Quarterly, March, 59-81.

Goodenough, D.R. (1976). The role of individual differences in field dependence as a factor in learning and memory. ***Psychological Bulletin, 83, 675-694.***

Head, T.J. & Moore, D.M. (1989). The effect of graphic format on the interpretation of quantitative data. ***Journal of Educational Technology Systems*** 17(4), 337-343.

MacDonald-Ross, M. (1977). How numbers are shown: A review of research on the presentation of quantitative data in texts. ***Audio Visual Communication Review, 25(4),*** 359-410.

Miller, I.M. (1969). Computer graphics for decision making. ***Harvard Business Review, 47(6),*** 121-132.

Shostack, K. & Eddy, C. (1971). Management by computer graphics. ***Harvard Business Review, 49(6), 52-63.***

Takeuchi, H. & Schmidt, A.H. (1980). New promise of computer graphics. ***Harvard Business Review,*** 58(1), 122-132.

Washburne, J.N. (1927). An experimental study of various graphic, tabular and textual methods of presenting quantitative material. ***The Journal of Educational Psychology, 18,*** 361-376.

Watson, C.J. & Driver, R.W. (1983). The influence of computer graphics on the recall of information. ***MIS Quarterly,*** March, 45-53.

Winn, B. (1987). Charts, graphs and diagrams in educational materials. In D.M. Willows and H.A. Houghton (Ed). ***The Psychology of Illustration: Volume 1 Basic Research,*** 152-198, New York: Springer-Verlag.

Witkin, H.A., Moore, C.A., Goodenough, D.R., and Cox, P.W. (1977). Field-dependent and field-independent cognitive styles and their educational implications, ***Review of Education Research, 47,*** l-64.

Witkin, H.A., Oltman, P.K., Raskin, E., & Karp, S.A. (1971). A ***manual for the embedded figures test.*** Palo Alto, CA: Consulting Psychologists Press.

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Television as a Source of Informal Science Learning for Pre-Adolescents: Design Considerations

Micheline Frenette

Abstract: Informal learning environments compel the design of activities that are both appealing and educational. This paper addresses issues involved in the design of science television programs for pre-adolescents, drawing more specifically on the case of a French-language series currently in production in Montreal. The program goals and format are discussed in relation to the target audience's developmental characteristics. Their attitudes toward science and their experience with the television medium. Such a series, it is proposed, should attempt to provide an emotional experience that is entertaining, involving and relevant as well as a cognitive experience that is challenging and empowering. Suggestions are offered as to how these qualities might be implemented in a television program. Experience with the series leads one to believe that the tenslon between learning goals and an entertainment format may be resolved creatively.

Résumé: Les contextes éducatifs non-formels nécessitent la conception d'activltes qui solent à la fols attrayantes et informatives pour le public-cible. Cet article aborde la problématique de la vulgarisation scientifique à la télévlslon en s'inspirant plus spécifiquement d'une série québécoise pour les pré-adolescents. Une telle série devrait s'efforcer de rejoindre le télespectateur sur un plan affectif en lui proposant une expérience divertissante, engageante et pertinente. La série devrait eéalement créer une situatlin stimulante et gratifiante sur le plan intellectuel. Des exemples concrets sont offerts pour illustrer comment ces objectifs peuvent se traduire dans la réallsatlon d'une emission. L'expérience demontre qu'il est possible de concilier des objectifs éducatifs avec un format de divertissement propre à la television.

INTRODUCTION

Formal science education prior to college is expected not only to provide basic training to future scientists, but also to impart tomorrow's adults with a working knowledge of science and technology. The limitedsuccess of curricular programs in achieving this ambitious goal has been the subject of much concern among educators, both in Canada and in the United States (SCC 1984; NSTA, 1984). Although no one would quibble with the importance of forma1 schooling and the necessity of working toward the improvement of science education, it is easy to lose sight of the science learning that also takes place in informal contexts. Indeed, children can also learn a great deal from their parents, from their peers, from extra-currricular activities such as science clubs and museums as well as from the mass media. Television in particular has unique advantages as a potential source of information about the world: it can overcome time and space barriers to present knowledge, experiences, unique views of phenomena and inspiring role-models that would otherwise remain inaccessible as direct experience for the majority of children. Given that children in Canada spend close to 20 hours a week watching television (Caron et al., 1990), it seems worthwhile to consider how to take advantage of the wide availability and strong appeal of television to complement the goals of formal science education.

On first thought, there may be an inherent paradox in wanting to promote science through television, a paradox that stems in great part from the commercial nature of the television medium. First, science programs have to contend with serious competition from expensively-produced entertainment programs for viewership. Second, children develop expectations toward the medium which may run counter to the educational goals of a science program. For instance, Salomon (1979) has shown how preconceptions of television as an 'easy' medium may lead children to invest less mental effort in processing television content than in processing print media. However, it will be argued in this paper that television does offer opportunities for informal learning about science to the extent that such educational programming successfully meets television on its own terms.

First, learning about things and learning about themselves figure among the main reasons children provide for why they watch television (Greenberg, 1974 in Palmer & Millward, 1986). Further, when educational programming is specifically designed with the target audience's needs and characteristics in mind, children do learn from television (i.e., Bryant et al., 1983). For instance, the series ***'3-2-1 Contact,'*** produced by CTW ***(Children's Television Workshop),*** succeeds in merging science content with an entertainment format by tailoring the program in accordance with 8 to 12-year-olds' social and intellectual needs while also taking into account their television preferences (Mielke, 1983). The relationship between enjoyment and achievement in formal learning situations is undoubtedly complex. Clark (1982) found that students learned less from the instructional methods they reported enjoying the most. With regard to television however, enjoyment appears to be a necessary component of the learning process. Children who reported enjoying 3-2-l Contact also learned more from the program (RCL, 1987).

The challenge involved in finding the right balance between entertainment and educational goals often leads concerned producers to turn to formative research to guide the design of a television program. "Formative research in television is a production and planning instrument that links producers and potential audience in the process of creating and refining a television product" (Caron & Van Every, 1989, p.17). Although formative research is by definition product-oriented, cumulative experience across a variety of programs eventually leads to the formulation of guidelines that have wider applicability (see for example Flagg, 1990). Formative research supporting the production of a French-language science television series for pre-adolescents entitled ***Les Débrouillards***[1] (i.e., ‘The resourceful ones”) (CYMS, 1988, 1989) will be used as a case in point to take a closer look at the design process involved in educational programming.

The idea for the television series originated from ***Agence Science-Presse*** (ASP), a press agency which has been active in promoting science for children in Quebec for over ten years. The overall goals of ASP are: 1) to satisfy children's quest for information about the world around them; 2) to awaken curiosity and foster a sense of wonder for the phenomena that surround them; 3) to promote a vision of science as an enjoyable and accessible activity; 4) to encourage children to engage in meaningful scientific experiences; and 5) to highlight the scientific and technological achievements of Canadian society. The agency publishes a monthly magazine (“Je-me-petit-débrouille”) for 8 to 12 year-olds as well as science chronicles in major dailies and regional newspapers throughout Quebec and other parts of Canada. ASP also entertains close links with the ***Conseil du développement du loisir scientifique,*** a non-profit organization which oversees a network of science clubs. The agency considered television as a means of complementing and highlighting both the print media and the science clubs and of winning a larger audience to science as a leisure activity. Accordingly, one of the first undertakings of the formative research program was to review psychological, educational and communication research that would be helpful in formulating appropriate goals for the television series and suggesting a format suitable for the target audience.

SCIENCE, TELEVISION AND PREADOLESCENTS

Pre-Adolescent Development

In some ways, pre-adolescents may be considered an ideal audience for a science television program given their level ofcognitive development. Children of this age group have been described by Piaget as being in a concrete operational stage of thinking (Ginsburg & Opper, 1979). They have moved away from perceptually-bound reasoning and are able to think through the causes and consequences of phenomena on logical grounds much better than before. They are reality oriented, interested in understanding and mastering the world around them and open to new experiences.

At the same time, a television program needs to acknowledge certain developmental shortcomings in order to communicate effectively about science with an audience of this age. For instance, pre-adolescents have not yet fully mastered the formal reasoning skills required for scientific experimentation

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[1]Les Debrouillards is funded in part by the CRB Foundation and produced by Les Productions SDA in Montreal, Canada. The series is scheduled for weekly broadcast as of September 1990 on the French-language national television network, Radio-Canada. Formative research is conducted by the Groupe de recherche sur lea jeunes et les médias (Centre for Youth and Media Studies), Département de Communication, Université de

that involves systematic hypothesis-testing, Hence, they are more likely to be attracted by the manipulation of materials that produce visible effects than by the investigation of phenomena that are not directly perceptible. Scientific terminology that has become commonplace among adult professionals (i.e., molecule, genetic code, etc.) may be totally meaningless or only vaguely familiar to children of this age. As a consequence, they experience a great need for abstract concepts to be supported by concrete illustrations. To this end, television can be an important means of presenting visual models of phenomena, both static and dynamic,

Further, children apply their own intuitive conceptions of phenomena in trying to understand the program's content. Thus, the presentation of science topics should be tailored to acknowledge these levels of understanding in order to help children make sense of the information (Linn, 1986). For example, children of this age group frequently think that sinking and floating phenomena may be predicted on the basis of the weight of an object. Therefore, a program on ships could seize the forthcoming question in a child's mind and provide the adequate explanation of floating based on the density of materials (and the shape of an object), while providing a graphic overlay to help grasp the meaning of density which is not directly perceptible.

In order to appeal to pre-adolescents, a television program about science should also acknowledge the affective and social characteristics of this age group. Children between 8 and 12 years of age are gradually emerging from the family circle and developing a solid social network of their own (Gardner, 1982). This peer group solidarity is manifest for instance in team sports, social clubs and special interest groups. One way to build upon this social reality then is to highlight the phenomenon of science clubs as a means of sharing interests with their peers. Also, pre-adolescents are on the point of making their first career-related choices as they embark on a high school course. Children of this age are therefore at a critical point in shaping their attitudes toward science as a field of endeavor, whether it be as an academic, leisure or professional pursuit. Not surprisingly, they also share some common cultural myths about science which may play a part in their avoidance or early dismissal of science related activities. Given the centrality of this issue to a science program's goals, understanding the basis of these attitudes provides important clues as to how to address these misgivings.

Children's Conceptions of Science

One of the prevailing myths about science corresponds to a benevolent encyclopedic view of the scientific enterprise. Science is perceived as a distant storehouse of unquestionable truths which only need to be (painfully) memorized but which at least provide answers (sometimes all of them) to most practical problems which besiege us. This pragmatic orientation to science has been observed among children and adolescents (CYMS, 1989; Tremblay, 1985). What appears to be a positive attitude in fact overlooks the process of scientific thinking as a human undertaking that can be mastered and that can (and should) withstand evaluation. Therefore, an important goal for a science program should consist in conveying a more complete (and more critical) picture of the scientific process in addition to sharing actual research findings with the audience. This goal might be achieved in a number of ways: 1) underlining the merits of science as a logical, reality-based approach to problem-solving as opposed to magical thought or a blind trial and error approach; 2) pointing to the limitations of science in the face of social, economic or philosophical issues; 3) providing a view of science as an evolving discipline with changing theoretical viewpoints and as yet unanswered questions; and 4) showing how intuition and imagination are also necessary thought processes in the pursuit of scientific discovery,

Another misconception that tends to interfere with aspirations toward a scientific career pertains to the view of the scientist as an unusually gifted individual, usually male, with a meagre social life. In this respect, preliminary explorations of children's attitudes toward science (CYMS, 1989) are in accordance with findings from larger studies (i.e., Mielke, 1983). Therefore, another important goal of a science program designed for children should be to present a more realistic picture of scientists and scientific work. To begin with, the social dimension of scientists' professional lives may be highlighted to counter the stereotype of the solitary worker. For instance, the program might show the actual team work that is behind most research as well as scientists' involvement with broader contemporary social issues such as health, the environment, etc. The program can also strive to provide glimpses into scientists' personal lives, showing them to have mates and families as anyone else. One way to qualify the stereotypical view of the scientist as inordinately bright might consist in highlighting the range of personal qualities involved in scientific work (i.e., intuition, persistance, and leadership in addition to intelligence) and pointing to the broad gamut of science-related occupations that call for different profiles of abilities.

