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IDENTIFIERS Amount of Invested Mental Effort

ABSTRACT

This study examined how learning, attitudes, and mental efforts are affected by changing the verbal information presentation format and relationship between the narrator and on-screen character in a junior high school-level science film. Twenty seventh-grade science classes (N=441) were randomly assigned to one of five treatment groups. Each class viewed a 16-minute film about a girl their own age designing and carrying out an experiment with plants. The visual channel remained the same for each group, but the narration was changed to create versions with an adult or teen narrator presenting the information in story or direction format. Altering the age and presentation format of the narrator also changed the relationship between the narrator and on-screen character. Recall and comprehension of information were measured along with self-reported amount of invested mental effort, interest, and confidence in doing plant experiments. Results indicated students learned more when the information was presented in a story format, especially when the narrator was their own age. Females indicated a higher level of interest in the film and confidence in doing plant experiments. A gender narrator "age" interaction for amount of invested mental effort was observed. Various ideas are advanced for explaining posttest results and survey data, including the effects of peer role models and dual code information processing. Implications for future instructional film research are discussed. Four tables and graphs are appended. (Contains 11 references.) (Author)

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Varying the Narration Presentation Format and On-Screen Character-Narrator Relationship in an Instructional Science Film

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Greg Sherman

Abstract

The purpose of this study was to examine how learning, attitudes, and mental effort are affected by changing the verbal information presentation format and relationship between the narrator and on-screen character in a junior high school-level science film. Twenty seventh-grade science classes (N=441) were randomly assigned to one of five treatment groups. Each class viewed a 16-minute film about a girl their own age designing and carrying out an experiment with plants. The visual channel remained the same for each group, but the narration was changed to create versions with an adult or teen narrator presenting the information in story or direction format. Altering the age and presentation format of the narrator also changed the relationship between the narrator and on-screen character. Recall and comprehension of information was measured along with self-reported amount of invested mental effort, interest, and confidence in doing plant experiments. Results indicated students learned more when the information was presented in story format, especially when the narrator was their own age. Females indicated a higher level of interest in the film and confidence in doing plant experiments. A gender by narrator "age" interaction for amount of invested mental effort was also observed. Various ideas are advanced for explaining posttest results and survey data, including the effects of peer role models and dual-code information processing. Implications for future instructional film research are discussed.

Introduction

Films and videotaped instructional programs serve many purposes in junior and senior high school science classes. Introducing new material, explicitly teaching scientific concepts and knowledge, reviewing important ideas, reinforcing concepts discovered, and presenting data to be analyzed as part of a scientific investigation are just some of the ways video and film are utilized in the classroom. Virtually all secondary education science classrooms have access to at least one television and VCR, and most science teachers regularly use videotaped science programs (Corporation for Public Broadcasting, 1984). As the number of preexisting science films become available in the more affordable VHS format, many teachers are finding it easier to integrate a wider variety of videotaped programs into their curriculum.

Although the use of televised programs in secondary education science classrooms is common, researchers are still unclear as to exactly what kinds of production variables significantly contribute to learning from instructional television (Mielke, 1983). Many instructional film variables have been experimented with in the past, but too few studies have measured the effects of altering production variables on learning. Since television is already being used extensively in many classrooms, and the acquisition of skills, knowledge, and attitudes can be facilitated by a well-designed and produced video presentation, a more comprehensive understanding of specific factors affecting how and why students learn from an instructional video program is in needed (Kozma, 1986).

The effects of manipulating an important production variable on learning from an instructional film was the primary focus of this current study. Since most of the information to be learned by the viewers of instructional films is explicitly stated in the narration, it is important to investigate factors that affect how the narrated information is studied and learned. This experimental study was conducted to determine if varying the narration presentation format as well as the narrator and central on-screen character (OSC) relationship in a junior high school-level science film had an effect on achievement, amount of invested mental effort (AIME), and attitude.

The different narration presentation formats and narrator-OSC relationships were obtained by altering the audio channel of a commercially produced science film. The film was chosen because it is a key film in a popular series of films used in junior high science classes, and because the film had only one on-screen character who appeared to be the same age as the intended audience. The 16 minute film focused on a teenage girl designing and carrying out an experiment to determine the effects of different colors of light on plant growth.

