How Genre Choices Effect Learning in a Digital Environment

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ABSTRACT

A growing body of research supports the claim that media choices make little difference in a student's ability to learn material. This paper defines the term, "genre," relative to instructional materials and presents quantitative studies, conducted between 1994 and 2000 that indicate genre choices may impact learning. Media choices matter to the extent they permit or preclude appropriate genres. To effectively design digital instructional material, we submit that educators should begin by identify the critical genres and select appropriate media to deliver them.

INTRODUCTION

There is a growing body of research within engineering education that supports the statement: media choices seem to make little difference in a student's ability to learn material. Among the research supporting this claim we note the works of Wallace and Mutooni [1], Hailey and Hailey [2, 3], Dutton, Dutton and Perry [4], Henson, Fridley, et al. [5], Nguyen and Paschal [6], Foertsch, Moses, et al. [7], and Haag and Palais [8]. Investigations of the performance of non-engineering students also support this claim. The works of Clark [9, 10] and Coppola and Myre [11] represent only a small percentage of the community that has examined the effects of digital media on learning and found media choices make little difference.

On the other hand, in 2001, Hailey, Grant-Davie and Hult published the article, "Distance Education Horror Stories Worthy of Halloween," that seems to imply completely different findings [12]. In this article, the authors argue that they found that Internet-based education with could be "unpredictable and explosive. A few troublesome online students may stage vitriolic and embarrassing attacks that can sometimes threaten a teacher's career." Based on an examination of more than 400 online courses taught between 1995–2001 in the Utah State University English department, the article argues that while online content can be effective, online classes are unlike face-to-face classes, and they can be dangerous to teachers who attempt to teach them naively. Other investigators have also claimed media choices are important, for example, Robert Kozma [13] and Robert Reiser [14].

Although this might seem to contradict researchers who maintain the "media make no difference" posture, we argue that there might be a different and more important issue. The problems that arise in the distance education classes we have examined come not only out of the media but also out of the genres the media permit. For example, an essay posted on the Internet will not have the same characteristics as a traditional lecture. Nor, according to our research, is it always an acceptable substitute. More subtly, streaming video of a "talking head" (e.g., those postage-stamp-sized news broadcasters on the Internet) may not be a viable substitute for a comprehensive "chalk talk" (traditional classroom presentation using black- or whiteboards). While the "talking head" and "chalk talk" are both lectures, they are nonetheless different genres with different pedagogical values.

In this paper, we will present definitions of media and genre. We will then present results of several studies that support the claim that genre choices impact learning. Media choices matter to the extent they permit or preclude appropriate genres. The studies were conducted in classes taught within the College of Engineering at Utah State University during the period of 1994–2000.

DEFINING TERMS: MEDIA AND GENRE

Media

The term "medium" includes everything from vocalizations, oil paint on canvas, ink on paper, or even a Volkswagen bus with a peace sign painted on it. Richard Clark [10] points out in "Reconsidering Research on Learning from Media," that media "are mere vehicles that deliver instruction but do not influence achievement any more than a truck delivering groceries causes change in our nutrition." Clark asserts that any level of learning in one medium can be replicated in a different medium, the only difference being cost. Ultimately, his point is that it is not medium but rather medium's content that influences learning.

We argue that in designing effective learning experiences, content is important. However, the structures used to present the content in combination with expectations of the reader and author are critical. In this paper, we view structure and expectation as elements of "genre." The term "genre" can be used to better understand the nature of instruction in both digital and traditional environments. Although genre theorists do not have a universal definition for "genre," in "Genre as a Social Action," Carolyn Miller [15] posits the argument that genres are both formal and situational. We will begin with this description to create an understanding of the term "genre" and eventually to create a working definition.

"Formal"—Form in Genre

By "form" we mean the physical and conceptual structures of the information. We can see how forms vary by looking at three very similar genres: guide, manual, and textbook. A guide will have concise segments of information written in terse language. The information will typically be segmented and configured for quick access (e.g., style guide). A manual is a written collection of longer informative segments, designed for quick access, but to relatively complex solutions. Depending on how the author elects to write them, consecutive sections of a manual need have no direct relationship. A textbook is also a written collection of informative segments, but the segments typically include self-testing components (homework, quizzes, etc.) and are usually segmented so that information from subsequent segments build on information from previous segments. Structurally, all three genres provide information in segmented format, but the segments and their relationships are different.