A recurrent finding in different cultural milieux is that myths about science may be more prevalent among girls than among boys (CYMS, 1989; Mielke, 1983; Tremblay, 1985). Boys are generally found to be more interested in science on the whole and to be especially attracted by technological achievements. On the other hand, girls are often less enthusiastic and tend to gravitate toward the natural and social sciences when they do show interest. Girls' reservations about science may be due partly to a limited view of scientific work which makes it seem incompatible with feminine qualitites. In some cases, girls' reluctance towards science has also been linked to a greater social consciousness of some undesirable consequences of technology (Mielke, 1983) although it appears that boys and girls share a growing common concern about environmental issues (CYMS, 1989). Therefore, efforts to highlight the creative and social dimensions of science, as discussed earlier, may be expected to benefit girls in particular. Another way for television to directly address these issues convincingly is to present female role-models successfully and happily engaged in scientific careers. By the same principle, role models for members of ethnic minority groups should reflect the increasingly diverse cultural mosaic of contemporary society

Children and Television in Quebec

Young Canadians, as their American peers, watch a great deal of television. Surveys over the last few years indicate that francophone Quebec children in particular areviewingbetween 20 and 25 hours of television weekly (Caron et al., 1990). With respect to genre, pre-adolescents especially enjoy action programs and situation comedies. Hence a survey among Quebec teenagers showing they intensely disliked science and news programs comes as no surprise (Tremblay, 1985). With respect to the format of television programs, pre-production research with the target audience (CYMS, 1989) revealed the same preferences for a narrative context, sophisticated visuals and realistic humor that have been found with larger samples of the same age group (Mielke, 1983). Given the cross-cultural similarities of Canadian and American pre-adolescents and their expectations of costly production standards, the translation of a successful television program for French-speaking viewers may at first appear to be a convenient and economical solution.

However, research on children's viewing habits and preferences (i.e., Caron et al, 1990; La Garde & Ross, 1984) runs counter to such a solution. Although French-speaking viewers watch English-language channels to some extent, and even though foreign programming is also available in translated versions, local programming is generally very popular. It is interesting to note in this respect that the popular foreign programs are exclusively entertainment fare. Indeed, children are often very critical of well-intentioned adaptations of foreign educational programs that appear less natural to them. On the other hand, the recent success of new educational programs (i.e., ***Club des 100 Watts, Robin et Stella,*** both from Radio-Quebec) indicates that young viewers can be very receptive to novel programs that are a reflection of their cultural reality. Given the competitive edge of entertainment programming and the goal of encouraging the viewer's identification with characters involved with science, it seems wiser to aim for a close cultural match in the hope of creating a more intimate rapport with the audience. In short then, an emergent television production is shaped by a multitude of factors, some general to children of that age group and to television in North America, others more germane to the specific cultural context of Quebec. Taken together, these research and programming considerations have inspired the production of a television series on science for pre-adolescents that will be presently described.

A SPECIFIC CASE STUDY

"Les Débrouillards" is a television series in the making designed to promote a better understanding of scientific phenomena and of scientific work and to generate interest and enthusiasm for the scientific realm. The program is meant to be entertaining as well as informative and gives special importance to humor. At the time of writing, the program featured three actors between 9 and 13 years of age as members of a science club under the amicable guidance of a young adult friend. Subsequently, the concept was redefined more along the lines of a magazine format hosted by two young adults and featuring as weekly guests children with special scientific interests or hobbies.

The program follows a modular structure comprised of three major types of segments: 1) studio segments featuring hands-on experiments and discussion of scientific phenomena; 2) field reports that consist of interviews with specialists as well as visits to various sites; and 3) comedy sketches. Briefer interconnecting segments include archival footage, information capsules and animated clips with a mascot borrowed from the print magazine mentioned earlier. Each episode revolves around a specific theme (i.e., the sun, flight, nutrition, etc.) which serves to introduce related concepts and applications from different fields of science and technology. The concepts are not linked to any specific curricular program but are selected among the array of possible topics as a function of their relevance to children's lives and their suitability for visual presentation. Following is a description of the pilot episode on sound which will serve to illustrate general points about the design process throughout the remainder of this article.

The pilot episode explored the nature of sound and its various manifestations in the world around us. The protagonists explained in concrete ways how sound is comprised of vibrations that travel through a medium, either gas, liquid or solid: for instance, they showed what happens when a gong is restrained from vibrating and what happens to ping-pong balls that are placed on an operating loudspeaker. An imaginary interlude on the moon provided an opportunity for talking about atmospheric conditions in an environment where air is absent. A visit to a hospital allowed a doctor to demonstrate how ultrasound technology is used to monitor the development of a baby in the mother's womb. Later on, a biologist explained how bats orient themselves by projecting sound waves while attempting to demystify children's fears about bats. Finally, an interview with a musician also provided the opportunity to demonstrate the applications of computer technology to modern music in an amusing fashion. In between these documentary parts, the children showed how to make a guitar and a stethoscope from simple materials. Their conversations, whether about dog whistles or the recording of their own voice, always centered on the program's theme of sound. The program ended on a humorous note with an opera singer demonstrating the power of her vocal cords.

TOWARD A DESIGN FRAMEWORK

The framework proposed here follows the premise that television viewing is both an emotional and an intellectual experience (i.e., Singer & Singer, 1983) and that both dimensions are essential for a sustained interest in science. Given the goal of fostering an interest in science among pie-adolescents via television, what might be the components of a successful viewing experience? First, it is suggested that the emotional appeal of such a program would rest on the viewer's perception of the program as being appealing and relevant. In addition, it is also suggested that a gratifying cognitive experience would be more likely if the program were experienced as challenging and empowering by the child viewer.

What production means are presently available that might facilitate such an experience? From a constructivist perspective (i.e., Wackman & Wartella, 1977) the total viewing experience ultimately depends on the interaction between the individual viewer and the program itself. However, guidelines may be useful in the process of designing a new program, as multiple decisions need to be made along the way. The framework outlined in Table 1 is therefore proposed as a working tool for the design of new programs on science as well as for the screening of existing science programs. In reality, these characteristics are closely interwoven and play out against each other to create a unique program style but they may also be examined separately for their specific contribution to the program as a whole. The list of suggested qualities is not

TABLE 1
Design Framework of a Science Television Program for Pre-Adolescents

Ideal Qualities of Program	Available Means
Emotional Level	
1. Appeal	a) Dramatic narrative b) Humor & stimulation c) Topic selection
2. Relevance	a) Life connections b) Identification c) Participation
Cognitive Level	
1. Challenge	a) Difficulty level b) Delivery and discovery c) Cognitive involvement
2. Empowerment	a) Children's conceptions b) Visual illustrations c) Language level

intended to be an exhaustive one but merely draws attention to some promising features.

Program Qualitites Related to the Emotional Dimensions of the Viewing Experience

Appeal. A science program needs to be appealing if it is to attract new viewers and hold their interest amidst a wide variety of programs. There are several ways of making a science program entertaining, which involve among other things, decisions about the genre that the science program will be molded into, the use of specific production features within the program and to some extent, the choice of the science topics per se.

Dramatic narrative. The narrative genre is widely used in television, both in dramatic and comical formats. The universal appeal of narratives is also manifest in science programming for the general public; scientists are often cast in the role of heroes conquering the forces of evil (i.e., disease, pollution,. . .) by means of their scientific discoveries (Silverstone, 1984). Although some concern has been expressed about the ideological consequences of implicitly presenting science as righteous and infallible by setting it within a narrative framework (i.e., Silverstone, 1984; Dornan, 1990), it seems reasonable to ask whether the narrative format may be a useful technique to awaken initial interest in science (even for adults). Moreover, pre-adolescents have acquired a good understanding of dramatic plots on television and are able to pick out relevant content from more peripheral content (Collins, 1983). Thus they may be more willing to follow through the history of a scientific discovery if it is set within a dramatic situation where the characters come to grips with unexpected events and personal problems in the course of their scientific pursuits.

In addition to its appealing qualities, the narrative structure may also serve an organizing function for the recall of information and help carry the viewer through less exciting material over the length of a program (Mielke, 1983). The narrative format has also been used with specific cognitive goals in mind. For example, 3-2-l Contact uses an adventure component to model inductive reasoning skills as the characters take on the role of detectives to solve crimes in their neighbourhood. Indeed, a critical outlook on science might be built into the narrative structure by showing that the protagonists make mistakes along the way and uncover more questions than they do answers. Whether such narratives will simply be perceived at face value by most viewers remains an empirical question but the dramatic component of television is an available means of enhancing the appeal of a science program.

Humor and stimulation. Comedies, it will be recalled, are a favorite genre of the target audience and it is therefore natural to ask whether there is room for humor in a science program. Humor in educational programming has been shown to increase attention and aid in the recall of information (Bryant, 1983). However, it is important to use humor and fantasy purposefully in a science program, in order not to undermine the credibility of the program or to confuse the viewer. Children of this age recognize the fictional nature of television in general but they are not necessarily adept at making fine distinctions about whether an event on televison could be a *possible* occurrence or a *probable* occurrence in real life (Dorr, 1983). Therefore, humor in the context of a science program should not serve to blur further the borderline between realism and fantasy.

Because of the natural tendency of some well-intentioned producers to make indiscriminate use of fantasy and special effects to make programs more appealing for children, a concrete example of misplaced humor will serve to support the point being made. One gag in the pilot program under study featured an opera singer appearing on a television show whose piercing vocal notes make the glass of the television screen fall apart. One drawback of relying too heavily on gimmicks of this sort is that pre-adolescents are likely to perceive such attempts at humor as "childish." Indeed, several children who viewed the program judged the exaggerated style of this segment to be incongruent with the realistic tone of the program. Further, it is unfair to lead someviewers to believe that such a phenomenon could take place unless it were pointed out as an event that calls for further investigation on the viewer's part.

When fantasy is used, it should be accompanied by cognitive signposts that clearly distinguish it from the realistic content of the program. For example, an animated character borrowed from the comic strip of the magazine that gave birth to the television series was a popular feature of the pilot episode. In this case, the animation technique clearly delineated these segments from the remainder of the program. In the series developed after the experimental pilot program, comical sketches were also intertwined with the science reports to provide pauses between the informative segments. Again, children of this age group can recognize clear variations between genres within a magazine format and interpret them accordingly Moreover, the interspersion of humorous segments within an educational program can actually facilitate learning possibly because it serves an alerting function to the material that follows (Zillmann et al., 1980 in Bryant, 1983).

The possible pitfalls involved in merging humor into a science program should therefore edge script-writers into finding additional creative solutions. In fact, to exclude humor totally from a science program might be perceived as reinforcing a common perception of scientific work as boring (a view that scientists undoubtedly do not share). Finally, the appeal of a television program may also be enhanced by the use of other production features (lively music, unusual camera angles, efficient visual editing and other special effects) that have also been shown to attract and sustain young viewers' attention and to facilitate information acquisition (Bryant, 1983). As a general rule then, educational programming should build upon the liveliness of television while aiming for moderate amounts of stimulation.

Topic selection. Finally, when the selection of topics to be covered in the program is not bound by curriculum constraints, one important criterion from the perspective of television should be the intrinsic appeal of that topic for children. A survey among 2,000 young readers of the JMPD science magazine

(GRJM, 1989) confirmed what the publishers and the science club workers had already gathered from their contacts with pie-adolescents over a number of years. They were especially interested in the biological sciences, technology, outer space and the environment. Therefore, a special effort can be made to link basic scientific concepts such as light, energy, etc., to biological and technological phenomena. As a case in point, the topic of sound provides the opportunity to explain how bate are special animals because they rely on sound waves to orient themselves in their surroundings and how ultra-sound technology allows us to monitor a baby's development in its mother's womb. Another way to generate interest in the subject matter might be to take advantage of children's fascination with the unusual and to link the topic under scrutiny to odd inventions, world records or even superstitions, whenever possible. For instance, hearsay about the danger represented by bats can be confronted with the biologist's explanations of bate' behavior. Such inserts provide natural opportunities to contrast 'magical' thinking with scientific thought.

Relevance

In addition to being attracted to the program as a potentially pleasant experience, the child viewer also needs to feel personally concerned by the content of the program. Thus, the program should strive to lead the viewer to a better understanding of the phenomena that are of importance to him or her, and encourage identification with the characters on the screen as well as active participation in the program.

