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## RCR Online Course: Build an Online Course to Augment RCR Training Using Evidenced-Based Learning Theory

Mary Ratliff, Nicole Masen, M.S.Ed., Stephen Sullivan, Michael F. Fleming, M.D., and Paula Carney, Ph.D.

Northwestern University, Chicago, Illinois, USA

### Abstract

This article demonstrates how to apply evidenced-based instructional design principles to develop a supplemental, online Responsible Conduct of Research (RCR) course. The supplemental RCR course may serve to appropriately augment the National Institutes of Health (NIH) required RCR training. The way to ensure that an online RCR course is effective is to incorporate evidence-based learning theories into the development of the course content. This article specifically demonstrates application of Bloom's taxonomy and Gagne's Nine Instructional Events to a research misconduct course. At the conclusion, the reader will be able to apply evidence-based learning theories to the development of any online course.

### Keywords

online; asynchronous; Responsible Conduct of Research training; Bloom's taxonomy; Gagne's Instructional Events; evidenced-based learning methodologies

## INTRODUCTION

The National Institutes of Health recently updated the Instruction in the Responsible Conduct of Research (RCR) guidelines to better define the required curriculum for RCR programs. The guideline clearly identifies the content areas to be covered in RCR courses and comments on the mode, duration and frequency of training (National Institutes of Health, 2009). While the guideline prescribes "substantial face-to-face discussions" as the primary format for RCR training, it also indicates that on-line courses can be a valuable tool to augment RCR training.

Supplemental on-line RCR courses may assist instruction by providing basic information and testing learners on application of the information prior to face-to-face discussions. These courses can be particularly effective if they incorporate evidence-based instructional design principles such as Bloom's taxonomy and Robert Gagne's conditions of learning theory (Patel et al., 2008). These evidence-based frameworks suggest objective development and instructional design incorporate key principles for effective learning. Bloom's Taxonomy and Gagne's instructional design framework have been used to develop instruction in medical education including bioinformatics workshops (Patel et al., 2008; Shachak, Ophir and Rubin, 2005) and clinical instruction (Al-Eraky, 2012). Bloom's taxonomy and Gagne's

framework for effective learning can be applied to asynchronous online RCR curriculum topics such as research misconduct.

## BACKGROUND

Throughout the last century, a great deal of work has been done by cognitive psychologists to develop and test theories about how people learn. Bloom's taxonomy and Gagne's conditions of learning are two theories that have influenced the evidence-based design of online courses (Chyung and Stepich, 2003; Nelson, 2000). Bloom's revised taxonomy and Gagne's instructional events are frequently used to design instruction, including online courses in various disciplines (Chyung and Stepich, 2003). These frameworks are commonly used in online instructional design and instructional design software tools often map to them. This paper will describe how the models are applied to an online course in research misconduct.

In 1956, Benjamin Bloom developed "Bloom's Taxonomy" which can be applied in the development of an online research misconduct course. Bloom's taxonomy delineates learning outcomes into cognitive, affective and psychomotor domains. The cognitive domain, which comprises intellectual tasks, was further classified into a model that organizes thinking into six tiers of complexity. These levels were further adapted by one of Bloom's students in the 1990s so his original nouns were expressed as measurable verbs and reflected changing instructional paradigms (Chyung and Stepich, 2003; Patel et al., 2008). The revised Bloom's taxonomy (Fig. 1) reflects the range in learning from remembering facts through creating new ideas. Verbs associated with each of the three domains provide the measureable outcome of learning objectives (Krathwohl, 2002).

In order to practically apply this framework to research misconduct, the course designer first considers the purpose and outcomes of online supplemental RCR training in research misconduct. The purpose of the training in this case is to deliver knowledge about research misconduct in advance of face-to-face discussions. Bloom's taxonomy suggests that obtaining knowledge falls within the cognitive domain:

The cognitive domain (Bloom, 1956) involves knowledge and the development of intellectual skills. This includes the recall or recognition of specific facts, procedural patterns, and concepts that serve in the development of intellectual abilities and skills. (Clark, 2010).

Although outcomes based curriculum design is largely preferred in medical education, at the most basic levels of cognition as demonstrated in this course, there is little difference between the models (Prideaux, 2003). With the cognitive domain established, the course designer can then determine the objectives expected of the learner at the conclusion of the course. The objectives crafted for the online Research Misconduct course included the following:

1. Define four types of research misconduct.
2. Identify roles that are involved in research misconduct.
3. Recognize and report research misconduct.
4. Explain the process of the Office for Research Integrity (ORI) role in research misconduct.
5. Describe the risks associated with research misconduct.

The course begins with the simplest objectives or outcomes and then moves to the more complex. Initially the objectives ask the learner to be able to "define" content. The verb,

according to Bloom's taxonomy, suggests the most basic level of the cognitive domain, creating. As the course continues, the objectives reflect the expectation that the learner is building on his or her initial knowledge to be able to "identify," "recognize," "explain," and "describe" objectives moving into the next level of cognitive domain, "evaluating." Applying Bloom's taxonomy to the objectives for an online research misconduct course ensures that the objectives accurately reflect both the type of learning and the level of mastery expected of the learner in preparation for face-to-face discussions about research misconduct.