To create the five experimental versions, the same general text of the narration was used, but the narrator age and person "voice" (first, second, or third person) combination was different for each version. The following is an example of a line of narration text that changed for each version:

First person voice: "When **I** select a procedure for measuring a factor in **my** experiment, here height and leaf count, **I** am making an operational definition."

Second person voice: "When **you** select a procedure for measuring a factor in **your** experiment, here height and leaf count, **you** are making an operational definition."

Third person voice: "When **Sarah** selects a procedure for measuring a factor in **her** experiment, here height and leaf count, **she** is making an operational definition."

The different relationships between the narrator and OSC as well as the different narration presentation formats can be summarized as follows:

Film Version: Narrator Age/Voice	Narrator-OSC Relationship	Narration Presentation Format
Teen Narrator First Person (TN1P)	Same	Story
Teen Narrator Second Person (TN2P)	Probably the same	Directions
Teen Narrator Third Person (TN3P)	Different	Story
Adult Narrator Second Person (AN2P)	Probably different	Directions
Adult Narrator Third Person (AN3P)	Different	Story

Three types of depended variables were measured. Learning the information was the primary dependent variable. Subjects responded to multiple choice and constructed response items measuring the recall and comprehension of general and specific information and procedures. Attitudes were also measured. These items included self-reported measures of interest and confidence in doing tasks similar to the ones presented in the film. The final dependent variable was a self-report on how much mental effort was invested in the act of trying to learn from the instructional film.

Method

Subjects

The students from twenty different 7th grade science classes across three junior high schools were the subjects for this study (N=441). The three schools were from the same school district located in a large southwest metropolitan area and had similar demographic profiles. Since science is a requirement for all 7th grade students, the entire mainstreamed 7th grade population for each school was represented in the sample.

Procedure

Each version of the 16-minute televised film was presented to 4 randomly assigned classes. Before viewing the videotaped film, the teacher for each class read a script indicating that the film would present material covering the scientific method and experimenting with plants. Students were also informed that a posttest covering the information would be administered immediately following the film and that performance on the posttest would be graded for points. The program was shown on a 21-inch color video monitor at the front of each classroom. Immediately following the viewing, students were given an attitude survey followed by a posttest covering the information presented.

Criterion Measures

The posttest consisted of 11 multiple choice and 9 constructed response questions covering the recall of general and specific information, various procedures presented, and information comprehension (reliability=.69). All information tested was presented visually and/or given in the text of the narration.

The attitude survey consisted of questions measuring interest, feelings of confidence toward performing science experiments, and four questions measuring the amount of invested mental effort. These mental effort questions were derived from the questions used by Salomon (1983,

1984) to measure self-reported invested mental effort and included items such as "I tried hard to learn from this video," and "Throughout the video, I concentrated hard on what was said by the narrator." Students responded to all survey items using a four point Likert-type scale with 4 representing "strongly agree" and 1 representing "strongly disagree." Responses to each of the four mental effort questions were added together to provide a maximum 16 point score for self-reported amount of invested mental effort. A reliability test on these four questions yielded a Cronbach alpha of .66.

Design and Data Analysis

This study utilized a posttest-only control group design. The independent variables included:

1. Adult versus teen narrator
2. "Story" versus "directions" narration presentation format
3. Different narrator-OSC relationships
4. Viewer gender

The dependent variables consisted of posttest performance, amount of invested mental effort, interest, and degree of confidence in designing experiments.

Analysis of variance tests using a 5 (version) x 2 (gender) factorial design with subjects nested within classes nested within versions was used to analyze the data among groups for all dependent measures (N=20 for statistical purposes). Single degree of freedom contrasts were used to determine if differences existed between adult and teen versions as well as first, second, and third person versions. Pearson's *r* test of correlation was used to analyze the relationship between posttest performance and amount of invested mental effort, interest, and confidence in performing experiments.

Results

Significant findings for each independent variable follow:

Narrator "Age"

ANOVA results indicate a significant main effect for the 5 versions, $F(4,15)=4.45$, $p<.05$. The means for posttest scores by gender are reported in **Table 1**. ANOVA single degree of freedom contrasts for posttest achievement scores indicate a significant overall difference between the adult versions ($M=11.51$) and teen narrator versions only when the teen narrator first person version is included in the teen narrator group ($M=12.73$), $F(1,15)=7.10$, $p<.05$.