Life connections. Whenever possible, specific topics should relate directly to the viewer's everyday life. For instance, two recent events in Quebec, a widespread blackout caused by a magnetic storm and an earthquake, provide a shared cultural experience from which to build episodes on electricity and geology. When one's daily routine has been upset and one's vulnerability suddenly revealed, it becomes relevant to understand the workings of nature. All subject matter, therefore, should be tailored to children's concerns and questions, whether these be of a capital or trivial nature. For example, a segment on aerodynamics should lead to a better understanding of how passenger planes fly but the application of those same principles to the flying of model airplanes and kites provides a better opportunity for the child to perceive those principles as immediately relevant.

Identification. The relevance of the science program for the child viewer may also be achieved through identification with the characters on the screen. Adult characters that are most likely to encourage identification are probably those who speak spontaneously and frankly to the audience while avoiding both an authoritarian or a compliant tone. Child characters need to be both believable and competent in order for child viewers to accept them as representative of their peer group (Bryant, 1983). Children of this age may indeed be quite critical of their peers on the small screen and do not easily forgive slip-ups. It is also useful to keep in mind that children tend to identify with characters their age or slightly older while girls engage in cross-sex identification more frequently than do boys.

Participation. Finally the child viewer maybe more likely to experience the program as relevant on a personal level if it leads to some form of direct involvement. Hence, experiments should be selected and presented in such a way as to facilitate replication at home. It goes without saying that security guidelines are then of paramount importance. Viewers might also be invited to perform some of the simpler activities while viewing, thereby enhancing the meaning of the content. For example, vibrating an elastic band between one's teeth with ears covered and uncovered allows the child to compare different sound vibrations as a function of the path of the sound waves. Finally, children can also have a part in the program when they are encouraged to forward their comments, questions and suggestions to the producers. In the case of the program being discussed, viewers can extend their television experience by writing to the science magazine or by taking part in a radio talk show.

Program Qualities Related to the Cognitive Dimensions of the Viewing Experience

Pre-adolescents have mastered the basic symbolic tools of their culture and are eager to expand their knowledge base and to develop their specific talents as they begin to establish themselves as autonomous individuals. Thus, even though television may often besought primarily for entertainment, it would be unfortunate to overlook the potential gratification that can derive from a successful learning experience through television. Given that a program attempts to reach the viewer on an emotional level as was discussed above, it should also strive to provide a challenging and empowering experience on a cognitive level.

Challenge

Learning from the television medium can only take place if the content is novel for the viewer and is more likely to occur if the viewer is actively involved in the learning process. For a science program to be intellectually challenging for pre-adolescents, it needs to be designed at an appropriate difficulty level, strive to achieve the right balance between delivery and discovery and attempt to actively involve the viewer at a cognitive level.

level. Children of this age group are quick to resent content that is too easy and will simply ignore content that is above their ability For instance, most pre-adolescents know about the existence of different gases but they may not understand the respective properties of gases or the laws of expansion that explain why helium and hot-air balloons rise in the air. Thus, a presentation that simply focused on gas as one of the four basic elements of the universe might be dismissed as too easy; on the other hand, an overly detailed presentation on the molecular structure of gases might be considered too difficult. Ideally, finding the right level requires the combined expertise of science teachers and cognitive psychologists and a constant adjustment of the scripts as a function of children's reactions.

Delivery and discovery. Another important dilemma for a television series is how to achieve the right balance between delivery and discovery, that is between providing information and bringing children to find out the answers for themselves, an issue that is also prevalent in science education (Linn, 1986). Excess in either direction would likely be detrimental to the goals of the series, On the one hand, adhering too strictly to a discovery approach may slow down the pace of the program to the point of losing viewer attention or it might needlessly deprive some viewers from a learning experience. On the other hand, an emphasis on the delivery of information might lead to a more superficial integration of content. Piagetian theory suggests that learning takes place through a combined process of assimilation (e.g., absorbing information into one's existing mental structures) and accommodation (e.g., adapting one's mental structures to account for new information) (Ginsburg Opper, 1979). Therefore, a program might aim for an equilibrium between the two corresponding modes of presentation. For instance, interviews with science people might naturally involve a high degree of information delivery while demonstrations carried out by the actors themselves could more easily lend themselves to a slower discovery mode, at times involving mistakes along the way.

Cognitive involvement. Television producers may be more adept at information delivery and viewers themselves may have become accustomed to minimal cognitive involvement during television viewing. Salomon (1979) for instance observed that children spontaneously display less AIME (Amount of Invested Mental Effort) when they view television than when they read a book, unless they are prompted toward more active processing. Therefore, it is the discovery mode of learning that poses a special, albeit not an unsolvable, design challenge for television. A good starting point might be to have the characters themselves model information-processing tasks by asking questions and formulating guesses about the phenomena under observation. The formal features of television may also be used to suggest interpretive processes to the viewer (Huston & Wright, 1983). For instance, dramatic musical notes during an experiment may cue the child to observe more intently by suggesting that something has gone wrong; the juxtaposition of seemingly unrelated images in the context of a science program may suggest that there is a logical connection to be identified. More active mental involvement on the part of the viewer may also be encouraged by inserting questions and puzzles for children to answer while viewing. Attempting to raise questions in the viewer's mind in addition to providing answers appears essential not only to create a sufficient amount of challenge for the viewer, but also to convey a more realistic view of science as a dynamic research process.

Empowerment

As a complement to the question-raising experience, the viewer also needs to experience some cognitive resolution. Empowerment in the context of a science program for children involves taking every available means to make the content comprehensible for the viewer. The design of the progam should therefore acknowledge the conceptions children already hold about phenomena, as well as their need for concrete visual support and for clear language.

Children's conceptions. A first important issue to address is how to make the program match children's intuitive conceptions about phenomena whenever possible. If a program designer is unaware of how children already conceive of a particular phenomenon, he or she runs the risk that the explanations will simply bypass the viewer's understanding. Let's consider one example among others. Children tend to think that a heavier steel cube will displace more water than an equal size aluminum cube (Linn, 1986). If the goal were to demonstrate the displacement of liquids as a function of volume, one would then design the demonstration so as to acknowledge the particular bias that viewers already hold about the phenomenon. However, following the above discussion of the entertainment dimension, there should also be a motivating context for such a sequence, such as the need to salvage a valuable object from underwater.

Visual illustrations. Pre-adolescents' need for concrete illustration of abstract concepts was alluded to earlier. A special advantage of television is precisely the availability of a range of production techniques that can serve as visual support. Some research on televised information has shown that iconic modes of representation, such as images which bear direct resemblance to the referent, may in some instances be processed more easily than symbolic representations such as verbal language that are arbitrarily connected to their referent (Huston &Wright, 1983). For example, having ping-pong balls bounce off a blaring loudspeaker shows the effect of the vibration of sound waves. Further illustration of the structure of sound waves varying in frequency and amplitude may be achieved through animation. Other special techniques such as graphic overlays, acceleration and deceleration photography, micro-photography, etc., may prove useful for clear and compelling exposition of complex processes and invisible phenomena.

Language level. The verbal mode remains very important nonetheless since information presented simultaneously in both modes is generally better understood than information presented in either mode alone (Huston & Wright, 1983). Hence a final issue related to the comprehensibility of science content is the use of an appropriate language level, one that is scientifically correct while avoiding needless technical jargon. However, paralleling the concern of producers in making scientific information accessible to the viewer, is the legitimate goal of science of introducing children to specialized terminology. To this end, the characters should take time to explain difficult terms or better yet, act as role models finding out what the words mean even as they struggle with the correct pronunciation. the extent that the combination of these features helps the viewer experience genuine understanding within the limits of a television program, such a feeling of empowerment may gradually convince the viewer that science content is within his or her intellectual grasp.

RESEARCH PERSPECTIVES

Science education objectives and the reality of children's television may at first appear to be irreconcilable but this inherent paradox may actually pave the way for some creative programming solutions. In this article, several suggestions have been offered to increase the likelihood that educational programming will be a rewarding experience that children will both enjoy and learn from. Some of the principles are supported by experimental research while others are proposed as working hypotheses. In practice, research and creativity converge to bring about a partial resolution of the paradox between learning and entertainment; indeed most design decisions appear to intertwine in their objectives and actually serve this dual purpose. Since each television program is unique, formative research can assist in making decisions about the design of a specific program.

In order for educational programming as a whole to benefit from these efforts, summative research or the evaluation of a program's success in reaching its goals, is also an important undertaking. Learning from television may be assessed at a basic cognitive level, at a more affective level or at a behavioral level. Thus summative evaluation could explore to what extent a science series leads to increased knowledge about science, nature and technology, to a more positive attitude toward scientists and scientific work or to increased participation in science-related activities. However, television's special contribution to science education needs to be viewed in a long term perspective and in interaction with other sources of formal and informal learning (parents, other media, science clubs, etc.). In closing then, these three areas of inquiry are proposed as interesting avenues to further our understanding of television as an informal source of learning.

Television and the social environment. A first area of research deals with the expected influence of a television program in the context of home viewing that goes beyond audience ratings. More often than not, the family context is an important mediating variable in children's learning from television (Ball, Palmer & Millward, 1986). For example, more than half the viewers of 3-Z-l Contact did something as a result of viewing (i.e., conducting an experiment, visiting a museum, reading a book....) (RCL, 1987) but an enriched home environment was a significant mediating factor in doing so. As researchers pay more attention to family viewing we should gain a better understanding of how parents can play a more active role in their children's experience of television.

In addition, research might also focus on children's relationship with television in the home context as they interact with siblings and friends and as they engage in various activities while viewing such as doing homework, playing with toys and pets, etc., (Palmer, 1986). Such naturalistic observations would provide a clearer picture of the kind of learning that can be expected to take place and of how program designers might accommodate the actual viewing context. Extending the immediate social environment to include the child's peer culture would also contribute to our understanding of how a television program finds its way into a child's life context. For example, how children talk about a science program, if at all, with their friends would also be of interest in understanding the social pressures related to viewing preferences and the additional processing of television information that may take place after the initial viewing.

Television and other media. A second area of inquiry could focus on the interrelationship between television and other media. Television offers the possibility of reaching out to afar greater number of children than usually does a science magazine for instance. The connections between the two media can be mutually beneficial, not only in terms of promotion but more importantly as a way to extend learning opportunities that neither medium could likely achieve on its own. For instance, the possibility of referring the viewer to detailed instructions in the magazine allows the presentation of more challenging hands-on experiments that are informative and enjoyable to watch on television. Hence a summative evaluation could address the issue of whether and how the television series and its twin magazine complement each other in leading children to engage in science activities. Also, a radio talk show presently on the air gives children the opportunity to ask questions and to discuss with science experts as a follow-up to the television program. Children's use of radio remains largely unexplored. A profile of the children who avail themselves of this opportunity and the consequences, if any, on their perception and appreciation of the television series could provide additional insights on ways to extend the television experience.

A related issue is how children control their own viewing exposure through the use of videocassette recorders (see for example, Levy, 1989 and Dorr & Kunkel, 1990). Knowing whether a science program would actually be recorded by the child and if so, whether the tape would be used for repeated viewing, selective viewing or modified viewing (i.e., slow motion) might provide important clues as to the appeal of a program and the kinds of learning that might be associated with different viewing experiences.

Television and school. A third area of inquiry could address the relationship between the science television series and the child's experience at school. The television series has opted to remain independent from the school curriculum in order to favor the spontaneous involvement characteristic of informal learning environments but these two areas of children's experience are likely to overlap (i.e., 1982 in Bryant, 1983). Although we should probably expect a reciprocal interaction between school learning and learning from television, some important questions remain about the connections between these two realms. Will teachers decide to use the television series in their science classes and if so, would children's perception and appreciation of the program change as a consequence? Will children themselves bring television into the school by using it for their assignments, talking about it in class or making direct suggestions to their teachers on the basis of the series?

The voluntary involvement of learners in informal situations such as television viewing compels program designers to search for ways to make science content appealing and relevant as well as challenging and empowering. Some of the principles that emerge from this practice as discussed in this paper might also apply to formal learning situations. Hence research that would focus more specifically on the relationship between school and television might eventually benefit both educational programming and curriculum development. Ultimately, we may want both formal and informal situations to merge as much as possible with each other if learning about science is to be both enjoyable and successful.

REFERENCES

Ball, S., Palmer, P,. & Millward, E. (1986). Television and its educational impact: A reconsideration. In J. Bryant, & D. Zillmann (Eds.), ***Perspectives on media effects*** (pp. 129-142). Hillsdale, N.J.: Lawrence Erlbaum.