"Situational"—Genre Purpose and Use

By purpose we mean, for what reason was the work created? Television news and documentaries are designed to inform and entertain. Although manuals are often used as textbooks and textbooks are often used for independent learning, this describes them being used in a manner different from their publishers' original intents. Textbook users are usually led by teachers who help them combine the information into a greater and more conceptual understanding of a global topic (e.g., heat transfer, quantum physics, history). Manual users will usually work independently, looking a topic up in the index, then reading and immediately applying the information they find in the relevant passages.

In short, a textbook can be contrasted from a manual in part by its purpose (educate broad as opposed to immediate concepts), its structure (usually containing homework problems, solutions and similar educational tools designed to support a class), and the manner in which it is designed to be used (students led by teachers through the materials).

Genre Definition

Given the above, we could define "genre" as "the name given to a segment of communication identified by its structure and by the relationship between author and reader expectations as they generate and/or use the segment." Within this definition, if a teacher is presenting a body of knowledge to a classroom full of students by writing segments of that knowledge on a black- or whiteboard, and if the students are (hopefully) paying careful attention, writing much of the information down, and asking questions for clarification, we name this genre a "traditional chalk talk." On the other hand, we have heard scholars describe the whole process of education as a genre, and given the above definition, they are right. Following the above definition, we could define an entire program as a genre (e.g., mechanical engineering as opposed to technical communications).

Using the term that broadly makes it impossible to use it as a meaningful tool, so to permit us to generate a more precise tool, we add the following caveat: "…such that if subdivided, the component parts no longer reflect the segment's nature." Our new definition, then, reads like this:

> The genre of a segment of communication may be identified by its structure and on the relationship between author and reader expectations as they generate and/or use the segment, such that if subdivided, the component parts no longer reflect the segment's nature.

Given our original definition and the additional caveat we created, "lecture" is not a genre because if we break the idea behind "lecture" into component parts, we get different types of lectures (e.g., traditional chalk talk, digital slide show presentation, demonstration, parental scolding, or religious sermon). If we break chalk talk, slide show presentation, demonstration, parental scolding, and sermon down, we find that their component parts no longer maintain the character of the genres from which they come. For example, in a slide presentation (perhaps developed using PowerPoint), the "slide" by itself can never be construed as a "lecture." If we subdivide "chalk talk" we find component parts such as board work, student questions, student notes, etc. These component parts add up to "chalk talk," but independently, none of them can be construed as a sub-species of chalk talk.

For the purposes of this study, and using the above definition, we identify "lecture" as a class of genres and "traditional chalk talk" as a genre. A class of genres is loosely defined as a collection of genres with identifiable commonalities. The class of genres called lectures have a common purpose, instruction, and have the author controlling the flow of information. With the class of genres, each genre will have a different form, each will place specific and different expectations on the speaker (author), each will place specific and different expectations on the audience (reader), *and* when broken down, the individual components lose the characteristics we affix to "lecture."

One way to illustrate our point is to examine examples from a class of genres familiar to many people, "mysteries." Shown in Table 1 are several examples of genres in the class of genres called "mystery."

Class of Genres: Mysteries

Genre	Example
Hard-boiled Detective	The Maltese Falcon by Dashiell Hammett
Cop-bonding Stories	Rising Son by Michael Crichton
Classical Detective	The ABC Murders by Agatha Christie
Fantasy Mysteries	Black House by Stephen King and Peter Straub
Clockwork Mysteries	The Firm by John Grisham

Table 1. Examples of various genres in the class of genres entitled "Mysteries."

To further illustrate our point, we have listed in Table 2 several examples of genres in the class of genres called "lecture" and one example of a genre in the class of genres called "interactive discussion." Note that in Table 2 it becomes clear that the communication medium is part of the make-up of a genre. It influences the expectations, as illustrated in the differences between a "traditional slide show" and a "digital slide show."

While designing a course, an instructor is not limited to a single genre and often selects a combination of genres and/or classes of genres. For some topics, a PowerPoint presentation may be the most effective way to communicate information, for other topics, a collaborative learning experience may be appropriate, and in other instances, selecting from the class of genres called "experiment" may be appropriate.

