

# Exploring the Relationship Between Media and Learning: Lessons from the Field of Educational Technology

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Is there a relationship between media and learning? Can one type of media attract more attention or hold attention longer? Or is the medium transparent, and instead the content or the instructional design variables accountable for variations in attention and learning? These questions become increasingly complex as media types proliferate with components intermixed in various multi-media formats. The issue is further clouded by commercial claims associated with media ("interactive video is the most effective way to attract visitors") and by research which has confounded the variables.

Research in both formal and informal learning environments has investigated the relationship between learning and media. Museum studies relying on research correlating attention and learning have investigated the attracting power and holding power of various media formats. Research in the field of educational technology has attempted to develop theoretical models to describe the relationship between media and individual learning. This paper suggests that integrating the research from these two fields may help museum professionals more clearly understand the issues involved and be better prepared to be either competent consumers or designers of media related research.

Critical to understanding research related to media is an understanding of the difference between research *with* media and research *about* media. Clark (1983) suggests that research *with* media refers to the investigation of outcome variables (such as achievement or motivation) with independent variables that are *not* media, but media is used to implement the independent variables. For example, a study interested in the effect of immediate versus delayed feedback could use media to present two lessons – one with immediate and one with delayed feedback. Any variation in results would be attributed to the independent variable of feedback, not the media. Research *about* media uses the media as the independent variable with outcomes such as cost effectiveness or user reactions accurately attributed to the media.

Clark and others argue that several decades of media comparison studies have often confused these two types of studies by comparing the outcomes

of instruction presented on two types of media, such as textbook vs. computer, and then attributing the variance on the medium. Clark argues that the instructional design variables applied to the design of a textbook vs. a computer program differ, and therefore the results are confounded by the different methods as well as the novelty effect. Clark suggests that understanding the relationship between media and learning necessitates avoiding these types of "media comparison" studies and instead engaging in research about media which looks at independent variables such as learners' beliefs and attributions associated with media and how those relate to learning.

In the museum field, the faces of new technologies are becoming increasingly common and museums often feel pressured to use new technologies to be "up-to-date." When faced with the difficult decision of selecting a media format, or with justifying a particular media, there is a temptation to refer to media comparison studies which often conclude with claims such as "interactive video is more educational than textbooks" or "computer programs are more effective at improving process skills." It is important to be able to critically assess these statements and recognize which findings are attributed to the media and which to the design of its program. Screven's well-known and often modeled research with adjunct devices has a strong influence in attributing visitor responses to instructional variables such as directing attention, providing feedback, interaction, practice, etc. (See for example, Screven, 1974) and recognizing media as interchangeable methods to implement the strategies. A number of instructional variables related to visitor learning have been identified (including cueing, conceptual pre-organizers, modeling, active participation and practice) and then implemented with a variety of media (including wall panels, audio tapes, interactive video).

Are the instructional design variables fully responsible for visitor reactions to media with none of the outcomes attributed to the medium? Clark (1983) states that "The fact that we learn (through education and experience) to prefer some media or to attribute varying levels of difficulty, entertainment value, or enjoyment to media might influence instructionally relevant outcomes" (p. 454). Beliefs and attitudes toward media are particularly relevant in the free choice setting of a museum where the visitor (the learner) is self-motivated and not bound by the conventions of formal education; before interpretive media can have any instructional value, the visitor must want to use it and choose to use it.

Informal observations of visitor behavior intuitively suggest that visitors do feel differently about various media formats; an exhibit on mounted fish is routinely ignored while a group of senior citizens congregate at a video program or a cub scout troop races to a computer program - also about fish. This is supported by studies measuring the attracting power of objects and exhibits. Media, such as video and audio, attract more attention than static media such as printed text or objects, and

exhibits including models and manipulable objects attract more attention than those without (Beer, 1987).

## Media and Learner Perceptions

Why do visitors prefer some types of media over other types and what are the implications of this in the museum setting? Research on learner beliefs and attitudes towards media has been largely influenced by schema theory. **Schema theory** suggests that knowledge and prior experiences are organized in cognitive structures, called schemata. The interaction between the learner and the stimulus characteristics influences the selection of a knowledge schema and a task schema (Kulhavy, Schwartz, and Peterson, 1986). The knowledge schemata includes previously acquired knowledge and experiences, and provides a framework for interpreting new information. The task schema is a goal-oriented set of procedures associated with a particular instructional task and controls the ways the learner activates encoding activities. The particular schema a person applies to a given instructional situation determines how the learner will view, approach, and process the new information.

Kulhavy, et al., (1986) suggest that schemas are selected as a result of the expectancies associated with a particular instructional stimuli. When an individual approaches a stimuli, such as a computer program, a video or a text label, previous experiences with related media will influence their expectancies and the consequent encoding activities. If the wrong task schema is applied, or when individuals wrongly attribute difficulties to a medium, it may result in the learner not investing adequate mental energy.

Salomon (1984) has developed a model which attempts to articulate how perceptions or expectancies relate to learning from media. Central to the model is the construct of **Amount of Invested Mental Effort (AIME)**. AIME is defined as the "number of nonautomatic mental elaborations applied to a unit of material" (Salomon, 1984, p. 648) and is related to both the depth of processing and the state of mindfulness. If information is processed in an automatic way, with no elaboration, then the AIME would be low and result in less learning.