Bryant, J., Alexander, A.F., & Brown, D. (1983). Learning from educational television programs. In M. J. A. Howe (Ed.) ***Learning from television: Psychological and educational research*** (pp. l- 30). New York, NY: Academic Press.

Bryant, J., Zillmann, D., & Brown, D. (1983). Entertainment features in children's television. In J. Bryant, & D. R. Anderson (Eds.), ***Children's understanding of television*** (pp. 221-240). New York: Academic Press.

Bybee, R.W., Carlson, J., & McCormack, A. J. (1984). ***Redesigning science and technology education.*** Washington, D.C.: National Science Teachers Association.

Caron, A. H. (1990). ***Television et videocassettes pour les jeunes: Analyse de l'offre et de l'ecoute.*** Montreal, PQ: Universite de Montreal. Groupe de recherche sur les jeunes et les medias.

Caron, A. H. et al. (1990). ***Television and videocassettes*** *for* ***children: An analysis*** *of* ***supply and demand.*** Montreal, PQ: Universite de Montreal. Groupe de recherche sur les jeunes et les medias.

Caron, A. H., & Van Every, E. (1989). The formative evaluation research model applied to children's television. In ***Children's Television*** (pp. 16-18). Toronto/Montreal: Children's Broadcast Institute & Center for Youth and Media Studies.

Center for Youth and Media Studies (1988). ***"Des Petits Débrouillards": Rapport de recherche sur le scenario de l'emission-pilote.*** Montreal, PQ: Universite de Montreal.

Center for Youth and Media Studies (1989). ***"Des Petits Débrouillards":*** Rapport d'evaluation de l'emission-pilote. Montreal, PQ: Universite de Montreal.

Clark, R. E. (1982). Antagonism between achievement and enjoyment in ATI studies. ***Educational Psychologist, 17(2),*** 92-101.

Collins, W. A. (1983). Interpretation and inference in children's television viewing. In J. Bryant, & D. R. Anderson (Eds.), ***Children's understanding of television*** (pp. 125-150). New York, NY: Academic Press.

Conseil des sciences du Canada (198 1). Les ***sciences au Quebec: quelle education?*** Ottawa: Ministere des approvisionnements et services.

Dornan, C. (1990). Some problems in conceptualizing the issue of "Science and the media". ***Critical Studies in Mass Communication, 7*** (l), 48-71.

Dorr, A. (1983). No shortcuts to judging reality. In J. Bryant, & D. R. Anderson (Eds.), ***Children's understandingoftelevision*** (pp. 199-220). New York, NY: Academic Press.

Dorr, A., & Kunkel, D. (Eds.) (1990). Children in a changing media environment. [Special Issue] ***Communication Research, 17*** (1).

Flagg, B. N. (1990). ***Formative evaluation for educational technologies.*** Hillsdale, NJ: Lawrence Erlbaum.

Gardner, H. (1982). ***Developmentalpsychology.*** Boston, MA: Little Brown.

Ginsburg, H., & Opper, S. (1979). ***Piaget's theory of intellectual development.*** Englewood Cliffs, NJ: Prentice-Hall.

Holdzkom, D., & Lutz, P. B. Eds.). (1984). ***Research within reach: Science education.*** Washington, D.C.: National Science Teachers Association.

Huston, A. C., & Wright, J. C. (1983). Children's processing of television: the informative functions of formal features. In J. Bryant, & D. R. Anderson (Eds.), ***Children's understanding of television*** (pp. 35-68). New York, NY: Academic Press.

La Garde, R., & Ross, L. (1984). La television des jeunes. In ***La culture: Une industrie?*** (Questions de culture 7) (pp. 53-75). Quebec: Institut quebecois de recherche sur la culture.

Lesser, G. (1980). The rationale for a series on science and technology. ***CTW International Research Notes, 3,*** (l-2).

Levy M. (Ed.) (1989). ***The VCR age: Home video and mass communication.*** Newbury Park, CA: Sage.

Linn, M. C. (1986). Science. In R. F. Dillon, & R. J. Sternberg (Eds.), ***Cognition and instruction*** (pp. 155-204). New York, NY: Academic Press.

Mielke, K. (1983). Formative research on appeal and comprehension in 3-2-l Contact. In J. Bryant, & D. R. Anderson (Eds), ***Children's understanding of television*** (pp. 241-263). New York, NY: Academic Press.

Palmer, P. (1986). ***The lively audience.*** Sydney: Allen & Unwyn.

Research Communications (1987). ***An exploratory study of 3-2-1Contact viewership.*** Chestnut Hill, MA: Author.

Salomon, G. (1984). Television is 'easy' and print is 'tough': The differential investment of mental effort in learning as a function of perceptions and attributions. ***Journal of Educational Psychology, 76, 647-658.***

Science council of Canada (1984). ***Science for every student - Educating Canadians for tomorrow's world.*** Ottawa, Ont: Ministry of Supplies and Services.

Silverstone, R. (1984). Narrative strategies in television science. ***Media, Culture & Society, 6,*** 377-410.

Singer, J. L., & Singer, D. G. (1983). Implications of childhood television viewing for cognition, imagination and emotion. In J. Bryant & D. R. Anderson (Eds.), ***Children's understanding of television*** (pp. 265-295). New York, NY: Academic Press.

Tremblay, H. (1985). ***Avoir 15 ou 16 ans en 1985: L'adolescence et la télévision.*** Québec: Ministere de l'Education.

Wackman, D. B. & Wartella, E. (1977). A review of cognitive development theory and research and the implications for research on children's responses to television, ***Communication Research, 4,*** 203-224.

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Instructional Technology Update: Using a Corporate Advisory Council to Link Academia and Industry

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Abstract: Instructional technology programs have traditionally suffered from a number of different problems including: 1) staying current with new technologies; 2) a lack of funding for new facilities and equipment; and 3) limited contact with the corporate sector where many graduates of these programs obtain eventual employment. Based on these problem areas, the Institute for Interactive Technologies at Bloomsburg University formed a Corporate Advisory Council that links its academic program wlth business and industry. Results of this linkage include benefits for the graduate program as well as advantages for those companies involved in this partnership.

Resume: La problématique des programmes de technologie éducationnelle tient a un certain nombre de situations, notamment: 1) la nécessité de se tenlr au fait des nouvelles technologies; 2) un financement insuffisant qui les empeche de se procurer du nouveau materiel et de nouvelles installations, et; 3) des contacts restreints avec les entreprises ou, pourtant, nombre de leurs dlplomés et dlplomées sont appelés a se trouver des debouches. Dans ce contexte, le Institute for Interactive Technologies at Bloomsburg University a formé récemment un conseil consultatlf entreprlses-unlverslte (Corporate Advisory Council) qul établit la liaison entre les programmes universitaires d'enseignement et de recherche et les milleux d'affalres ainsi que l'industrie. Cette collaboration bénéflcie au premier chef aux programmes d'etudes superieures et procure également des avantages aux firmes qui participent a cette forme de partenairiat.

INTRODUCTION

University-based instructional technology programs have grown considerably since the days of 16mm film and 35mm slides. While once based on the production and use of traditional media, these programs are now moving toward an "electronic era" where computers and other forms of digital technology hold the primary emphasis. This shift is particularly significant because many of these technology forms were unavailable only a decade ago.

Although often difficult to implement, such changes are important for maintaining the innovative edge required by instructional technology departments and for producing effective teachers for education and trainers in indus-

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try. Indeed, with access to the proper people and appropriate funding, instructional technology may prove to be the ideal arena for demonstrating how academia can remain a "leader" in education and training, rather than a "follower."

However, such changes have not come easily. New technology can be extremely expensive and is often difficult to implement, with difficult decisions to make concerning new types of hardware, equipment standardization, and effective utilization, among others. The situation in academia is particularly critical, with limited budgets, a lack of quality time, and potential problems communicating with experts outside the academic realm.

One solution to these problems is the formation of a corporate advisory council, which can act both as a consultant to the program as well as a link between academia and the "outside world" where graduates will eventually need to find permanent employment. Composed of personnel from business and industry, this advisory council can provide needed expert advice to these programs as well as monetary and networking support where warranted. This paper, therefore, focuses on the overall rationale for such councils, suggestions for their formation, benefits to involved institutions and corporations, and the experiences of one instructional technology program which profits from this relationship.

PROBLEMS FACING INSTRUCTIONAL TECHNOLOGY PROGRAMS

One of the most difficult problems currently facing academic instructional technology programs is the high cost of "high tech" hardware and software. While this problem is not new to these programs, it is becoming particularly acute due to the high cost of computers and other related equipment. Such costs are also problematic due to the current belt-tightening that is prevalent in many academic departments.

A second problem concerns the need for these programs to stay current with new technologies and other areas of importance in the field. In addition to the costs associated with the continual updating of equipment, it is also difficult to correctly decide which type of hardware or software to buy and when to purchase it. This continual revamping becomes quite difficult on a year basis, yet is expected by administrators and students since technology is perceived as a field where all the equipment must be the newest that is available. Professionals in the field are also expected to be knowledgeable about every new aspect of instructional technology, regardless of a person's specific area of expertise.

Finally, it is becoming increasingly difficult to provide appropriate "real life" experiences for graduate students within these programs, since such experiences must now encompass such a wide range of activities. Not only are these students expected to gain a significant appreciation for the theory behind instructional technology (learning theory, instructional design, etc.), they must also learn to use the specific tools required in the work force (computer programming, video editing, etc.). Providing significant experiences in both areas, however, is important for the proper education of students who plan to find employment in the area of educational technology.

EDUCATION AND INDUSTRY WORKING TOGETHER

One solution to the above problems (and similar ones faced by other academic areas) is mutual cooperation between education and industry for the benefit of both groups. In this sense, industry can provide resources (personal expertise, professional contacts, monetary support, etc.) while higher education provides access to university research, insightful professional expertise, and high-quality students who are seeking internship sites and full-time employment opportunities.

A number of ways that industry and education can work together have been described by Brown (1985), Melchiori (1984), and Nelkin and Nelson (1987). Specifically, these suggestions include:

- general research support from various companies (gifts, equipment donations, and endowments);
- cooperative support or knowledge transfer between institutional entities (industrial parks, extension teaching, and research institutes);
- funding consortia;
- free-standing corporations that reach out to universities;
- industry representation on advisory committees; and
- university-industry-government research programs.

Brown (1985), Mai (1984), and Tolbert (1984) have described the benefits that may be specifically available for higher education institutions. These include:

- gifts, grants, and research contracts;
- technology transfer;
- faculty consulting;
- the availability of research subjects;
- the potential use of various materials to enrich classroom teaching;
- the use of specialized corporate facilities;
- insight into current commercial concerns; and
- the possibility for summer or adjunct employment for faculty

While such liaisons can obviously be beneficial to educational institutions, they can also be very helpful to business organizations. According to Melchiori

(1984) and Tolbert (1984) these industry incentives could include:

- the acquisition of new personnel;
- access to new science and technology;
- access to university facilities;
- marketable prestige through using university and scholars' names;
- access to career-long training for technical personnel; and
- insight into new developments in various fields.

According to Brown (1985) and Melchiori (1984), however, there are potential disadvantages to this type of relationship including:

- differences concerning the availability of research results;
- varying organizational structures for each group, with universities tending to be flat while industry is typically hierarchical; and
- concerns about the holder of proprietary rights for current or future products.

Another disadvantage concerns the different time scales used by each organization, with universities using a long-range scope and industry typically focused on a shorter return.

THE ADVISORY COUNCIL AT BLOOMSBURG UNIVERSITY

Based on the benefits to be gained from a relationship with various industries, the Institute for Interactive Technologies of Bloomsburg University has formed a Corporate Advisory Council composed of representatives from various corporations interested in the development and use of new technologies. Chosen from a variety of different firms (including some companies without a specific technological focus), the Council is currently composed of six hardware/software developers, two chemical or pharmaceutical companies, one insurance company, one utility company, and several other firms. The Council meets three times a year with faculty and staff members of the university and is currently managed by the Director of the Master's of Instructional Technology program who coordinates all communication between the university and the council members.

The overall functions of the Advisory Council include:

- enriching the experiences of master's students through a variety of activities (in-class lectures, corporate visits, etc.);
- helping provide future direction for the master's program; and
- acquiring financial assistance to enhance the operational budget of the instructional technology program.