In conclusion, naming the genre, saying "we created a traditional thermodynamics chalk talk," or "we created a digital thermodynamics slide show," provides us with useful information. On the other hand, saying "we created a multimedia module with video and sound" describes a collection of containers and is no more descriptive than saying "we created a chapter with alphanumeric text and photos."

Learning Objectives, Program Outcomes and Genres

Before an instructor selects appropriate genres and media to deliver the genres, he or she must be concerned with the learning objectives and program outcomes associated with the course. By learning objectives, we mean specific intellectual skills the students should achieve by the conclusion of the course. For example, in a Thermodynamics course, one learning objective might be: "Analyze

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Class of Genres: *Lecture*

Genre		
Genre: Chalk Talk	**Structure**	Author is information provider, using a chalk or white board to record key concepts, e.g., definitions, formulas, figures. Information is presented linearly, concept by concept.
	Author Expectation	Readers take notes. The act of note taking is viewed as part of the learning process. Readers will ask questions to clarify material but will not dominate class time.
	Reader Expectation	Important information is presented, one concept at a time. Author controls interactivity so all information can be provided.
Genre: Traditional Slide Show	**Structure**	Author is information provider, using slides, e.g. PowerPoint slides, to record key concepts. Multiple concepts can be presented in parallel on a slide in contrast with a chalk talk.
	Author Expectation	Readers take limited notes. Multiple concepts on a slide facilitate understanding of the "big picture." Readers will ask questions to clarify material
	Reader Expectation	Multiple points/formulas/figures can be presented at one time. Copies of slides available. Author controls interactivity so all information can be provided.
Genre: Digital Slide Show	**Structure**	Author is information provider, using electronic pages to record key concepts. Multiple concepts can be presented in parallel on a slide in contrast with a chalk talk.
	Author Expectation	Readers take limited notes. Multiple concepts on a slide facilitate understanding of the "big picture." Readers will use electronic navigation (or e-mail) to clarify material.
	Reader Expectation	Multiple points/formulas/figures can be presented at one time. Key pages can be printed. Author controls nature of navigation, reader controls pace of presentation.
Genre: Traditional Monologue	**Structure**	Author is information provider by speaking to readers without the use of slides or board work.
	Author Expectation	Readers are responsible for determining key concepts to put in notes. Readers will ask questions to clarify material
	Reader Expectation	Key concepts are reinforced verbally. Author controls interactivity so all information can be provided.

Class of Genres: *Interactive Discussion*

Genre		
Genre: Traditional Collaborative Learning	**Structure**	Author shares authority with readers. Author designs assignments that permit groups of readers to take responsibility for their learning through collaboration, building up their current knowledge, to acquire new understanding.
	Author Expectation	Understanding comes from readers' interactions. Readers will work effectively in teams so that each reader actively participates in the learning experience.
	Reader Expectation	Author does not control the experience. Well-designed assignment appropriate for collaborative learning and other readers willing to be equal partners in the process.

Table 2. Illustration describing several genres and classes of genres used for instruction.

basic thermodynamic processes for closed systems." Instructors must also be aware of how a course's learning objectives support the program outcomes associated with a course, where program outcomes are defined using ABET engineering criteria.

Anthony Tripp [16], facilitator of over sixty asynchronous courses points out that online course developers often develop courses with technology tools in mind rather than consideration of the learning process. We agree with his premise and want to emphasize that genre and media selection follow only after the instructor understands the learning objectives and program outcomes associated with a course and the pedagogical approach he or she plans to take to achieve the objectives and outcomes.

RELEVANT STUDIES

We have anecdotal evidence and case studies from more than 400 classes in academic and professional environments (e.g., English composition, technical communication, and engineering, water sampling/testing techniques for the EPA, parachute rigging and assembly for DOE), that support our first claim that educators should have a sound understanding of how each genre affects learning when substituting one for the other during the creation of digital instruction. However, qualitative evidence is incomplete until we can provide quantitative support.

Testing Media Differences

Between 1994 and 1997 we developed a digital slide show for safe and appropriate use of machining equipment. The show was made up of more than 1700 pages in 21 chapters or modules and supported a student lab in a sophomore-level Manufacturing Processes course [2, 3]. The instructions were designed to replace 21 presentations using 35mm slides and audiotape (an analog slide show). When students examined the slides and listened to the tape while filling in a worksheet. The digital slide show content was identical to the analog version and students completed identical worksheets. The analog slide show and digital slide show had very similar genre. In both, the reader and author expectations were the same. The only difference was in the structure because of the media differences.