Please insert Table 1 about here.

Comparing posttest scores between subjects viewing the adult and teen narrator versions excluding the teen narrator first person version (a crossed design) did not yield significant differences. Comparing posttest scores for subjects viewing the second person adult and teen narrator versions did not yield significant differences either. When posttest scores for the third person versions were compared, the students viewing the teen narrator version ($M=13.49$) scored significantly higher than students viewing the adult narrator version ($M=11.69$). Figure 1 illustrates posttest differences between the adult and teen narrator second and third person versions.

Please insert Figure 1 about here.

ANOVA results indicate a significant gender by narrator "age" interaction ($p<.001$) for AIME. Contrasts revealed this interaction consisted of higher teen narrator version AIME scores ($\underline{M}=11.46$) than the adult narrator version AIME scores ($\underline{M}=10.82$) reported by females and lower teen narrator version AIME scores ($\underline{M}=10.32$) than adult narrator version AIME scores ($\underline{M}=11.10$) reported by males, $F(1,15)=28.83$, $p<.001$. Figure 2 illustrates this significant interaction. It is interesting to note that all four questions used to determine self-reported amount of invested mental effort displayed the same type of significant differences when analyzed separately.

Please insert Figure 2 about here.

ANOVA results also indicated a version main effect for the survey item "If I had the material, it would be easy for me to design and carry out an experiment even more complicated than the plant experiment." Contrasts revealed the subjects who viewed the teen narrator versions reported a significantly higher level of confidence in being able to do complicated experiments ($\underline{M}=2.41$) than the subjects who viewed the adult narrator versions ($\underline{M}=2.12$), $F(1,15)=11.87$, $p<.01$.

Narration Presentation Format

ANOVA contrasts revealed significant differences in posttest achievement scores for subjects viewing the second person versions ($\underline{M}=11.48$) and third person versions ($\underline{M}=12.59$), $F(1,15)=6.16$, $p<.05$, as well as second person versions versus all the other versions ($p<.05$). Tukey's HSD pairwise comparison test revealed significantly higher ($p<.05$) scores for the teen narrator first and third person versions over both second person versions (See Figure 3).

Please insert Figure 3 about here.

Narration-OSC Relationship

Single degree of freedom contrasts revealed no significant differences between subjects viewing the first and third person teen narrator versions.

Gender

The average posttest score for female subjects was higher than the average posttest score for male subjects. This main effect for gender approached significance, $F(1,15)=3.60$, $p=.077$.

ANOVA results also indicated a significant main effect for gender and AIME, with females reporting a higher amount of invested mental effort ($\underline{M}=11.19$) than males ($\underline{M}=10.6$), $F(1,15)=17.7$, $p<.001$.

A gender main effect for the survey item "This video program was interesting" was determined by ANOVA, with females indicating a significantly higher level of interest in the film ($\underline{M}=2.4$) than males ($\underline{M}=2.2$), $F(1,15)=4.33$, $p<.05$. Females also indicated a higher level of agreement with the statement "I would like to do plant experiments in science class," with a mean score of 2.75. The mean score reported by males for this survey item was 2.43, indicating a highly significant difference, $F(1,15)=8.91$, $p<.01$.

Pearson's r test for correlation indicated there were significant correlations between posttest performance and reported amount of invested mental effort, $r=.24$, $p<.01$, and between posttest performance and interest, $r=.14$, $p<.01$. Confidence in designing more complicated experiments and posttest performance correlated significantly as well, $r=.26$, $p<.01$.

The major findings in this study are summarized in Table 2.

Please insert Table 2 about here.

Discussion

The most important finding in this study was the difference in posttest achievement due to narration presentation format. Junior high students recalled and comprehended more information when it was presented in story format, particularly when the narrator was close to their own age. These results might be explained in light of the way both audio and visual channels of information are believed to be processed, as well as the influence of peer role models.

Like most instructional films, the program used in this study presented information in both the audio and visual channels. These channels correspond to the verbal and visual stimuli represented in the integrated dual-coding model of learning (Paivio, 1986). Even though the information presented in all five versions was essentially the same, the visual images corresponding to the information may have meant something different to the viewers depending on the version.