Another influential cognitive psychologist who provided a framework for evidence-based instructional design was Robert Gagne. Gagne studied the cognitive processes associated with learning and identified nine instructional events which can be applied to online research misconduct training to enhance learning. The nine instructional events are based on a cognitive information-processing model which suggests "that information is presumed to undergo a series of transformations as it passes through the stages of memory" (Driscoll, 2000). Gagne incorporates stimulation from the external environment, storage in short and long-term memory, retrieval, and feedback processes in his model (Gagne, 1977). According to Gagne, learning takes place only when these processes are activated and the goal of instruction should be to facilitate this activation (Driscoll, 2000). Table 1 demonstrates how the instructional events are applied in the online research misconduct course. Gagne's nine instructional events framework may be applied to this course and other online courses to ensure the learner processes and retains the course content to aid in face-to-face discussions.

## APPLICATION OF GAGNE'S FIRST INSTRUCTIONAL EVENT

The first instructional event Gagne identifies corresponds to motivation of the learner or expectancy which he calls *activating motivation* or *gaining attention*. For the research misconduct course, Gagne's instructional event is applied at the outset of the course using a combination of pictures and audio. The audio quotes Dr. Martin Luther King Jr., well-known for his commitment to justice and equality, setting the tone for the course. The quote from Dr. King, "the time is always right to do what is right," is followed by a question meant to pique the learner's interest in the remaining course content, "but what happens if you see something that could negatively impact [clinical] trial results?" Finally, the photo of the stethoscope used on the screen (Fig. 2) is symbolic of the medical profession and is intended to assist learners in connecting the importance of research integrity as it impacts human health. The audio and visual elements used at the outset of the online research misconduct course motivate the learner, prepare the learner to gain more from the course content and meet the criteria for Gagne's first instructional event, gain attention.

## APPLICATION OF GAGNE'S SECOND INSTRUCTIONAL EVENT

The second instructional event in Gagne's framework is *inform the learner of the objective*. By informing the learner of the objectives for the course, Gagne's framework suggests the "primary effect of providing learners with an expectancy of the learning outcome is to enable them to match their own performances with a class of performance they expect to be 'correct.' Thus the reinforcement in the form of informative feedback, confirms the learner's expectancy" (Gagne, 1977). The online research misconduct course applies the instructional event at the beginning of the course (Fig. 3) through a slide stating the learning objectives. The information sets learner expectations by providing the learner with the purpose of the course and states at the conclusion what they can expect to achieve from participation in the program. Stating the objectives for the program prior to presenting course content during the online research misconduct course demonstrates implementation of Gagne's instructional event and allows the learner to move into the apprehending phase of learning.

## APPLICATION OF GAGNE'S THIRD INSTRUCTIONAL EVENT

Gagne's third instructional event is to *stimulate recall of prior knowledge* for the learner. During the course, the designer aids the learner in recalling information he or she may already know about a given objective. This may build on something previously presented within this course or be from another source or experience. Gagne states, "If a new intellectual skill is being learned, subordinate skills must be retrieved so that they can be re-coded as parts of the new skill" (Gagne, 1977). In the online research misconduct course, the designer stimulates recall of prior learning through pretests at the outset of each objective. Two examples of pretests found in the research misconduct course are "Pick It" and "Drag It."

In the "Pick It" exercise (Fig. 4), the designer asks the learner to complete a statement defining the term "red flag." If the learner is familiar with the red flag as a symbol of warning or potential danger, recalling that fact may assist them as they learn about looking for "red flags" in research misconduct. A second example (Fig. 5) appears in the second objective in the exercise "Drag It." Prior to presenting the material, the designer asks the learner to categorize (or drag from one column to another) various research roles identifying those that contribute to research. The results of the pre-test aid the learner in recalling who may be involved in research misconduct.

The effect of the pre-test for the learner should be to confirm mastery of the material from a previous source or to motivate the learner to gain the knowledge offered when the stimulus is presented in the next step. The pre-test for each objective may also allow the learner to be more efficient with their time. For example, if the learner already has mastery of a particular objective based on the pre-test, then he or she may consider moving on to the next objective. In this way the learner may guide his or her own learning experience (Fox, 2003). Through the pre-test at the beginning of each objective, the designer stimulates the learner to recall prior knowledge about research misconduct. The learner may now move to the next event in Gagne's framework, present the stimulus.

## APPLICATION OF GAGNE'S FOURTH INSTRUCTIONAL EVENT

With the foundation in place, the learner is ready to receive new information. *Present the stimulus* is the fourth instructional event. Presenting the stimulus or material in an online educational course may involve a variety of media including text, video, sound and images. The goals of instruction should be considered in determining how the material is presented and should influence the designer's approach. However, across all instructional goals, "the stimulus presentation should emphasize distinctive features or essential elements of the desired outcome in order to facilitate the process of pattern recognition and selective perception" (Driscoll, 2000). The material for the research misconduct course is considered to be verbal information. Verbal information, according to Gagne, consists of facts and patterns derived from the facts which the learner can communicate at the conclusion of the presentation (Gagne, 1977). Presenting the stimulus for verbal information outcomes may involve a combination of text, images, and verbal information to aid the learner in encoding the material depending on the complexity of the objective.