To determine whether media made a difference, we randomly divided a class of 38 students into two groups, one using the Analog Slide Show, the other using the Digital Slide Show. Students saw the same slides, heard the same audio, and filled out identical worksheets. We monitored the students as they worked and noted that individuals from both groups attacked their projects in the same manner, taking a similar amount of time to complete them.

Immediately after completing the presentations, students were quizzed for what they had retained about the safe and appropriate use of machining equipment. The quizzes given to both groups were identical and included ten multiple choice, true/false, and short answer questions. Due to the small sample size, we employed Student's t statistical analysis [17]. After grading the quizzes from the two groups, we found no significant difference between the average test scores of the two groups at a 0.01 level of confidence (see Table 3).

At the time of the study, we concluded media made no difference. We would now conclude that slight changes in genre do not seem to matter.

In a series of follow-on studies done between 1998 and 2000, we continued to examine the effect of genre on learning. A sophomore-level Thermodynamics class of 53 students was randomly divided into two groups of 25 and 28. The material to be covered was use of the property tables. The first group only had access to a Web-based lecture (WebBased1) while the second group received identical content in a traditional environment (AnalogClass). The Web-based lecture consisted of a digital slide show that students could navigate in a sequential fashion. Each page consisted of concise text presenting a concept and a supporting image. In this test the teacher that developed the Web-based material also taught the analog class. In an attempt to duplicate the genre of the Web-based material, the teacher prepared a traditional slide show using overhead transparencies identical to the pages in the digital material. Although the lecture component was not delivered word-for-word identically to the digital text, the instructor tried to follow the script closely.

One difference in the genres of the WebBased 1 slide show and the Analog Class slide show was pace of information retrieval by the students (reader expectations). Students in the WebBased 1 study could control the pace of information presentation. They could navigate backwards to review material they did not clearly understand or "fast" forward to quickly skim over material they understood clearly. Students in the Analog Class were required to acquire information at the instructor's pace. They could ask questions of the instructor if they did not clearly understand material. In an attempt to duplicate the backwards navigation of WebBased1, the instructor tried to respond to questions by simply repeating scripted material again rather than providing an alternative explanation.

At the conclusion of both presentations, students were given identical quizzes. The quizzes consisted of 12 "fill in the blank" questions finding data from the property tables. As in the previous tests, we used Student's t test for our statistical study.

Similar to the results presented in Table 3, we note that the two genres in this study were almost identical and the differences did not significantly effect student performance on a quiz.

Group	Group Size	Standard Deviation	Average Misses	Level of Significance	Conclusions
Analog Slide Show	14	0.751	1.71	0.01 (99%)	Quiz scores **are not** statistically different.
Digital Slide Show	16	0.774	1.68		

Table 3. Statistical comparison of groups given identical genre but different media environments. Testing the proposition that both groups will perform equally on a post-presentation quiz.

Testing Genre Differences

Initially, we inadvertently tested genre differences in the studies presented in references 2 and 3. At the time, we knew some scholars had argued that students learn better if they can be left to explore the topics on their own—"discovery learning." [18]. In a separate test designed to examine this contention, we randomly divided 38 students in a Manufacturing Processes course into two groups, each group was assigned to digital presentations that were formatted differently. The material presented covered an introduction to the operation and programming of the CNC mill. One presentation was formatted like an interactive, learning game, with students given more control over their paths (Digital Game). The module remained within the class of genres entitled "lecture" but the author and reader expectations varied from that of a slide show. The author expected students (readers) to navigate through all sections, but order was unimportant to learning. The reader expected the author to supply a worksheet to assist with navigational choices. Questions on the worksheet represented material in all sections of the Digital Game environment to help eliminate the possibility of overlooked material. Then we created Digital Slide Show-2 by arranging the modules in the Digital Game sequentially and limiting the navigation to forward and backward until the student worked through all material. Students worked their ways through both modules as before, filling out an identical worksheet as they progressed.

Once the students completed the module, they were quizzed for their understanding of the material. The quiz consisted of 18 true/false, multiple choice, and short answer questions and both groups were given the same quiz. Again, because of group size we used a Student's t test. On average, students accessing the Digital Slide Show-2 presentation missed 1.68 questions while the other students missed 3.94 questions on the same test. (See Table 5 for

details.) We determined that the average scores of the two groups were statistically different at 0.01 level of confidence.