In the first and third person versions, the narrator described what the central character was doing. The narrator was telling her story. In the second person versions, the visual images may have been perceived as examples for the information presented. The narrator never acknowledges the OSC, consequently the viewers may have perceived her role as simply one of providing examples for the information being presented in the narration. If this were the case, the viewers may have been perceiving the verbal and visual stimuli more separately in the second person versions than the other versions. They may have been more conscious of the differences in information presented in the verbal and visual modes, and they may have had a more difficult time processing both channels of information.

Baggett (1984) and others have described the importance of presenting visual and auditory information simultaneously for the effective recall of information presented in instructional films. It is possible that the information presented in the second person versions was not processed at exactly the same time as the other versions since the viewers may have been mentally switching between information and examples. Baggett and Ehrenfeucht (1983) determined that, although more processing time is allowed when visual and verbal stimuli in a film are presented separately, the most effective recall strategy is to present the information simultaneously. These results may be explained in light of the integrated dual-coding model approach to information storage and recall. It is conceivable that, when verbal and visual stimuli are presented as a story, the learner comprehends both channels of information at exactly the same time, thus aiding in the development of mental connections between the visual and verbal stimuli. This idea is consistent with the findings of Mayer and Anderson (1991). Although the mechanisms underlying the integrated dual-coding model are not clearly understood, it is reasonable to assume that a difference in the perceived relationship between the verbal and visual stimuli would result in different types and amounts of mental connections established.

Although quite speculative, it seems natural that the ideas and ramifications of Paivio's integrated dual-coding model approach should be applied to instructional films and instructional television since the presentation of visual and verbal stimuli are the modus operandi for television and film media.

Higher posttest scores for the teen first and third person versions as well as reported higher levels of confidence in performing difficult experiments after viewing the teen narrator version. might be explained by the effectiveness of same-age role modeling by the teen narrator. Role model research has indicated that adolescents in particular respond positively to the use of peer role models in academic settings.

Since the narrator and OSC were both female, the higher levels of interest and AIME reported by female viewers are not surprising. Beyard-Tyler and Sullivan (1980) demonstrated that seventh grade students prefer stories in which the protagonist is their same gender. It is reasonable to assume that the females in this study preferred the female protagonist, conversely the males might have preferred a male narrator and/or OSC. Even though research indicates lower confidence and interest in science reported by females at this grade level (Linn and Hyde, 1989), females in this study reported significantly higher levels of interest in this science-content film. These results illustrate the potential for using media to help promote higher levels of science interest in females.

The significant correlation between the amount of invested mental effort and information recall and comprehension supports the work Salomon and others have done to determine how hard people try to learn from various media and how much they actually do learn. The narrator "age" by gender for amount of invested mental effort interaction was an unexpected occurrence. It is possible that the males felt the credibility of the adult narrator was higher than that of the teen narrator so they concentrated harder on what was going on in the film and found the information easier to understand. In any case, the gender main effect and interaction for amount of invested mental effort illustrate the need to look at other production factors involved in connecting the presentation content with the audience.

The results from this study indicate that learning, amount of invested mental effort, interest and confidence are affected by simple changes in the presentation of narrated information in a junior high school-level science film. Many questions were raised as a result of this study. Future research in this area might include determining whether information presented in first or third person voice really is interpreted as more of a story format than second person voice. It would also be interesting to see how the results might differ if a male narrator and OSC were used in a similar film. It could also prove important to determine if different presentation formats affect the recall and comprehension of information presented only in the visual channel.

Since the use of video-taped films are widespread in science education, more research dealing with film and video information presentation variables is needed. To ensure the highest degrees of effectiveness, efforts should be made to apply current research findings to the development of new instructional films.

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Table 1.

Mean Posttest Scores by Gender

Narrator		Females	Males	Total
Teen				
	First Person	13.56 (2.61)	12.98 (3.43)	13.27 (3.04)
	Second Person	10.98 (3.60)	11.98 (3.74)	11.42 (3.67)
	Third Person	14.25 (3.24)	12.71 (3.95)	13.49 (3.66)
Adult				
	Second Person	11.95 (3.08)	11.23 (4.02)	11.53 (3.66)
	Third Person	12.79 (3.46)	10.64 (3.73)	11.69 (3.74)
Total		12.57 (3.42)	11.84 (3.85)	12.20 (3.66)

Note. Total N=441 with 35-53 per cell.
Standard Deviations in parentheses.
Maximum posttest score = 20.