Each of these functions is important for the master's students as well as the welfare of the overall program.

BENEFITS FOR THE INSTRUCTIONAL TECHNOLOGY PROGRAM

Since its formation in 1988, the Corporate Advisory Council has provided a number of specific benefits for the instructional technology program at Bloomsburg University Although the project is still in its early stages, many of these advantages have proven to be extremely useful to faculty, staff, and students involved in the program.

One of the most important benefits that has evolved from this relationship has been a number of on-campus visits from council members to provide lectures to students on a variety of topics (e.g., instructional design in a corporate setting). Information from these professionals is extremely important for students choosing to change careers or update their skills. These informal, in-class lectures provide students with a description of situations where they can apply their new knowledge and adds credibility to the theoretical framework presented by their academic coursework.

In a similar way, visits to corporate sites provide students with a view of their eventual employment potential and helps them better understand the type of work situations for which they are being trained. Such visitations also provide a diversity of experiences that would not typically be available within the classroom. The placement of numerous student interns as well as a number of graduates of the program in these locations shows the significant potential for the utilization of these corporate partners.

The Advisory Council has also been extremely helpful in the promotion of the Institute for Interactive Technologies, a University service center designed, in part, to provide experience for graduate students within the program. In this respect, the Advisory Council has:

- assisted with the marketing of several interactive products developed by the Institute;
- contributed cash in excess of $55,000;
- supplied hardware and software whose value exceeds $60,000;
- provided in-kind support (class lectures, travel to Corporate Advisory meetings, etc.) for an approximate value of $170,000; and
- served as a catalyst to obtaining state grants in excess of $374,000 through matched funds.

Finally, the Corporate Advisory Council has been helpful by providing assistance in the planning and implementation ofchanges within the Institute for Interactive Technologies and the Master's program in instructional technology. Such suggestions have included, for example, shifting the emphasis among several computer operating systems and recommendations for changes in the content of academic courses. This type of assistance is invaluable in high technology programs that must remain current in their field while staying within the budget constraints that are a reality in higher education today

BENEFITS FOR CORPORATE ADVISORY MEMBERS

There are also significant benefits for the corporations who choose to join this Advisory Council. One of the most significant benefits for advisory members is the availability of well-trained students for internships and/or time employment. Although these students could find employment with other companies, they often choose Council members because these corporations are already known to them through class presentations and Advisory Council meetings.

Some Corporate Advisory members are also benefitting by using Bloomsburg University as a test site for company products, including two authoring packages used for developing computer-based projects as well as a system designed for presenting computer-based materials to students in a classroom environment. In this way, the Institute for Interactive Technologies provides personnel and facilities for testing various products that member companies wish to market, an invaluable service for companies wishing to evaluate early versions or updates of their products.

In a similar manner, this relationship provides company personnel with access to various experts in their respective fields who can provide information to help these companies develop and produce a variety of different "high tech" products. Such assistance may include staff and/or students familiar with a specific software package or development expertise for a project being developed by a Council member's company. While sometimes informal, such help is often invaluable to corporations in a highly competitive market where additional information can be extremely important to the success of a product.

FUTURE POTENTIAL OF THE ADVISORY COUNCIL CONCEPT

At present, the Corporate Advisory Council is proving to be extremely beneficial for the instructional technology program, the University service center associated with the program, and the corporate members themselves. In addition to providing significant input into the successful operation of the academic program and its affiliated institute, the Council has generously donated hardware, software, and professional time which has been extremely valuable to all academic personnel associated with the program. The only real problem has been the difficulty arranging meeting times when busy professionals from both groups are available, which has been somewhat alleviated by planning such meetings far in advance and limiting meetings to two half-day sessions.

The future of this relationship is extremely bright for all involved organizations. Options currently under investigation for the near future include: 1) a graduate student project developed and produced for the Advisory Council with little or no faculty/staffinvolvement; 2) significant student input into the tri-yearly meetings that bring all parties together; 3) an advisory council newsletter; and, finally, 4) an "Adopt a Graduate Student" program, where a corporate sponsor could cover a significant portion of a student's educational program.

Implementation of the above ideas could significantly improve the education of the involved students and their potential within their chosen field as well as help corporate sponsors obtain well-qualified people and experience working with academia. Coupled with successfully implemented past projects, such ideas will help keep this relationship alive and beneficial to all those involved.

REFERENCES

Brown, T. L. (1985). University-industry relations: Is there a conflict? ***Journal of the Society of Research Administrators, 17(2),*** 7-17.

Mai, K. L. (1984). University and industry — A productive relationship. ***American Education 20(6), 2-4.***

Melchiori, ***G. S.*** (May, 1984). ***Research on university-industry linkages: The state of the*** art. Paper presented at the Annual Forum of the Association for Institutional Research, Fort Worth, TX.

Nelkin, D., & Nelson, D. (1987). Commentary: University-Industry alliances. ***Science, Technology, & Human Values,*** 12(l), 65-74.

Tolbert, T. L. (Sept., 1984). Industry access to university technology -- Prospects and problems. In E. J. Freise, (Ed.), ***The private sector/ university technology alliance: Making it work.*** Proceedings of a Conference of the National Council of University Research Administrators, Dallas, TX, pp. 2428.

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Student Support and Computer Mediated Communication in Distance Education

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Abstract: Computer mediated communication offers a number of advantages to distance educators in provlding faster and more interactive channels for student support. Experience in the use of this technology in Europe, Canada, the United States and Australia suggests that both students and tutors benefit. This article presents a classlflcatlon of potentlal applications for student support In distance education.

Résumé: Les avantages sont nom breux pour l'enselgnement à distance d'adopter l'informatique comme moyen de communication puisqu'elle fournit un support plus rapide et interactif aux étudiants. Les experiences sur l'utillsation de cette technologle en Europe, au Canada, aux Etats-Unis et en Austraile nous montrent que les etudiants autant que les enseignants peuvent en profiter. Une classification des demandes éventuelles pour cette nouvelle technologle dons l'enselgnement à distance est présentée dans cet article.

According to Nipper (1989), in a "third generation" distance education environment, radio and television will probably be superseded by cooperative learning, using computer mediated communication (CMC), much in the way that correspondence courses are being superseded by courses using multi-media and mass-media delivery techniques.

It is self-evident that the success of distance education is highly dependent on the availability of communications technology. However, it would also seem that human factors have a major contribution to make.

In this paper CMC will be presented as an efficient vehicle for providing student support in distance education. The perspective adopted is similar to that expressed by Kaye:

> CMC will not in every case replace teachers, texts, telephone tuition, or residential seminars – for the majority of learners it will complement these earlier technologies, and in so doing vastly enrich the distance education experience. And for particular groups -the

> housebound, the handicapped - CMC may well become the major lifeline to interactive learning opportunities. (Kaye, 1989, p.9)

Education at a distance has several general characteristics. In distance education, knowledge is transported instead of learners; communications represents an important vector in this function. In addition, the teaching process is typically organized through a division of labour; course planning and development is carried out by one team, delivery and tutoring by another. In well-designed distance education, the learner is offered a choice in modes of support. Another general characteristic of distance education is teachers and learners rely on informal contracts to meet objectives within a given period. Finally, self-instruction is viewed as an important activity for the learner (Dieuzeide, 1989).

COMPUTER MEDIATED COMMUNICATION AND DISTANCE LEARNING

Computer mediated education or "on-line education" (Mason & Kaye, 1989; Henri, 1988) is accomplished through the transfer of text and data from a central computer, independent of the constraints of time and distance. It requires a telephone line, a modem, a microcomputer, wordprocessing software and communications software. There are three types of on-line service currently being used: electronic mail for the exchange of short messages between subscribers to a bulletin board service; computer conferencing as a medium for synchronous or asynchronous communication among members of a group; and on-line database for access through a terminal or microcomputer to schedules, menus, bibliographies, directories, data banks, etc.

Computer mediated communication is used in distance education as a means of facilitating group discussions, as well as encouraging learner autonomy and strengthening peer motivation. As a communications medium, CMC may replace scheduled telephone conferences or individual telephone calls between tutors and students, and allow participants to share relevant information within the group without the constraints of time and availability (Kaye, 1987; Mason, 1990). However, CMC may not entirely replace face-to-face or written communications because currently available communication technologies provide limited graphics transmission, and lengthy documents are not easily read on an 80 character, 25 line screen display (Mason, 1990). Postal service and facsimile transmission continue to be a better alternative for many documents (Kaye, 1987; Hailes, 1985; Montgomerie, 1987). Human factors, such as nonverbal communication, are also difficult to simulate in CMC, limiting the range of communication available (Hiltz, 1990).

Channels for Student Support in Distance Education

Many elements can comprise channels for student support, and for the purpose of this analysis, the elements will be categorized as didactic materials, tutoring, peer interaction and didactic resources.

- ***Didactic Materials:*** textbooks, assignments and study guides developed in such a way as to encourage profound learning (Willen, 1988) and better integrate student concerns about course content (Paul, 1988);
- ***Tutoring:*** guidance, counseling and advocacy (Abrioux, 1985; Lebel & Michaud, 1989);
- ***Peer Interaction:*** facilitating cooperative learning (Amundsen & Bernard, 1989; Wangdhal, 1981) and responding to affiliative needs (Boyd, 1985); and
- ***Didactic Resources:*** facilitating access to main computer, libraries and experts in order to reduce feelings of isolation (Wangdhal, 1981; Willen, 1981; Thompson, 1989).

Roles of Student Support in Distance Education

Institutions have two goals in providing student support for distance education: assist the learners in their pursuit of knowledge, and foster their personal quests for autonomy lb that end, the following support services are provided:

- Methodological support as a basis for the acquisition of knowledge and skill;
- Metacognitive support based on conscious control and organization of cognitive processes;
- Emotional and motivational support including preferences, negative and positive feelings towards persons, ideas and things;
- Administrative support or assistance through institutional processes and procedures, technical assistance (Lebel & Michaud, 1989, p. 35-36; Lebel, 1989).

Hart (1987), of the Open Learning Agency, also distinguishes between the essential contributions of “orgware” as adequate organizational arrangements, and “teachware” as adequate and effective use of hardware and software.

Student Support in Distance Education Using Computer Mediated Communication: Research Findings

To date, most of the research in the use of CMC in distance education has been limited to certain developed countries: Australia, United States, Great Britain, Canada and Norway (Naidu, 1989). Computer mediated communication has been tested in a number of educational settings: with small groups (Hiltz, 1986; Harasim, 1986; McCreary & van Duren, 1987; Boyd, 1987; Beckwith, 1987) and with larger groups (Mason, 1989; Kaye, 1987; Bates, 1986). Although computer mediated communication has been around for at least fifteen years (Meeks, 1985), the predominant problems continue to be the reliability of equipment, the lack of satisfactory software and few user-friendly environments (Naidu, 1989; Harasim, 1987). In the matrix below, the interaction between channels for student support and roles of student support is presented. Examples of the use of CMC as the medium of support, together with comments on its successes and limitations, and their sources, are shown in the cells of the matrix. This matrix is based on theoretical presentations (Henri, 1988; Boyd, 1987,1989; Kaye, 1988) and on case studies (Hart, 1987; Archer, 1989; Nipper, 1989; Mason and Kaye, 1989; Kaye, 1989; Harasim, 1986, 1987; McCreary & van Duren, 1987; Davie, 1988, 1989).

On the whole, it would appear that student support roles are well served by CMC. The most apparent improvement seems to be an increased interaction amongst tutors, students and their peers (Harasim, 1987). Electronic messaging offers an effective alternative to real-time communications, such as the telephone, where scheduling can be a problem for both tutors and students. However, for large groups it would appear to be difficult to persuade more than a third of the students to actively participate, even when training and equipment are made available (Mason, 1990). It may well be that only the more sociable students are comfortable with this new medium, the others tending only to "lurk" (Harasim, 1989).

A recurrent theme in the literature relates to the special qualities expected of distance instructors and tutors: contextualization of student input, frequent browsing through messages, group motivation and frequent feedback. Are these not also the skills necessary for the face-to-face teacher? One of the main arguments in favour of CMC is its flexibility in comparison with scheduled telephone access or postal communications. Also, CMC may offer a viable alternative to the typically intensive summer course which puts the student under considerable stress. However, the successful application of CMC techniques to distance education appears to be linked to the involvement of the educators themselves in the training process (Harasim, 1989). Good results have been achieved in the use of CMC in training health professionals and financial managers (Henri, 1988; Hiltz, 1988; Kaye, 1989).