Salomon's model suggests that the AIME depends on two perceptions: (1) Perceived Demand Characteristics (PDC), and (2) Perceived Self-Efficacy (PSE). The degree that a medium is perceived to be demanding is characterized as the level of PDC. For example, if a medium is associated with complex information or is generally used for learning versus entertainment, an individual may regard that medium as having high PDC. An individual's PSE is characterized by his/her perception of his/her ability to process information presented with that medium. The model suggests a relationship between PSE and AIME which is influenced by PDC. When PDC is high, PSE is positively correlated to AIME; the higher an individual perceives their ability to learn from a medium, the more effort

they will expend *when they perceive the task as difficult*. When the PDC is low, PSE is negatively correlated with AIME; i.e., when the task is perceived as easy, learners with a high level of self-efficacy will expend less mental effort than those with less self-efficacy, leading to less learning.

Beentjes (1989) explains the interaction between PSE and PDC:

“The amount of mental effort that is invested in a medium is determined by the interaction between perceived demand characteristics and perceived self-efficacy. Someone who perceives oneself as being very capable of obtaining information through a certain medium will not invest much mental effort unless he or she sees the medium as making high demands. A subject who doubts his or her efficacy, however, will invest mental effort only if the medium makes demands low enough to make the effort worthwhile.” (p. 49)

Salomon’s model has been the starting point of much of the recent research investigating attitudes and learning from media. A summary of the major findings of these studies is presented:

- Three dimensions of beliefs and attributions about media have been identified by Clark: preference, difficulty and learning. Research by Krendl has verified student variations across these dimensions when associated with television, computer, reading, and writing (Clark, 1983; Krendl, 1986).
- Individuals differ in these three dimensions across gender and grade level (Krendl, 1986). Krendl’s study found females reported more perceived difficulty and less learning than males when using computers. Females reported more learning from reading and writing and less from television than males. Computer preference declined steadily from third grade to tenth grade.
- Students prefer the medium they find easiest to use and mistakenly assume they learn more when they enjoy it; they like the media activity least from which they learn the most (Salomon and Leigh, 1984; Krendl, 1986).
- The amount of invested mental effort (AIME) in any learning task is a predictor of learning. AIME is related to the learner’s perceived self-efficacy (PSE). This relationship is a positive correlation when the task associated with the media is viewed as difficult and negative when the task is viewed as easy. For example, watching television is perceived as easy; individuals with a high self-efficacy invest less mental effort and “achieve less, apparently behaving mindlessly”

(Salomon, 1984, p. 654) than individuals with a low self-efficacy. Reading books is perceived as difficult; individuals with high self-efficacy invest more energy than individuals with low self-efficacy (Salomon, 1981; 1984).

- The amount of effort invested in learning from media can be influenced by changing the task description. For example, students asked to watch a television program for instructional purposes learned more than students watching the program for enjoyment. According to Salomon's model, the invested effort increased because the perceived difficulty of the task increased.

### Implications for the Museum Setting

The research cited above was conducted in formal learning environments with non-adult audiences. However, research on use of media in the museum setting has found differential levels of preferences for media types and some of the differences have been attributed to individual differences such as gender and age. Therefore, it seems worthwhile to consider the implications of these studies as generalizable to the museum setting with further research testing this assumption.

In the museum setting, interpretive media are prevalent including audio and video, printed text, graphics, and the objects themselves. If visitors are like students and prefer the media they will learn least from, in the free choice setting of the museum, that is the medium they will likely use. Media associated with a high attracting power may also be perceived by visitors as "easy" or as a medium they are very competent learning from. According to Salomon's model, this would suggest less mental effort invested and less elaboration – leading to decreased inferential learning and storage in long-term memory. For example, video has been shown to have a higher attracting power than printed labels, but if video is perceived as similar to television, it may be viewed as "easy."

This discussion implies that specific types of media are associated with widely held, specific perceptions. However, Salomon's research identified large individual differences in the perceptions of each medium not explained by ability. He suggests that individual differences are particularly likely "where no clear instructions are imposed on learners, thus leaving more room for the learners' own anticipatory schemata" (Salomon, 1984, p. 656). This suggests that informal learning settings may be even more vulnerable to variations in perceptions of media, with demographic variables such as age, gender or educational background potentially influencing not only whether visitors will be attracted to specific types of media, but how they will process that information.

However, the visitors' approach to, or interaction with interpretive media, can be influenced by changing their perceptions of the task or

purpose. Salomon suggests that children's cognitions are affected by "specific kinds of *programs* with which they carry out specific kinds of *activities*, under specific kinds of external and internal *conditions* for specific kinds of *goals*" (Salomon, 1990, p. 27). This is substantiated by museum studies which have effectively used interpretive media to influence visitor interaction with exhibits by specifying objectives, tasks or critical information thereby influencing visitors perception of the difficulty of the task. Koran, Koran, and Foster (1989) suggest handouts designed to "influence visitor perception by describing the complexity of conceptual relationships, or employ other ways to increase the number of non-automatic mental elaborations" (p. 74).

## Conclusions

Research supports a relationship between learning from media and individual beliefs and attributions about media. The learner's perceived self-efficacy towards a medium is related to the amount of invested mental energy, but this relationship varies in direction depending on whether the task is viewed as difficult or easy. Visitors' beliefs and attributions about a media may be erroneous and may lead to selecting the medium they will learn least from, or to engaging in processing activities which are inappropriate for the learning task. This suggests the importance of providing guidance in recognizing the complexity or difficulty of interpretive materials presented by media which are perceived as "easy" and providing support and encouragement to use media that visitors may not feel comfortable utilizing.

While much of the research discussed in this paper is consistent with museum studies, and may not appear to necessarily cover new ground, research in the field of educational technology (particularly the model proposed by Salomon) presents a theoretical construct to interpret museum studies and to frame new questions for research such as:

- What are the beliefs and attributions about media in the museum setting?
- How are these beliefs and attributions related to individual differences?
- How do they influence attending behavior and information processing?
- How can perceptions about media be altered in the museum setting?

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