Since they were using the same media and identical genres, students in the group accessing Digital Slide Show-2 performed similarly to those of Table 3. In the second test, the students accessing Digital Game did far worse, and for some of them the results were even worse than the averages imply (see Table 6).

These results point to the importance of understanding genre when developing presentation material. Some genres are more effective in communicating certain types of material than others. In this study, we were primary concerned with communicating safe operation of the computer-numerical-controlled mill and the digital slide show genre seems to be better suited for this application.

In another study examining genre differences, we compared student performance in two different sophomore-level thermodynamics classes. The material covered was use of the property tables. One class was given online instruction using the slide show genre, identical to that described in Table 4 (WebBased2), while the other was given face-to-face instruction using a chalk talk genre. The teacher in the traditional class authored the digital material but made no effort to match the genres (ChalkTalk). The same material was covered; however, the teacher delivered an animated lecture, emphasizing important concepts on the board through sketches, formulas and cryptic text. The teacher interacted with the students during the course of the lecture, and adjusted the lecture content to address student questions, typical of most "chalk talks."

The two classes were different in size, one containing 76 (ChalkTalk) students and the other containing 21 students (WebBased2), but an examination of the average final grades in the class indicated that they were statistically identical. The groups were larger so we used a statistical analysis tool called a Z-test [19]. At the conclusion

Group	Group Size	Standard Deviation	Average Misses	Level of Significance	Conclusions
WebBased1	25	1.69	2.04	0.01 (99%)	Quiz scores **are not** statistically different.
AnalogClass	28	1.97	1.61		

Table 4. Statistical comparison of groups given virtually identical genre but different media environments. Testing the proposition that both groups will perform equally on a post–presentation quiz.

Group	Group Size	Standard Deviation	Average Misses	Level of Significance	Conclusions
Digital Slide Show-2	19	0.795	1.684	0.01 (99%)	Quiz scores **are** significantly different.
Digital Game	19	0.736	3.947		

Table 5. Statistical comparison of groups using different genres testing the proposition that both groups will perform equally on a post–presentation quiz.

Group	Average Questions Missed	Average Score (mean)	Fewest Questions Missed	Highest Score	Most Questions Missed	Lowest Score
Digital Slide Show-2	1.68	83%	0	100%	6	66%
Digital Game	3.94	60%	1	95%	17	5%

Table 6. Comparison of best and weakest student performance using game-like and digital-manual modules.

Group	Group Size	Standard Deviation	Average Misses	Level of Significance	Conclusions
WebBased2	21	2.51	3.19	0.01 (99%)	Quiz scores **are** significantly different.
ChalkTalk	76	1.45	1.05		

Table 7. Comparison of student performance with unmatched genres testing the proposition that both groups will perform equally on a post-presentation quiz.

Group	Total Students Scoring 100%	Total Students Failing (below 60%)	Scores Below 50%	Mean	Mode	Median
WebBased2	3 (14%)	6 (28%)	3 (14%)	73%	75%	66%
ChalkTalk	33 (43%)	3 (2%)	0	87%	100%	75%

Table 8. Comparison of best and weakest student performance.

of both presentations, the students were given identical quizzes consisting of 12 questions directed at finding missing data from the property tables. In this study the results of student performance of the two groups were statistically different, implying that genre differences matter (see Tables 7 and 8 for details).

Again, the average differences fail to tell the whole story. The group of 21 students in the WebBased2 section scored 100 percent only 14 percent of the time and scored 50 percent or less 19 percent of the time. Students in the ChalkTalk group scored 100 percent a full 43 percent of the time and scored as low as 50 percent less than 1 percent of the time.

This study reinforces our argument that genre changes can impact learning. In part, because of bandwidth, we were required to substitute a digital slide show lecture, largely text-based essay with images, for the richness of a highly animated instructor delivering a well-prepared "chalk talk." Media matters to the extent that they permit or preclude appropriate genres. The genre choices we make are important, and if the structure of the media precludes those choices, then the media matter.

Genre Choices and Order

Since it was clear that we had given the students in the studies discussed in Table 4 less than complete instruction, the teacher elected to reintroduce the material to both groups of students. The students who received the digital content (WebBased1) now received the analog content (AnalogClass) and vice versa. Recall that both WebBased1 and AnalogClass had very similar genres, with media determining the differences. The content in both genres was identical.