A number of casestudies have also shown that instructional activities can be carried out quite successfully using computer conferencing (Hailes, 1985; Harasim, 1987; Hiltz, 1988). "On-line instruction" can either be teacher-directed or learner-centred, depending on the situation. The "virtual classroom" can become more like the extension of the campus rather than the traditional distance education environment in which there is a separation of learning and teaching in time and in distance.

A New Paradigm for Student Support in Distance Education?

Are we experiencing the development of a new paradigm in distance education, as proposed by Nipper (1989), and are we beginning to experience a third generation distance learning environment? There are some encour-

Table 1
Potential Uses of Computer Mediated Communication for Student Support in Distance Education

Channels for Student Support (Willen, 1981; Thompson, 1989; Paul, 1988)	*Didactic Materials:* Assignments, Textbooks Study Guides	*Tutoring:* Guidance, Counseling; Computer conferencing as a mediator	*Peer Interactions:* Proctors, Cooperative Learning	*Didactic Resources:* Bookstore, Library, Mail Computer
Roles for Student Support (Lebel & Michaud, 1989)				
Methodological: (Lebel, al. 1989) "Orgware" (Hart, 1987)	CMC for cooperative writing courses (Davie, 1988, 1989) Lack of compatible hardware (Hiltz, 1988; Harasim, 1987)	CMC free from time & space constraints (Kaye, 1988) Restricted to the literary skillful (Boyd, 1989)	CMC facilitates group interactions and discussions, small group voting capacity (Henri, 1988; Bates 1988, Lamy, 1985)	Access to databases, electronic mail
Metacognitive: (Lebel, al. 1989) "Teachware" (Hart, 1987)	CMC convenient for written communication, more reflective, analytical (Hiltz, 1988)	CMC requires new skills: tutor must be host, chairperson, contextualizer, "weaver" (Archer, 1989)	Session planning is essential (Harasim, 1986) Participation of everyone in group (McCreary & van Duren, 1987)	Strategic organization is necessary
Emotional & Motivational: (Lebel, al. 1989)	CMC assists students in submitting assignments sustains persistence & develops more favourable attitude towards communication (Hiltz, 1986)	CMC more interactive than other communications media such as telephone, correspondence, more room for varied input from tutors, peers; even help among tutors (Nipper, 1989)	CMC fosters egalitarian access, less efficient than face-to-face, more efficient than telephone or meetings (Mason, 1989) Possible time lags in reactions	Accelerated access and feedback from centralised services
Administrative: (Lebel & Michaud, 1989) "Orgware" (Hart, 1987)	Electronic messaging capacity (Kaye, 1989) Distance & cost limitations (Boyd, 1987) Need for organizational change (McCreary, 1989)	CMC efficient for training tutors & keeping them informed (Kaye, 1989) (Mason & Kaye, 1989)	Group "cafes", chatting places, take care of grapevine functions E-mail mode	No need for queuing, no time constraints (Boyd, 1987) Two weeks of training essential (Hiltz, 1986)

aging signs. In developed countries, computer mediated communication is increasingly being adopted as a new medium for student support, especially for tutoring and cooperative learning (Harasim, 1989). In certain cases, on-line instruction (predominantly computer conferencing) has been used on a regular basis (Hiltz, 1988; Harasim, 1989). Conferencing software is becoming more user-friendly and thus it facilitates increased participation (Meeks, 1985; Myer, 1985). This is not particularly surprising; the end use is a function of the medium, thus increased group participation and interaction are the obvious outcomes of a system designed specifically for the purpose.

Harasim (1989) suggests that "on-line" education should become a 'hew domain" of investigation and teaching. She argues that its main attribute, collaborative learning based on a many-to-many mode of interaction, is different from traditional distance education which relies on a one-to-many (broadcast) or a one-to-one (tutor/student) mode.

But there is a price for access to this new, perhaps utopian, paradigm. Bates (1986) and Mason (1989) both caution that the implementation of CMC at the Open University has resulted in the transfer of some of the operating costs to the student, thus raising a further economic obstacle against socio-economically disadvantaged individuals for access to education. For example, in one particular course, the student assumed the cost of the hardware and telephone charges (in the UK, there are charges even for local calls). For the most part, students resented this extra burden. However, it is not clear how these costs compared with traveling expenses, time spent and general inconvenience of getting to and from a traditional educational institution. The Open University has been reluctant to extend the use of CMC because of long distance charges. However, there has been some success in providing nodes for local calls through the university network (Heap, 1990).

Distance education has, in most cases, been the domain of the highly motivated and educationally privileged adult learner. There is the possibility that computer conferencing, based on written communication, further widens the gap for socio-economically and educationally disadvantaged individuals (Boyd, 1987,1989; Nipper, 1989). Today, only 15% of households in developed countries have computer facilities at home, and of these, most represent the better educated segment of the population.

It has generally been observed that there is a considerable increase in workload for tutors and students associated with CMC distance education. However, Paulsen (1989) points out that a pioneering effort always requires a greater contribution and that, over time, the workload will become more balanced. Mason (1989) foresees a situation arising in which tutors will have to decide whether to accept working in new environments such as those created by CMC or to demand more training and increased remuneration. However, it has been estimated that three hours of CMC for training per tutor would only add 1% to the total presentation costs (Heap, 1990).

CONCLUSION

In summary, the distinguishing feature of distance education using CMC is the environment it creates for cooperative learning. This would appear to present a number of advantages: reduced feelings of isolation, a chance of "deeper learning" (Entwistle, 1981), greater control over pacing, more varied student support and more rapid feedback. With these advantages, it offers a second chance to the adult learner, and more open access to high quality education from the best experts in the field.

But, its high cost, currently limited accessibility, literary character, lack of user-friendly software and transparent protocols, weaknesses in "noise reduction and filtering" (Boyd, 1987), and graphic limitations are all factors that are preventing this new medium from being adopted as the dominant paradigm for distance education,

Improved telephone technology based on digital signals, integration of voice and data, expert communication software, government regulation of telephone tariffs for educational use and distribution through satellite through digital encoding of data on commercial broadcast services are all technical innovations that will have a profound effect on student support systems within the next five years – even in developing countries. Using slow scan video transmission over telephone lines, learners, instructors and tutors will be able to see one another and leave pictures and text in E-mail boxes. However, this loss of anonymity could possibly inhibit the participation of the less confident learners.

The introduction of a third generation distance education environment will probably involve substantial changes in the behaviour of students, instructors and tutors. It will also introduce new opportunities in distance education that practitioners in the field should be ready to exploit.

REFERENCES

Abrioux, D. (1985). Les formules d'encadrement. In F. Henri &A. Kaye (Eds.),. *Le savoir a domicile. Pedagogie et problematique de la formation a distance. Quebec:* Presses de l'Universite du Quebec.

Amundsen, CL., & Bernard, R.M. (1989). Institutional support for peer contact in distance education: An empirical investigation. *Distance Education,* 10(l), 7-27.

Archer, N.P. (1989). Improving idea generation during decision making in small group computer conferences. *Canadian Journal of Educational Communication, 18(2),* 111-123.

Bates, T. (1986). Computer assisted learning or communications: Which way for information technology in distance education? *Journal of Distance Education,* 41-57.

Beckwith, D. (1987). Group problem-solving via computer conferencing: The realizable potential. ***Canadian Journal of Educational Communication,*** 16(2), 89-106.

Boyd, G.M. (1989). The life-worlds of computer mediated distance education. In R. Mason, & A. Kaye A. (Eds.), ***Mindweave: Communication, computers and distance education*** (pp. 225-227). London: Pergamon Press.

Boyd, G.M. (1987). Flexible learning through computer mediated communications: opportunities and limitations. In A.J. Trott,F. Percival, D. Craig, & D. Buglass (Eds.), ***Aspects of educational technology, volume XX: Flexible learning system.*** London: Kogan Page.

Boyd, G.M. (1985). Providing for lifelong affiliation with distance education institutions and the feasibility of doing so with personal computer communications. ***Canadian Journal of Educational Communication,*** 14(l), 8-9.

Davie, L. (1988). Facilitating adult learning through computer mediated distance education. ***Journal of Distance Education, 3(2), 55-69.***

Davie, L. (1989). Facilitating techniques for the on-line tutor. In R. Mason, &A. Kaye A. (Eds.), ***Mindweave: Communication, computers and distance education*** (pp. 74-85). London: Pergamon Press.

Dieuzeide, H. (1989). ***L'enseignement a distance et lespays en developpement.*** Conference presentee a la Tele-universite, a Quebec le 26 octobre.

Entwistle, N.J. (1981). ***Styles of learning and teaching: An integrated outline of educationalpsychology for students, teachers, and lecturers.*** Chichester: John Wiley & Sons.

Hailes, P.J. (1986). ***An analysis of computer conferences supporting the distance learner.*** Paper presented at the Annual Conference of the American Educational Research Association, San Francisco, CA.

Harasim, L. (1986). Computer learning networks: Educational applications of computer conferencing. ***Journal of Distance Education,*** l(1) 59-70.

Harasim, L. (1989). On-line education: Anew domain. In R. Mason, &A. Kaye (Eds.), ***Mindweave: Communication, computers and distance education*** (pp. 50-62). London: Pergamon Press.

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

Hart, R. (1987). Towards a third generation distributed conferring system. ***Canadian Journal of Educational Communication, 16(2),*** 137-152.

Heap, N.W. (1990). Implementing learning networks A large scale case study, ***Proceedings of the Third Guelph Symposium on Computer Mediated Communications,*** May 15-17, Guelph, Ontario, pp. 28-36.

Henri, F. (1988). Formation a distance et communication assistee par ordinateur. ***Perspectives,*** 18(l), 86-92.

Hiltz, R.S., Shapiro, H., Ringsted, M. (1990). Collaborative teaching in the virtual classroom. ***Proceedings of the Third Guelph Symposium on Educational Mediated Communications.*** May 15-17, 1990, Guelph, Ontario, pp. 37-55.

Hiltz, R.S. (1988). Learning in a virtual classroom. In ***A virtual classroom on EIES: Finalevaluation report. Research report*** #25, ***volume 1.*** Newark, NJ: New Jersey Institute of Technology,

Hiltz, R.S. (1986). The “virtual classroom”: Using computer mediated communication for university teaching. ***Journal of Communication, 36(2), 95-*** 104.

Kaye, T. (1987). ***Computer conferencing for distance education.*** Paper presented at the Symposium on Computer Conferencing and Allied Technologies, June 1-4, 1987, Guelph, Ontario: University of Guelph.

Kaye, T. (1989). Computer mediated communication and distance education. In R. Mason, & A. Kaye(Eds.), ***Mindweave: Communication, computers and distance education*** (pp. 3-21). London: Pergamon Press.

Kaye, T. (1988). L’enseignement a distance: un etat de la question. ***Perspectives, XVIII,*** 1: 41-54.

Lamy, T. (1985). La telematique: un outil convivial? In F. Henri, & T. Kaye (Eds.), ***Le savoir a domicile. Pedagogie et problematique de la formation a distance*** (pp. 303-328). Quebec: Presses de l'Universite du Quebec.

Lebel C., & Michaud, B. (1989). Le tuteur et le support a I’etudiant en enseignement a distance. In R. Sweet (Ed.), ***Post-secondary distance education in Canada: Policies, practices and priorities*** (pp. 35-42). Athabasca, Alberta: Athabasca University

Mason, R. (1989). An evaluation of COSY on an Open University course. In R. Mason, & A. Kaye (Eds.), ***Mindweaue: Communication, computers and distance education*** (pp. 115-145). London: Pergamon Press.

Mason, R. (1990). Conferencing for mass distance education. ***Proceedings of the Third Guelph Symposium on Computer Mediated Communication,*** May 15-17, 1990, Guelph, Ontario, pp. 55-64

Mason, R., ***& Kaye,*** A. (Eds.). (1989). ***Mindweave. Communication computers and distance education.*** London: Pergamon Press.

Mayer, A. (1985). User friendliness at 300 baud. (The COSY approach to the human interface). In R. J. McQueen (Ed.), ***Computer conferencing and electronic messaging.*** Guelph, Ontario: University of Guelph.

McCreary, E., & Van Duren, J. (1987). Educational applications of computer conferencing. ***Canadian Journal of Educational Communication, 16(2)*** 107-115.