For all objectives, simple and complex, Gagne's conditions for learning verbal information suggest "it is important to present information in meaningful chunks so as not to overload the learner's processing system" (Driscoll, 2000). In the research misconduct course, one of the simpler objectives is to recognize research misconduct (Fig. 6). To present the material for this objective, the designer divides the material into logical, meaningful chunks. First, the designer discusses the definition of research misconduct red flags. Second, the designer provides examples of the three most common research misconduct "red flags." By

presenting the definition and then providing concrete examples, the designer of the research misconduct course presents the stimulus and aids the learner in encoding the information for storage in memory.

With more complicated material, like a process (Fig. 7), the designer may consider developing images to aid in the verbal presentation of the information. To discuss the research misconduct review process, the designer uses a process flow to organize the material (Fig. 7). The material can be easily presented and recalled; as Gagne suggests, “The key to remembering bodies of information appears to be one of having them organized in such a way that they can be readily retrieved” (Gagne and Briggs, 1974). The process flow illustrates the research misconduct review process in four stages (assess, inquiry review, investigation review, sanctions and reporting) and ten steps. As the narrator discusses each step, the step and the stage are highlighted in a gold color, bolded and brought to the center of the screen. The process flow aids the learner in understanding the stimulus, enabling easy encoding and subsequent recall of the information presented. Throughout the research misconduct course, the designer applies Gagne’s fourth instructional design principal for all objectives, both simple and complex, and increases the encoding and subsequent recall processes for the learner.

## APPLICATION OF GAGNE’S FIFTH INSTRUCTIONAL EVENT

The fifth instructional event in Gagne’s framework the designer applies to research misconduct is *provide learning guidance*. Learning guidance typically refers to the communications that “are stimulating a direction of thought and thus are helping to keep the learner *on the track*” (Gagne and Briggs, 1974). Throughout the online research misconduct course, the designer uses a variety of mechanisms such as the “Did You Know?” segments (Fig. 8) and objective summaries (Fig. 9) to guide the learner. The “Did You Know?” segment occurs at the beginning of each course and presents compelling facts about each topic to the learner in the form of a question. In the first example (Fig. 8), the narrator asks the learner, “Did you know in 2004 a large pharmaceutical company paid \$430M to resolve research misconduct charges?” This fact is meant to aid the learner in appreciating the scope of clinical trials and the impact of research misconduct violations. The “Did You Know?” segment guides the learner by providing context for the upcoming material and aids the learner in identifying the value of the materials.

A second example of learning guidance occurs in the research misconduct course at the conclusion of each objective when the designer summarizes the three main points for encoding by the learner. The designer selects three points at the conclusion of each objective (Fig. 9) and restates them. The restatement of the three key points is critical to the encoding process for the learner. The information guides the learner away from trying to memorize every step in the process and focuses the learner on appreciating the value and purpose of the research misconduct review process.

The “Did You Know?” segments and the summaries at the conclusion of each objective provide two clear examples of Gagne’s fifth instructional event from the research misconduct course and prepare the learner to move to the next event, eliciting performance.

## APPLICATION OF GAGNE’S SIXTH INSTRUCTIONAL EVENT

The sixth instructional event in Gagne’s framework is to *elicit performance*. The purpose of this event is to illustrate to the learner that learning has occurred in relation to the objective (Gagne, 1977). The designer elicits performance during the research misconduct course through short quizzes at the conclusion of each objective. The quizzes may be multiple-choice, fill in the blank, or ask the learner to categorize specific items. One example of an

interactive exercise that the designer uses is called “Choose It.” At the conclusion of the objective to define research misconduct, the designer elicits performance through a “Choose It” quiz (Fig. 10). During the quiz, the narrator describes a scenario that incorporates a type of research misconduct and the learner is asked to select the type of research misconduct described. By choosing the correct answer, the learner demonstrates knowledge of the definition of the term, but also recognition of the scenario in which that type of misconduct may occur. The quiz may be viewed as the reinforcing event that completes the learner’s performance (Gagne, 1977). The “Choose It” quiz and other similar quizzes throughout the research misconduct course elicit performance from the learner in each objective and allow the learner to demonstrate encoding has occurred.

## APPLICATION OF GAGNE’S SEVENTH INSTRUCTIONAL EVENT

Gagne’s seventh instructional event is to *provide feedback*. Feedback can be given to a learner in a variety of ways including verbal cues such as use of the words “correct” or “incorrect,” subtle clues such as a nod from a professor in a classroom, or by either a teacher or course moving on to the next part of a lesson (Gagne, 1977). The research misconduct course provides feedback after each instance where performance is elicited. At the conclusion of each course, the designer elicits performance through a quiz. Feedback is provided to the learner at the conclusion of the quiz to reveal the correct and incorrect answers. The learner may then review the correct answers and be encouraged to move forward or reflect upon information not yet encoded correctly. The design of the course allows the learner to return and review content at any time throughout the course to reinforce learning. Once the learner reviews the correct answers to any missed questions, the learner is able to go back to review any content that he or she feels is necessary. This feedback helps guide the learning experience of the learner (Fig. 11).