Table 2.

Summary of Results

Independent Variable	Results
Narrator "Age"	Students viewing the third person versions recalled and comprehended more content when the narrator was their own age. Students were more confident they could do more difficult experiments on their own when the narrator was their own age. Females reported higher AIME for the teen narrator versions, while males reported higher AIME for the adult narrator versions.
Narration Presentation Format	Students recalled and comprehended more content when the narration was presented in "story" format (first or third person).
Gender Differences	Females reported higher AIME than males. Females were more interested than the males in the film. Females were more interested than males in doing experiments in class similar to the one demonstrated in the film.

Figure 1. Mean Posttest Scores by Narrator "Age"

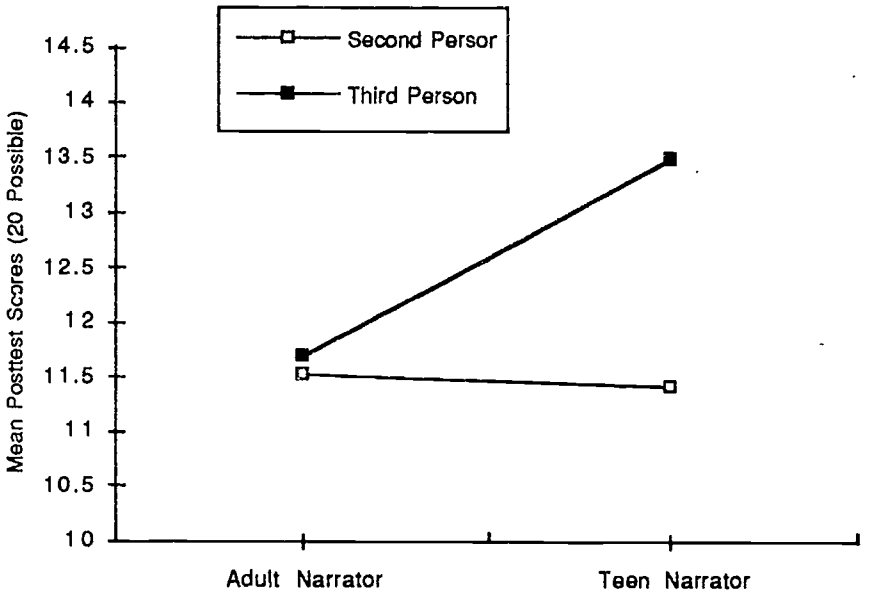

Second Persor
Third Person
Mean Posttest Scores (20 Possible)
14.5
14
13.5
13
12.5
12
11.5
11
10.5
10
Adult Narrator
Teen Narrator