McCreary, E. (1989). Computer mediated communication and organisational culture. In R. Mason, ***&*** A. ***Kaye (Eds.), Mindweave: Communication, computers and distance education*** (pp. 101-114). London: Pergamon Press.

Meeks, B. N. (1985). Computer conferencing: An overview of conferencing systems. ***Byte,*** December, 169-184.

Montgomerie, T. C. (1987). Facilitating ‘extended campus’ graduate education through electronic communication. ***Canadian Journal of Educational Communication, 239-256.***

Naidu, S. (1989). Computer conferencing in distance education. ***ICDE Bulletin,*** 21, 23-31.

Nipper, S. (1989). Third generation distance learning and computer conferencing.In R. Mason, &A. ***Kaye*** (Eds.), ***Mindweave: Communication computers and distance education*** (pp. 63-73). London: Pergamon Press:

Paul, R. (1988). If student services are so important, then why are we cutting them back? In D. Sewart, & J.S. Daniel (Eds.), ***Developing distance education*** (pp. 50-56). Oslo: International Council for Distance Education

Paulsen, M. (1989). EKKO, a virtual school. In R. Mason, & A. Kaye (Eds.) ***Mindweave: Communication, computers and distance education*** (pp. 201-207). London: Pergamon Press,

Thompson, D. (1989). The provision of student-support services in distance education: Do we know what they need? In R. Sweet (Ed.), ***Post-secondary distance education in Canada Policies, practicies and priorities*** (pp. 43-50). Athabasca, Alberta: Athabasca University

Wangdahl, A. (1980). Who are the correspondence students and what about their handicap of isolation. ***Pedagogical Reports*** No. ***13*** Lund.

Willen, B. (1981). ***Distance education at Swedish universities: An evaluation of the experimentalprogmmme and a follow-up study.*** Stockholm: Almqvist & Wiksell International.

Willen, B. (1988). What happened to the Open University: Briefly. ***Distance Education,*** 9(l), 48-70.

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Microware Review

The MacroMind Director

L. F. (Len) Proctor

The MacroMind Director is a software package designed to turn the Macintosh into a sophisticated multimedia production studio. While other computer graphics packages do a very credible job of assisting the user to create and present computer generated slides or overhead transparencies, few tools allow the user to combine the attributes of sound, animation and graphics in one document. The MacroMind Director is one presentation authoring package that does have this kind of flexibility. It can be used to create presentations that range in complexity from the production of a simple black and white title slide to a full color, animated motion picture production with an accompanying sound track.

System Requirements

The package, as it arrives from the manufacturer, includes the program, a help file, desk accessories, a guided tour of the program's features, tutorial files, clip animation files, sound files, and reference manuals. For black and white presentations, the program requires at least 1 megabyte of memory in a Macintosh Plus, SE or II and a hard disk drive. A minimum of 2 megabytes of memory is required to work in color. Installing the program, its utilities and the demo files will take up about seven meg. of space on the hard disk. The program is available from MacroMind, Inc. 410 Townsend St., Suite 408, San Francisco, CA 94107. The retail cost is approximately $695.00 Canadian.

Program Features

The main program has been segmented-into two modules. The movie creation module is called the "studio". The program presentation module is called the "overview". In the studio, which is analogous to a motion picture animation studio, eight windows have been dedicated to the creation of animated images, one VCR-like window controls the movie playback and one window is available to the author to add comments or production notes. The overview, which is analogous to a production script, details the timing and assembly of graphic images, text, movie clips, visual transitions, and sounds that will be used to build the presentation.

In the studio module, the "paint" window can be used to draw or edit any bitmapped image that will appear in any frame of the movie. The "tool" window has tools for creating QuickDraw text and graphics directly on the stage. The "stage" is the window that displays the presentation much like the frames of a motion picture film are displayed on a screen. The "cast" window is actually a frame by frame database of the presentation's graphics, sounds and colors. When played in rapid succession, the frames create the illusion of watching an animated movie. In addition to controlling the timing of special effects like transitions, sounds and color palettes, the "score" window is used to keep track of the position of each castmember on the stage, in each frame of the movie 4 The "palette" window determines which of the seven types of color palettes (e.g., NTSC) that will be used to use to color the castmembers present on the stage. The "text" window is used to write, store, and edit text that is to be used in the presentation. Text can either be displayed on the stage, or heard as synthesized Macintalk speech. The "tweak" window facilitates the precise positioning and movement of any castmember on the stage.

On the control side of the studio, the "panel" window is analogous to a VCR control panel. A movie may be played, stopped, rewound or stepped forward and backward. The "comment" window is used to record staging or acting directions, detail storyboard scripts, or preserve the speaker's notes. When storyboards, transparencies, or handouts are printed, they may include pictures of selected frames of the movie along with the comments that have been written in the comments window.

The second major module is the overview. Overview displays all the documents that have been created in the studio or with other applications programs and the special effects that have been employed in the presentation. For example, still images maybe imported from a variety of paint, draw, or glue programs and animated motion sequences may be imported from VideoWorks or earlier versions of the MacroMind Director.

Interactivity

MacroMind Director is the successor to VideoWorks Interactive. Like VideoWorks Interactive, there are two basic tasks that have to be completed when creating interactive presentations. First, the animation sequences need to be developed, and second, controls need to be provided to the user so that the user can select the appropriate response to the activity or activities presented on the screen. The animation sequences are created in the studio and the control functions are provided by scripts written in an authoring language called Lingo. Lingo scripts in MacroMind presentations are are similar to HyperText scripts in HyperCard stacks. Frame scripts are activated automatically when the frame containing the script is displayed on the screen. Frame scripts are different from sprite scripts. A sprite may be any graphic that appears on the screen. A sprite script is activated when the user clicks on any sprite that has a sprite script attached to it.

Documentation

Two manuals, one for the overview and one for the studio and an interactivity guide are included in the package. Each manual has a tutorial section, a reference section, and a section containing examples of how to use each of the features of the program. The tutorials are logical, well-organized and well written. The inclusion of sample files on an accompanying tutorial disk helps to reduce the time between creating the presentation and viewing the actual presentation as it will actually appear on the computer's screen. The usage section gives explicit, step by step instructions on how to make each feature of the program function. The reference section describes the menus and windows that are found in each module of the program. In total, there is almost 1000 pages of documentation.

CONCLUSIONS

With one computer and one piece of software, the production of still graphics, animated motion pictures, and sound clips can be achieved. In the past, this kind of production would have required the use of a 35mm. slide camera, a motion picture camera, an audio-tape recorder and extensive editing facilities. Similarly, the hardware required to display a multi-media presentation would be equally complex. Today, for black and white presentations, a computer driven liquid crystal display tablet and an overhead projector has replace much of the complex equipment previously required. For color presentations, the computer may be attached to any standard type of video projector.

The MacroMind manual indicates that the user does not have to be a programmer in order to use the Lingo language to create interactive presentations. This is true for the creation of screen displays and sound clips, but to create user involvement in the sense of creating interactivity, a rudimentary knowledge of programming would be a definite asset. For example, having the control of a screen display based on the user making "if-then" types of decisions, the assignment of user inputs to variables and the use of built in functions can all be very confusing to an author who does not have some background in programming. Lingo, like HyperTalk in HyperCard stacks, is a programming language. And, while they are both more humane than some of their predecessors, for an author to really take advantage of the power of these programs, a knowledge of the basic programming concepts is essential.

MacroMind Director is representative of the growing trend toward merging traditional forms of media into a singular, electron-based form. It capitalizes on what we already know about the production of still pictures, motion pictures and soundtracks. It takes advantage of the metaphor of theater and the terminology associated with motion picture animation to aid the author in the design and creation of the presentation. And, it uses current technology to simplify the process of editing and revising a presentation. However, there is a price to be paid. The price is the size of the files that can be generated. Sound files in particular can become quite large and make the use of a hard drive equipped computer essential for presentation playback. Assuming that this minor limitation can be overcome by good planning, the MacroMind Director is indeed a valuable addition to any presenter's tool box. It will repay the user handsomely for any time spent in learning about the capabilities of this program and how to use them effectively.

REVIEWER

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Book Reviews

Mary Kennedy, Editor

Formative Evaluation for Educational Technologies by Barbara N. Flagg, Hillsdale, New Jersey: Lawrence Erlbaum, 1990. ISBN O-8058-0127-8 (CDN $46.95)

Reviewed by Griff Richards

As a designer and developer of interactive videodiscs, I approached ***Formative Evaluation for Educational Technologies*** with much professional interest, In one of my earliest interactive videodisc projects, it seemed that the interactive developers and the evaluation researchers approached evaluation from very different perspectives. Any formative evaluation was done informally by the developers, while summative evaluation, completed by the evaluators, culminated in the publication of a study, the results of which were not shared with the developers. It is hoped that Barbara Flagg's book will help to close the gap between developers and evaluation researchers, and between formative and summative evaluation.

Educational formative evaluation has a role to play in the production of quality programs. Making successful educational programs requires not only solid content and good design, but also ongoing review and revision during the development process. As a developer I am interested in finding more efficient methods of conducting formative evaluations -better, faster, and less costly ways of bringing a quality product together.

What I found in ***Formative Evaluation for Educational Technologies was*** a good overview of methods currently in practice, and a thorough examination of these methods from the perspective of what constitutes good formative evaluation. What I did not find was a recipe book of how to conduct formative evaluations, nor did I find guidelines regarding how much should be spent on program improvement. While Flagg's book did not provide answers to my more pragmatic questions, it did provide considerable insight into the complexities and issues of current practices in program evaluation.

The book is written for newcomers to formative evaluation. A second audience would be producers of electronic technology software. The boo appears at a time when technologies such as interactive videodisc are maturing. Developers know the capabilities of hardware systems, and audiences are no longer dazzled by the glitz of the electronic displays.

Formative Evaluation for Educational Technologies is presented in three sections. Part I: The Concept presents a theoretical discussion of formative evaluation. Part II: The Practice presents a series of case studies contributed by producers of instructional electronic technology programs. Part III: The Methods presents a framework for planning formative evaluation, and examines the appropriateness of various methods and approaches in terms of gauging user friendliness, program reception, or learning outcomes.

Throughout Part I Flagg avoids being prescriptive, and instead is cautiously descriptive of the processes of formative evaluation and the variety of media, settings, and research variables which are encompassed within formative evaluation. By illustrating different methodological approaches through examples from real case studies and from the evaluation literature, the reader comes to view formative evaluation as a real issue in the world of educational technology production.

In Part II the case studies solidify the notion that formative evaluation is indeed an integral part of the systematic design of educational technology products. The examples present generous titbits of information about the nature of the development decisions in the electronic technologies of broadcast television, interactive videodisc, teletext, and computer software. But examined together they highlight the disparity and discontinuity of formative evaluation practices from project to project. What Flagg does is establish that formative evaluation efforts can be better planned to encompass the whole development process, from beginning to end.

Part III, in attempting to present a framework for the planning of formative evaluation, fails to tell the reader how to plan effectively for this highly iterative process. The chapter on planning appears disorganized, with too many concepts introduced and left hanging rather than being interwoven. The chapters on methods are particularly useful, however, and they include simple design guidelines for evaluators to check, as well as a plethora of evaluation techniques. Flagg cautions the reader to use a variety of techniques which cover both quantitative and qualitative aspects, to ensure that unintended program effects, as well as intended program effects, are revealed.

Formative Evaluation for Educational Technologies is a very interesting and useful book. It is timely in its appearance and it will prove to be a good reference for students, developers, and evaluators alike. I particularly appreciate the inclusion of the case studies – they provide contextual frameworks that enable the developer to choose a production similar to his/her own as the starting point for the development of a formative evaluation plan. After reading Flagg's book, I feel that my future projects can have a better rationalized approach to formative evaluation.

My disappointment with the book lies in its failure to address some of the more pragmatic issues. The book fails to discuss the relationship between formative evaluation and market research. A failing of some interactive videodisc programs is that they offer so much depth that they actually take longer for students to use: what formative measures should be taken to ensure efficient use of students' time? The cost-effectiveness of formative evaluation is not discussed. If fifty percent improvement in effectiveness of a computer program can be accomplished in the first series of one-on-one trials, how much of the project's budget should be allocated to other formative evaluation activities, and at which phases of the project?

But in all, the development of educational technology products will be the better for the release of this book. I look forward to the release of a second edition, where perhaps there will be room to address some of the more pragmatic issues.