The learner is given clear feedback (Fig. 11) by regarding each question in any type of post-test utilized in this course. This feedback either provides the learner with reinforcement of learned content by informing the learner that the correct answer was given, or it gives the learner feedback such as, “Click the *Correct Answer* button to see the correct answer.” Feedback is an important element of Gagne’s framework and is demonstrated in the research misconduct course through each post-objective quiz and course exam.

## APPLICATION OF GAGNE’S EIGHTH INSTRUCTIONAL EVENT

The eighth instructional event in Gagne’s framework is to *assess performance test*. It is said that new knowledge must be demonstrated consistently for most teachers to agree that learning has occurred, and this event focuses on giving the learner an opportunity to demonstrate learning (Driscoll, 2000). The designer includes a final test at the conclusion of the course to apply this instructional event. The final test for the course covers all objectives and important topics from the course in ten multiple choice questions. The post-test (Fig. 12) utilizes multiple choice questions. The learner is also required to score a certain percentage on the test in order to earn a completion certificate. Because the percentage score is given to the learner, this allows the learner to assess his or her own learning performance for the course. If the learner is below the required percentage to receive a course certificate, he or she has the option to return to the section of the course necessary to review and learn the correct information.

The course also includes a survey at the conclusion to gather feedback. The survey gathers both quantitative and qualitative responses. There are open-ended questions that allow the learner to provide feedback regarding course content and suggestions for course improvement. This survey assists the designer in assessing learner’s view on the effectiveness of the course, and also gives the designer feedback to make improvements for



future learners. Both of these features in the course allow for assessing the performance of the learner and the designer.

## APPLICATION OF GAGNE'S NINTH INSTRUCTIONAL EVENT

Gagne's ninth instructional event is to *enhance retention and transfer*. The ninth event focuses on retention of the new knowledge and the transfer of new knowledge to situations outside of the course or classroom (Gagne, 1977). While this instructional event appears throughout the course, it is primarily implemented through the course learning map, the glossary, and slide summaries in the responsible conduct of research online course. A learning map is a development tool created prior to course content that illustrates the most beneficial order to present the objectives to the learner. In a series of courses, the learning map may also consider the order the courses should be taken. For example, a learner must encode the definition of clinical research before understanding clinical trials (Fig. 13). In addition to the learning map, the research misconduct course also utilizes a glossary function to enhance retention and transfer throughout the course. Important concepts or facts are underlined and each underlined term has a glossary entry. The glossary tool may be used by learners at any time during the course presentation. The entries for each term contain both a formal definition of the term as well as links to external resources for the learner to explore the idea or term further. Finally, the ninth instructional event is implemented through the slide summaries at the conclusion of each objective. The summaries highlight the key points from each objective the learner should retain going forward in the course and also for the test at the conclusion of the course. Through the use of a learning map, the glossary and the slide summaries, the designer ensures that the learner enhances retention and transfer of the information from the course and fulfills Gagne's ninth instructional event.

## TECHNICAL COURSE DEVELOPMENT

In addition to Gagne's nine instructional events, the designer also utilizes three phases of technical construction to build, prepare and deliver the research misconduct course. Several software packages are useful in developing the course for online delivery including Microsoft Powerpoint, Raptivity, Articulate Rapid eLearning Studio, and a learning management system (Fig. 14). During the first phase of construction, the designer uses both an authoring tool and a flash-based interaction tool to build the course. The designer uses Microsoft Powerpoint as the authoring tool for the research misconduct course. PowerPoint serves as the backbone of online, asynchronous course development. PowerPoint provides one software package where the designer can author the content of the course including text, graphics, audio narration, and video to create the materials (Table 2). The software also allows the designer to incorporate many different file types from external resources and auxiliary software programs into one comprehensive project. Microsoft PowerPoint or another similar authoring tool is a critical component to the initial phase of course development. The designer uses Raptivity, a flash-based interaction tool, for the research misconduct course. Raptivity generates learning interactions for asynchronous eLearning course modules and works in conjunction with PowerPoint (Harbinger Knowledge Products Pvt. Ltd., 2012). Developed with the methods of various instructional design paradigms (Bloom's taxonomy, Gagne's Nine Events, Keller's ARCS Model and Experimental Learning), Raptivity provides a way to quickly assemble an interaction or presentation segment and publish it to Flash for use in PowerPoint (Malamed, n.d.). In accordance with Gagne's nine instructional events, the course designer can select pre-objective and post-objective exercises and interactive games to stimulate recall or prior learning and elicit performance and provide feedback to the learner throughout the course. Through the use of PowerPoint as an authoring tool and Raptivity to generate interactive exercises, the designer completes the initial phase to build the research misconduct course.