Figure 2. Narrator "Age" by Gender Interaction for AIME

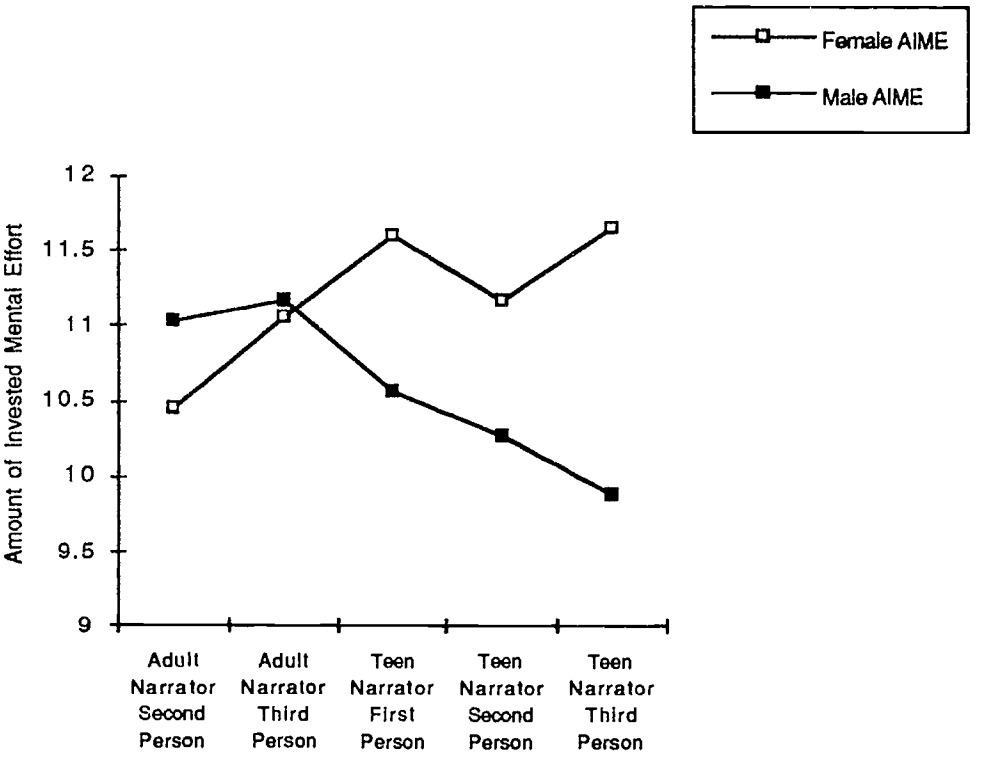
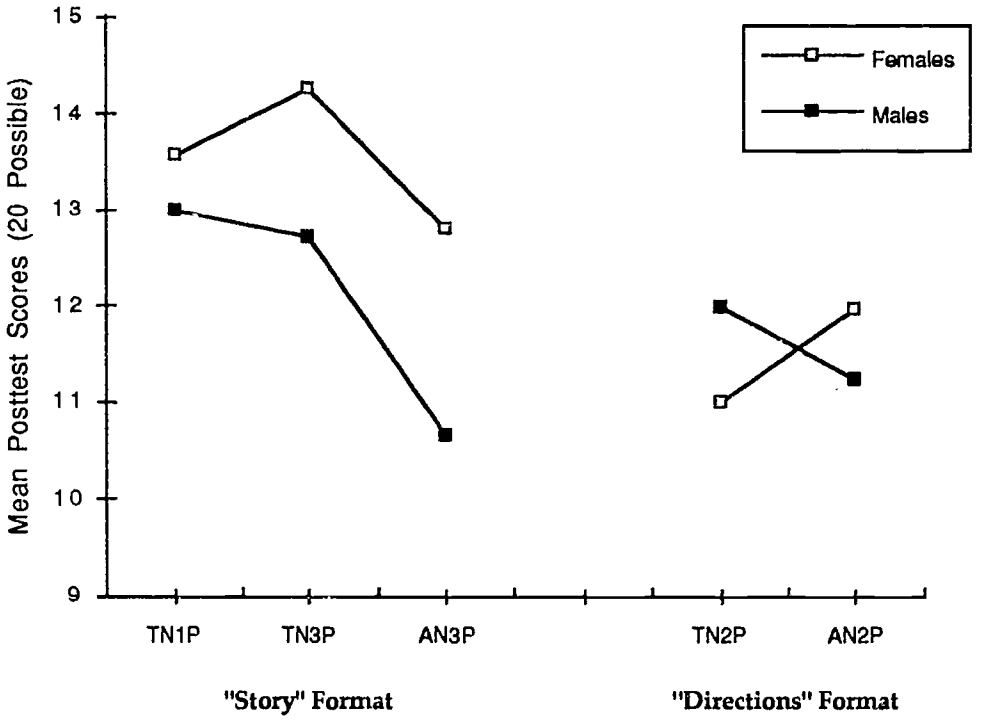

Female AIME
Male AIME
Amount of Invested Mental Effort
12
11.5
11
10.5
10
9.5
9
Adult Narrator Second Person
Adult Narrator Third Person
Teen Narrator First Person
Teen Narrator Second Person
Teen Narrator Third Person

Figure 3. Mean Posttest scores by Narrator Presentation Format.


15
14
13
12
11
10
9
Mean Posttest Scores (20 Possible)
Females
Males
TN1P
TN3P
AN3P
TN2P
AN2P
"Story" Format
"Directions" Format