REVIEWER

Griff Richards is currently on leave from BCIT, where he is project leader for the IBM/BCIT Interactive Videodisc Development Project. He is pursuing doctoral studies in Educational Technology at Concordia University, Montreal, Quebec.

Human Learning (2nd Edition) by Thomas H. Leahey and Richard J. Harris, Scarborough, Ontario: Prentice-Hall of Canada, 1989. ISBN O-13-44-52-143 (CDN $61.33)

Reviewed by Reinildes Dias

Human Learning provides a comprehensive and integrative discussion of that complex process which has enabled human beings to achieve scientific, technological, and social improvements throughout the centuries. Human learning is a large and complex field of inquiry, with many sub-fields that deserve attention on the part of those who set out to delineate it. The authors deal with the process of human learning well, describing different theoretical perspectives, illustrative experiments, and examples that provide empirical evidence for their assertions.

Leahey and Harris organize their text around four themes in the psychology of learning: 1) learning and behavior; 2) learning and cognition; 3) learning and biology; and 4) learning and development. The organizational structure aids in the establishment of the integrative character of the book.

The introductory chapter examines human learning from an historical perspective, and reviews concepts and ideas related to copy theory, realism, idealism, and pragmatism. The four themes around which the book is structured are also introduced and briefly discussed.

Part I, dealing with issues of human learning and behavior discusses the principles underlying conditioning and the traditional and contemporary theories related to it. The contributions of theorists such as Pavlov, Guthrie, Hull, Watson, and Skinner, among others, are described. The focus is on the study of learning in terms of how behavior adjusts itself to the environment, without invoking the attributes of mind to animals. Human learning is presented as behavioral links to the environment without the mediation of the mind.

The authors provide a useful categorization scheme for behavioral psychologists, grouping them as either radical, methodological, or mediational behaviorists. Through this scheme readers are provided with a continuum of positions within the behaviorist group of theorists from the radical viewpoint, which excludes from the science of learning reference to anything that cannot be observed, to the mediational viewpoint, which admits to the presence of mediators (covert behaviors that influence overt responses) in the human learning process.

Part II focuses on the mental cognitive processes that underly human learning. Topics such as memory, forgetting, rehearsal, retrieval, encoding, and problem-solving are explored from a cognitive perspective. Such a perspective integrates assumptions from communication theory, from developments in computer processing, and from studies in artificial intelligence.

The relationship between the computer and the human mind permeates the discussion in Part II. Unlike the behaviorists who use animals as models for the study of human behavior, cognitive psychologists use the computer as their model. The point is made that generally most cognitivists believe that the human mind resembles the computer in that it accepts input through tion, processes input through thought, stores it in memory, and acts on it in making decisions.

Part II also includes an excellent discussion of the role of schema (generally defined as structures of overall knowledge that human beings have stored in their minds) in the processing of information for comprehension. The point is stressed that "spoken or written text does not in itself carry meaning; rather, it provides directions for listeners or readers on how to use their own stored knowledge to retrieve and construct the meaning" (Leahey and Harris, 1989, p. 201).

The point is also made that, like the behaviorists, cognitive psychologists failed to consider the importance of biology in their view of human learning.

Part III explores the relevance of biology to an understanding of the learning process. Attention is focused on two different aspects of biology: the biology of proximate causes highlights revealing aspects of the relationship among learning, memory, and the brain, while the biology of ultimate causes highlights the relationship between learning and evolution.

The chapter on sociobiology explores the biological bases for four major categories of social behavior - altruism, aggression, sexual behavior, and parental care - moving from accounts of animal to human behavior. The point is made that an adequate understanding of human learning requires attention to both cultural and biological factors.

Part IV explores the relationship between learning and development. Topics include the evolution of communication in animals, the mixed results of ape-language studies, speculations on human language evolution, and significant findings on child-language acquisition. Chomsky's position that language is an evolved species-specific entity, rather than the result of learning, cognition, or thinking, is also discussed.

The most influential developmentalist theories are reviewed, contrasted, and related to the learning process. Leahey and Harris note that theorists such as Freud, Erickson, and Kohlberg "merit attention in a book on learning and cognition precisely because they challenge standard notions of behavioral and cognitive learning" (p. 385). Also included in Part IV is a review of social learning theory, an influential and heuristically non-developmentalist theory that offers an alternative to the thinking of developmentalist theorists.

In summary, *Human Learning* provides a clear and comprehensive account of the research in learning and cognition without being simplistic. It has the quality of connecting seemingly divergent ideas in its description of the learning process. The inclusion of the theme of learning and biology, which encompasses sociobiology, makes this book a major contribution to the field, since that perspective is not usually addressed in books on human learning. A most attractive feature in the layout of Human Learning is the use of boxes which provide illustrative examples of the theories being discussed. This feature aids in the organization of the text, and provides a welcome break from the linear format, hence it increases the readability of the book. The authors acknowledge the helpful comments of students who used initial drafts of some chapters, and it is obvious that the feedback from students and teachers has been incorporated in the design of the text, creating a book that can readily be adopted for use in a course on human learning.

What is lacking in *Human Learning* is a discussion of human learning in relation to educational issues. A section which integrates learning and instruction is essential for the instructional designer or educational technologist. Such a discussion could readily become a fifth theme of this book.

Human Learning is of interest to language students and to teachers who do not normally have theoretical information about how learning occurs. It is also of value to instructional designers, who normally deal with the learning process from an application perspective, in the development of instructional materials. The book also meets the needs of the psychology student who is interested in understanding how present theories view the learning process from divergent -though complementary – perspectives. Human Learning integrates apparently disparate ideas in a clear account of this intricate process.

REVIEWER

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Managing Interactive Video/Multimedia Projects, by R.E. Bergman & T.V. Moore. Englewood Cliffs: Educational Technology, 1990. ISBN O-87773 209-1, 215 pages, 39.95 (U.S.).

Reviewed by Richard A. Schwier

INTRODUCTION

This book provides a detailed description of the design and development of large-scale interactive videodisc projects, and couches the discussion within the larger scope of multimedia production. The material draws heavily on the IVD Project Manager's Workshop offered by IBM. Two things leap at the reader at first glance: the material is very comprehensive and well organized, and the focus seems to be on fairly large-scale development projects.

CONTENT AND ORGANIZATION OF THE BOOK

This book is broken into two main sections: a guidebook for multimedia project managers, and a set of resources for project managers. The guidebook sets out a development model and takes the reader through each step in a complete multimedia development project. The second section, in the form of a set of appendices, offers a dizzying array of checklists, forms, design matrices, multimedia documentation, writing advice, references and a glossary.

Section One: The Project Manager's Guide

The Project Manager's Guide is made up of twelve chapters under four major headings: orientation, preparation, construction and implementation and management. These headings represent the major stages in a large development effort. Each chapter is organized into roughly four parts: an introduction (Preview of...); a context and brief overview of the content of the chapter (Looking Over the Territory); the actual content of the chapter; and a brief summary (The Last Word). If it sounds to you like there is a lot ofstructure to this book, I share your opinion. I found the structure comforting in many ways, as I could use the book for brief overviews, thorough discussion or reference.

Orientation. The "Orientation" section introduces multimedia technology and provides an overview to the development process and the organization of the book. Three chapters define multimedia applications and systems introduce and describe a development model for multimedia projects, and discuss the roles and responsibilities of project team members.

Preparation. In its first chapter, the preparation section offers prescriptions for planning a multimedia project including such things as goal setting, resources, personnel and cost estimates. The next chapter deals with analyzing the application. Audience analysis, objectives, needs assessment and task analysis are all compressed into this chapter, under somewhat different (more corporate) labels.

Construction. Five chapters comprise the section on "Construction." Collectively, these chapters address the major activities in the development process, and make the transition from "thinking about and planning" the project to making it come to life. The chapters include designing the treatment developing associated documentation such as storyboards and shooting scripts, producing the audio, video, text and graphics, authoring the context which synthesizes the various components, and evaluating the product.

Implementation and Management. The large-scale projects discussed in this book are evident in the last two chapters. Chapter 11, 'The Implementation Phase," describes the formation and management of the team and resources who will design, build and install the product in its new home. The last chapter covers the management functions for a project, including leadership, control and accounting.

Section Two: Project Manager's Resources

As mentioned earlier, this section is really a collection of seven appendices. Appendix A offers a set of evaluation checklists for each of the project phases. Appendices B and C include the "Super Storyboard Form" and design matrices for planning treatments. Appendix D outlines the various types of multimedia documentation for the steps in production. Appendix E discusses how to write a successful "Request for Proposal," and even contains four appendices of its own. Appendices F and G round out the resource section with a brief set of references and a glossary of terms.

CONTRIBUTIONS OF THE BOOK

I think it is particularly useful to have a book which thoroughly describes large multimedia development projects from a manager's perspective. Because of the scope of many multimedia development projects, many less experienced developers may find themselves flirting with the corporate world and large development teams. It is useful to have a document which uses the language of business (e.g., deliverables, RFP, vendors) to discuss fairly conventional instructional development ideas, especially when many of the contracts for this type of work will come from corporate contexts. I imagine some of my instructional developer colleagues will bristle a bit at the labels and concepts drawn loosely from ID models (does "validation" sound a lot like "formative evaluation"?). Still, if you are an instructional developer working with clients on large scale multimedia projects, you will be relieved to find a book which details the "business" side of things so well. Everything from production team management to budgeting is detailed, and the accompanying forms and appendices will be most useful. Why, Appendix E even discusses how to write an RFP. I suspect it was relegated to an appendix because the content fitted somewhat uneasily in the book, but many people will find the ideas helpful. In fact, if I were to offer one significant criticism of the work, it is that the authors offer very useful ideas, but they are sometimes lost in the wash of surrounding information. This may be partially a function of converting a series of workshops to print; in the workshop format, an instructor can shape the information for the audience -emphasizing some things and de-emphasizing others. This book seems to give equal importance to everything discussed, and leaves it to the reader to impose emphasis. Fair enough. Certainly the audience for this book will be sufficiently sophisticated to make those decisions.

Those in education may flinch at the size of the projects discussed in the book, especially given the modest and constantly threatened budgets we often face. This is not a reason to lay this book aside, because most (if not all) of the components discussed in the book have application for scaled-down projects. A $20,000 project will go through the same steps of analysis, design, development, production, authoring and validation described in this development model as the $200,000+ projects mentioned as examples. Because of the assumed size of projects discussed, the steps are certainly much more detailed than would be needed for most smaller projects. For example, Bergman and Moore discuss in some detail how to manage the implementation phase of the project, including such things as physical display planning, technical training of site personnel, a "roll out" plan for introducing the system, and coordination of complementary systems. This is not a criticism of the work, but merely a suggestion to readers that some picking and choosing will be necessary if you are using this reference with scaled-down multimedia projects. The authors do not do that for you.

The reader of this book will probably appreciate the liberal use of point form and graphics as much as I did. The layout is dynamic, and the reader is not bogged down in long streams of prose. Rather, the reader is permitted to gallop through the material, and graze on items of special interest. I suspect many project managers and instructional developers will this a very useful reference as a result.

Among the many gems contained in this book, I really like the "Super Storyboard" form discussed in Chapter Seven and reproduced in Appendix B.

Anyone who has managed a multimedia development project realizes the need for having a single form to manage the various source media and displays which can come into play A single sequence might include motion video, computer-generated graphic and textual overlays with a window from CD-ROM. Throw in two or three audio sources, and you have a storyboarding nightmare on your hands. This form goes a long way toward a solution. Abetter multimedia storyboard format may come along, but this is the best I've seen to date. The authors' permission to duplicate multiple copies for projects was also a nice touch.

SUMMARY RECOMMENDATION

This book is a welcome and useful addition to the literature on interactive media design and development. It will be a particularly useful resource for project managers working in corporate settings or with clients, but most parts can also be used by managers of smaller projects. Instructional developers will also find this book useful. I recommend this book more for seasoned developers than beginners, but it could provide a very helpful structure for a course on multimedia design.

REVIEWER

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CJEC welcomes papers on all aspects of educational communication and technology. Topics include, but are not limited to: media and computer applications in education, learning resource centers, communication and instructionaltheory, instructionaldesign. simulation, gamingandotheraspects of the use of technology in the learning process. These may take the form of reviewsof literature, descriptionsof approachesor procedures, descriptions of new applications. theoretical discussions and reports of research

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

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