Once the course is built, the course designer moves on to phase two, preparing the course for online delivery. With the course materials and files all in one comprehensive project, the designer employs Articulate Rapid eLearning Studio to transform the PowerPoint into a single flash file for online delivery through a learning management system (Table 3). Articulate provides several key technical components to the course including slide navigation, screen design and layout, glossary, and final graded assessments. Slide navigation allows the learner to self-pace completion of the course going forward, backward or pausing to take a break and return to the material. The screen design and layout also aids in course navigation allowing the learner to have helpful information such as the overall course outline on the left hand side and status bars to update on the running time of each slide and corresponding audio. Articulate also provides the ability to create a glossary of terms. In the research misconduct course, each underlined word in the program has a glossary definition. In addition to the simple definition, the glossary also provides links to external resource where the participant can learn more about the topic. Finally, the final graded assessment and overall course feedback is created in Articulate. The software package allows not only for authoring the final assessment, but creates a way for the final assessment to communicate with the learning management system to indicate whether a learner has passed or failed if such requirements exist. Through Articulate the designer is able to create the final materials for the course such as the glossary and the exam and publish it for delivery in the learning management system.

The designer is now ready to deliver the course to the online learner through a learning management system (LMS). An LMS is defined as “an information system that administers instructor-led and online courses and keeps track of student progress. Used internally by large enterprises for their employees, an LMS can be used to monitor the effectiveness of the organization’s education and training” (PC Magazine n.d.). In the case of research misconduct, the learning management system provides a mechanism to deliver the content to the learner via the web. Learning management systems may also have a range of additional functions for the learner such as housing user profiles, hosting virtual course content, generating post-course evaluations and survey, and offering certificates of completion. Although large universities and academic medical centers typically have an LMS for their employees, smaller organizations or individuals interested in course delivery can partner with a variety of free or fee-based vendors that specialize in hosting online courses and tracking the results. The designer completes the technical development for the online research misconduct course and delivers the final project through a learning management system.

## CONCLUSION

The interaction of objective development and instructional design with the course content is a critical component to the creation of an online research misconduct course. Although in-person discussions are an important part of the required NIH RCR training, supplemental online courses may appropriately augment RCR training and allow learners to come more prepared for face-to-face discussions. For the research misconduct course, the designer applied evidenced-based learning methodologies including Gagne’s Nine Instructional Events and Bloom’s taxonomy to develop an effective course for the learner. Further, Gagne and Bloom’s evidenced-based methodologies can easily be applied to any content to develop an online program. Using a learning app, the appropriate software, and the right subject matter experts, organizations can develop more effective training by applying these theories. The evidenced-based frameworks applied to research misconduct and illustrated in this article may aid any organization in developing more effective compliance training and reduce the overall risk of research misconduct.