When we retested the students, we discovered that the order in which the genres are presented seemed to matter. The students who viewed the digital slide show after an almost identical, traditional slide show did statistically better on a post test. (See Table 9.)

Similarly, we permitted the students in WebBased2 and ChalkTalk (Table 7) to view the digital or analog materials that they had not yet seen; WebBased2 got to see the lectures and ChalkTalk got to examine the digital materials. For ChalkTalk, reviewing the digital material was strictly voluntary, but all students were retested.

The results are interesting. As in the previous study, students working initially with WebBased2 materials were twice exposed to

Group		Group Size	Standard Deviation	Average Misses	Level of Significance	Conclusions
WebBased1 Then AnalogClass		25	1.69	2.04	0.01 (99%)	Quiz scores **are not** significantly different.
		25	1.24	.96		
AnalogClass Then WebBased1		28	1.97	1.61	0.01 (99%)	Quiz scores **are** significantly different
		28	.62	.36		

Table 9. Comparison of students presented with analog material first compared to students who viewed digital material first, testing the proposition that both groups will perform equally on a post-presentation quiz.

Group		Group Size	Standard Deviation	Average Misses	Level of Significance	Conclusions
WebBased2 First Then ChalkTalk	Test 1	21	2.57	3.19	0.01 (99%)	Quiz scores **are** significantly different.
	Test 2	21	1.24	1.2		
ChalkTalk First Then WebBased2 (volunteers only)	Test 1	9	2.59	4	Group size precludes statistical analysis.	
	Test 2	9	1.85	1.2		
ChalkTalk First (all students)	Test 1	76	1.45	1.05	0.01 (99%)	Quiz scores **are not** significantly different.
	Test 2	76	1.45	1.17		

Table 10. Comparison of students who took analog material first compared to students who took digital material first, testing the proposition that both groups will perform equally on a post-presentation quiz.

the same material, but now in this study the presentations included different genres. The Web-based presentation followed by a traditional chalk talk resulted in improved learning. This is in contrast to the results of the previous study (Table 9), where students accessed two presentations of very similar genre. Their second quiz results showed no improvement. Some of the students (67 total) were only exposed to the chalk talk presentation. They felt no need to improve their grades and elected not to review the Web-based material, but they were tested twice. It appears their average quiz scores did not improve. Those who did review the Web-based material chose to do so because they had largely done badly on their previous quiz and had a great deal of room for improvement. Their overall improvement was 31 percent (see Table 10).

CIRCUMVENTING MEDIA LIMITATIONS

It follows from our studies that genre choices seem important to learning. We argue that if genres are carelessly changed or removed,

they impact learning. Educators should select only instructional media capable of maintaining the integrity of relevant genres.

We have found ourselves selecting a medium and then attempting to adjust genres to meet the medium's needs and have eroded the quality of the instruction. This has sometimes happened with courses delivered over the Internet because of limited bandwidth. One key to effectively converting traditional instruction to digital instruction is to have access to sufficient bandwidth. While it is possible in some cases to stream sound and video over the Internet, resolution is low and results are unpredictable. CD-ROM and DVD are too small to carry more than supplemental educational information. We suggest that distributing portable hard drives to students, however, permits an alternative. External drives, ranging from 10 GB to 150 GB make it possible to provide students with all 48 hours of "chalk talk" typically found in a 16 week course in 640 × 480 or higher resolution video, plus additional hours of demonstration video, 3-D game technologies, 3-D animation, interactive testing, and record keeping. In this environment, the Internet is used for interactive communication and for file transfer,

while the drives are used for distributing high bandwidth content. In recent months, removable hard drives have become available for less than one hundred dollars, making them a cost effective alternative.

CONCLUSIONS FROM OUR STUDIES

Our preliminary work suggests genre choices can influence learning. At a minimum, our studies indicate there is considerable room for additional research in the broad areas of genre and media applied to instructional development in engineering education. In the cases we have examined, if genres are carelessly changed or removed, they impact learning. As we did in one of our studies, instructional developers frequently select a medium and then attempt to adjust genres to meet the medium's needs. We feel that this is a seriously misguided approach. Instead, we recommend that instructional designers identify the critical genres and select media to support them.

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