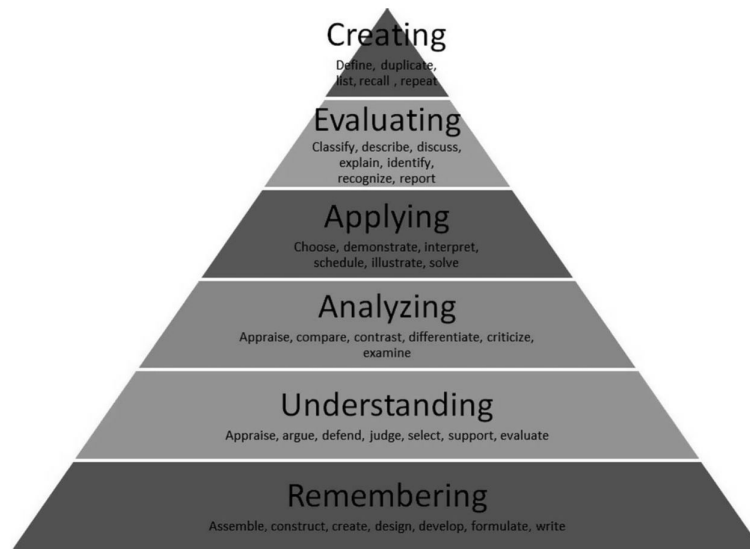


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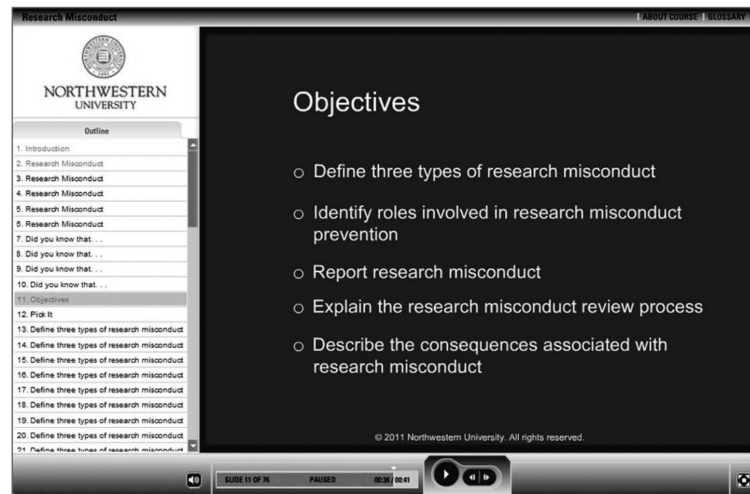
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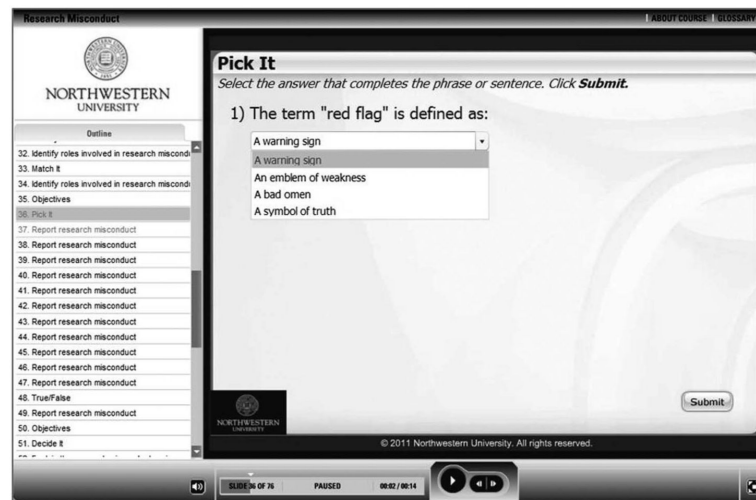
**Figure 1.**  
Bloom's Taxonomy (Overbaugh and Shultz, n.d.).



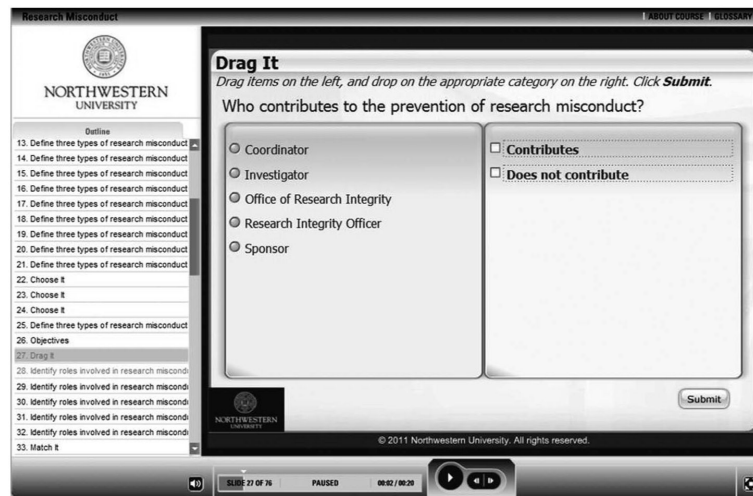
**Figure 2.**  
Gagne's First Instructional Event—Gain Attention—Demonstrated with a Quote from Martin Luther King Jr. and a Stethoscope Photo Symbolic of the Medical Profession.



**Figure 3.**  
Gagne's Second Instructional Event—Inform the Learner of Objectives—Applied at the Beginning of the Course when Objectives are Stated.



**Figure 4.**  
Gagne’s Third Instructional Event—Stimulate Recall of Prior Knowledge—Exercise “Pick It” as a Pretest for an Objective.

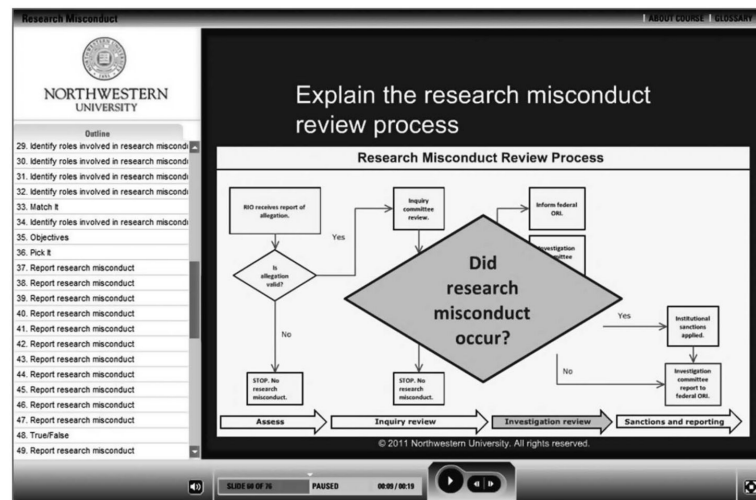


**Figure 5.**  
Gagne's Third Instructional Event—Stimulate Recall of Prior Knowledge—Example from  
"Drag It" Exercise Aids the Learner in Identifying Roles that Contribute to Research.

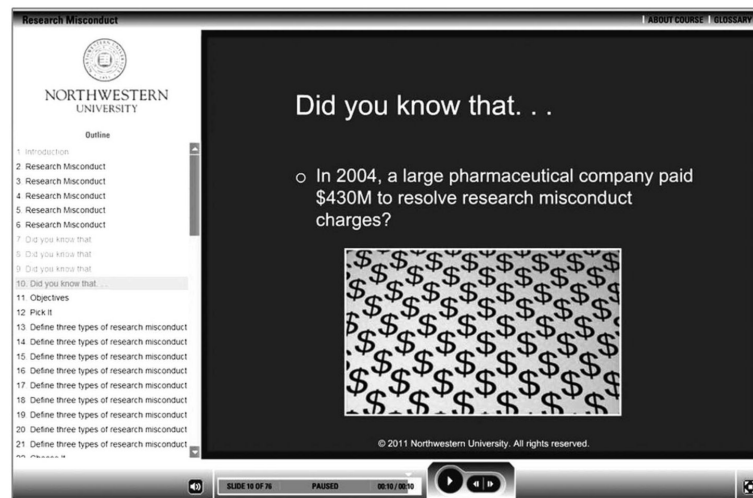




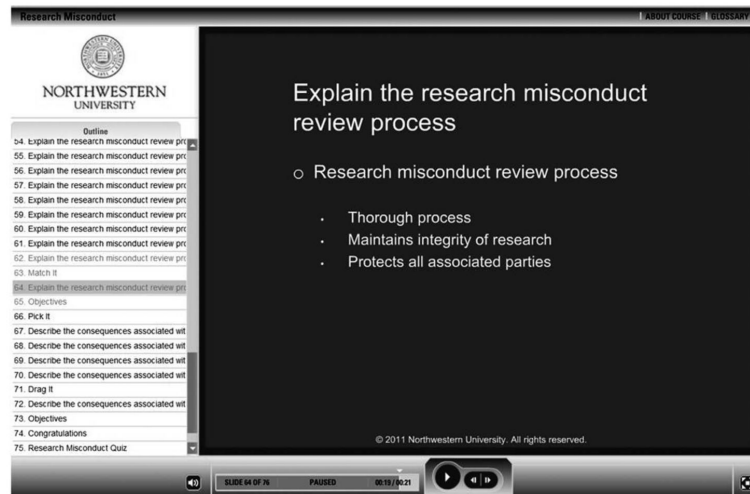
**Figure 6.**  
Gagne's Fourth Instructional Event—Present the Stimulus—Using Text, Images, and Verbal Information for Encoding.



**Figure 7.**  
Gagne's Fourth Instructional Event—Present the Stimulus—Use of a Process Flow Chart to Present More Complex Material.



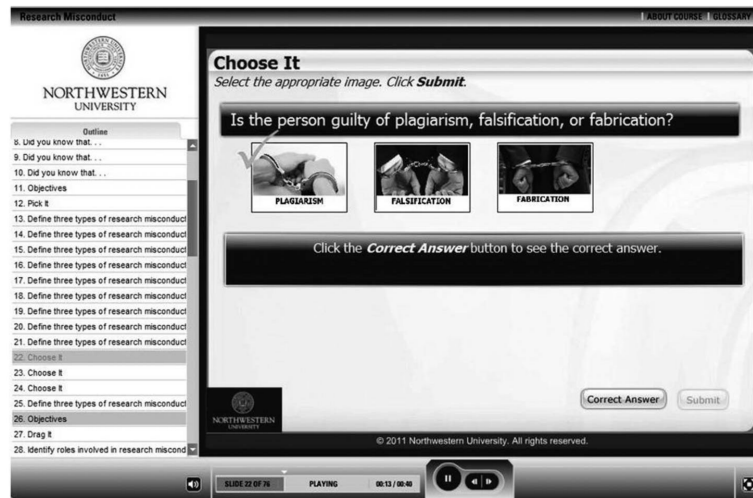
**Figure 8.**  
Gagne's Fifth Instructional Event—Provide Learning Guidance—Through “Did You Know” Segment at the Beginning of the Course to Present Compelling Facts about the Material and Aid the Learner in Identifying the Value of Course Participation.



**Figure 9.**  
Gagne's Fifth Instructional Event—Provide Learning Guidance—Occurs at the Conclusion of Each Objective when the Main Points are Summarized for Encoding by the Learner.

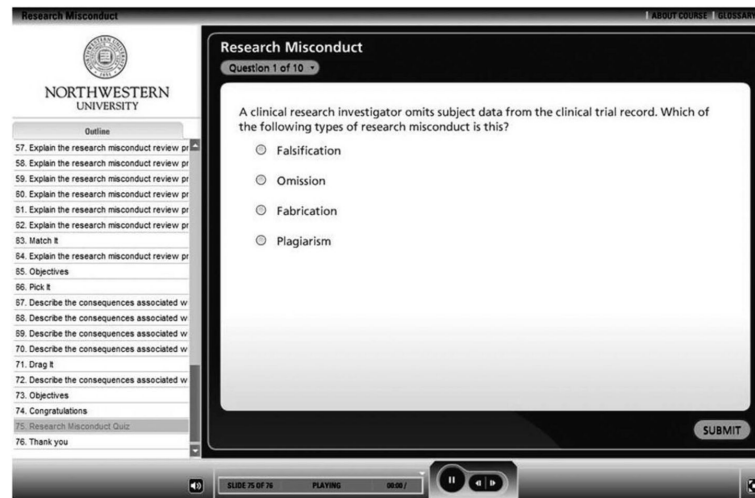


**Figure 10.**  
Gagne's Sixth Instructional Event—Elicit Performance—Demonstrated Through the  
"Choose It" Exercise as a Post-Test Following an Objective.

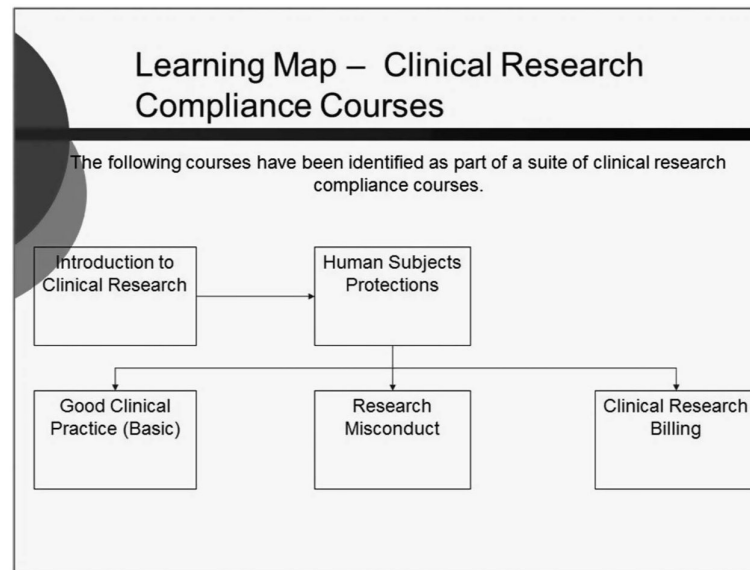


**Figure 11.**  
Gagne's Seventh Instructional Event—Provide Feedback—Guides the Learning Experience by Allowing the Learner to Know which Quiz Questions were Answered Correctly and Incorrectly.

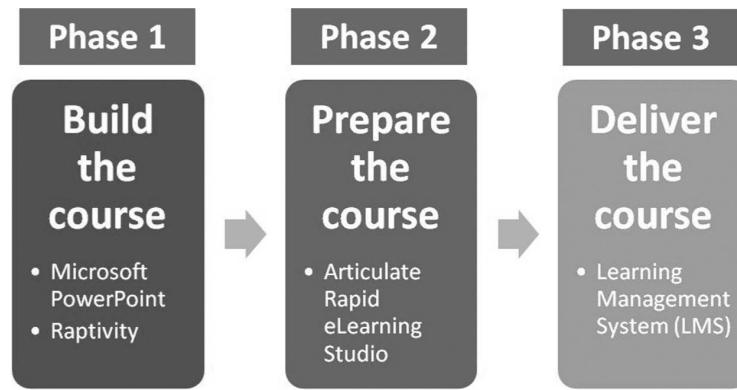




**Figure 12.**  
Gagne's Eighth Instructional Event—Assess Performance Test—at the Conclusion of the Course to Aid in Encoding Information for the Learner and Apply the Information.



**Figure 13.**  
Gagne’s Ninth Instructional Event—Enhance Retention and Transfer—Applied during Course Development through the Use of a Learning Map to Establish the Optimal Sequence of Objectives.



**Figure 14.** Technical Course Development—Three Phases of Construction for an Online Asynchronous Course.

**Table 1**

Gagne's Instructional Events Application in Research Misconduct Course.

Instructional Event	Application
1. Gain Attention	Case scenario slides and information about real events presented at the beginning of each course
2. Informing Learner of the objectives	Slide at the beginning of the course stating the objectives, return regularly to the objectives for learning guidance throughout the program
3. Stimulate recall of prior knowledge	Pretest, Did You Know, Narration
4. Present the material	Text, graphics, transitions
5. Provide learning guidance	Initial navigation instructions, transitions re-stating objectives, program navigation (pause, skip, resume), glossary
6. Elicit Performance "Practice"	Quizzes/post tests at the conclusion of each objective
7. Provide Feedback	Feedback on post-tests at the conclusion of each objective and at the conclusion of the program
8. Assess Performance Test	Final test at the end of the course
9. Enhance retention and transfer	Glossary, links to outside resources for further information, allow learner to return and review course content

**Table 2**

Technical Course Development—Course Elements and File Types for Building a Course.

Course Element	File Type(s)
Voiceover Narration	.mp3, .wav
Interactive Games	.swf
Images	.jpg, .gif, .png
Text	.txt
Sound Effects	.mp3, .wav
Videos	.flv, .mov, .m4a, .wmv

**Table 3**

Technical Course Development—Course Elements and File Types for Preparing a Course.

Course Element	File Type(s)
Microsoft PowerPoint	.ppt, .pptx
Articulate	.xml
Glossary	.intr
Quiz	.quiz