Chapter 16

Conducting Formative Evaluations of Online Instructional Materials

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Learning Objectives

1. Distinguish between different approaches to formative evaluation.
2. List the steps in the Dick and Carey model.
3. List the steps in the Alessi and Trollip model.
4. Describe the variables in the DECL Model.
5. Describe the purposes for formative evaluation.
6. Describe the instruments used in a formative evaluation.
7. Develop an appropriate formative evaluation plan and construct instruments for a set of newly created instructional materials, selected or adapted materials, instructor-delivered instruction, or some combination of these.
8. Collect data according to a formative evaluation plan for a given set of instructional materials or instructor presentation.
Abstract

Although most online instructional material probably will never see a formative evaluator, most online get some vetting by an expert in a quality review (a Stage 1). This chapter includes a discussion of two of the best-known 3-stage models of formative evaluation of instructional material, namely: the Dick and Carey model and the Alessi and Trollip model. These models help to make formative evaluation tried and true. Other ingredients for a tried and true formative evaluation are “learning domains” and “events of instruction.” These are still crucial and must always be part of a formative evaluation of online instructional materials. Also important however, is knowing the main emphasis of the instructional material in the distributed environment, and sufficient evidence of acknowledgment of multimedia learning principles.

The Shelf-Life of Instructional Material

Formative evaluation is not concerned with matching learning outcomes to goals or objectives, nor is it really troubled with learner satisfaction. Formative evaluation asks only one question, “What revisions need to be made to these instructional materials?” The real goal is to ensure that after a fair hearing, what was initially intended as “the online learning environment” will eventually foster better performance or enhanced cognitive schema. Formative evaluation must be both effective and quick given the brief shelf-life of most instructional material.

Balanced Model of Formative Evaluation

A “successful Web course” to some degree at least, is defined by its sponsor. The sponsor determines emphasis. A corporate Web course, for example, has a different emphasis to that of a school or a religious training college. Figure 1 shows a graphical comparison of the emphasis in three different Web courses (from Mann, 1993, 1995, 1997): Figure 2 shows the DECL model with all factors balanced instructional system. “DECL” stands for delivery, environment, content and learner factors that comprise student achievement. The size of the circles in Figure 2 indicate their equal emphasis and equal impact on the rest of the system, and on achievement. The factors are explained in Figure 3, based on Richey’s theoretical and conceptual bases of instructional design (Richey, 1986).

Delivery. Your evaluation should also consider the strategies that are used, including both the media mix and the instructional devices. Consideration of the media mix means the design of the audio, video and graphics for possible effects on students cognitive
load. Consideration of instructional devices would include a discourse analysis of asynchronous text discussion, asynchronous text chat, or audio conferences. If it’s a hybrid (e.g., Web/face-to-face) course, the evaluator might also look at the amount and quality of whole group instruction, individualized instruction, work-embedded instruction, fault-free questioning, constructed answers, partial answers, elaborative interrogation.

Regarding the Presentation variables in the delivery, its recommended to consider tactics, which are comprised of six functions, adapted from Gagne’s events of instruction. Concerning the form of the presentation, consider how the mix of technologies is encoded, using research on Mayer and Moreno’s “cognitive theory of multimedia learning” (Mayer, 2001), Sweller’s “cognitive load theory” (Chandler & Sweller, 1991), and Mann’s “structured sound functions (SSF) model” (Mann, 1995, 1997, 2000b). Regarding learner control, consider the type and amount of learner control, level of interactions, expository/discovery.
**Environment.** In the environment domain, you should account for the learning climate (e.g., K-12 school, business, government, medical and nursing, college, military) and its setting which could be characterized as online or hybrid (e.g., Web/face-to-face).

**Content.** In the content domain, your formative evaluation should examine the mental operations required to learn the content, the tasks involved, and the learning domain. Regarding the mental operations required to learn the content, consider the requirements to select and focus attention, student expectations, and guidance provisions. Is there time for retention, to organize, rehearse for storage, and retrieve and use. Finally there should be advice about learning transfer through lateral, vertical, problem solving or creative thinking activities. Regarding the tasks involved, it’s best to consider everything you can such as the basic skills that are assumed, any gender or cultural concerns, vocational aspects, and personal skills such as time management or goal setting. Concerning the domains involved, it may be good to know the extent of motor and intellectual skills, verbal information learning and cognitive strategies to augment or supplant learner precepts. Finally, consider the “buy-in factor” in the content, perhaps more accurately called the axiological variable.

**Learner.** In the learner domain, “attitude” can have a direct effect on student performances in certain learning tasks. Attitudes are defined as likes and dislikes, with roots in social, emotional, behavioral, and cognitive experiences. Attitudes can also be value-laden (e.g., moral and religious beliefs, school pride, or work ethic), self-concept (e.g., academic, personal, professional), or motivational (e.g., goals, interests, perseverance). “Capacity” relates to innate ability, as opposed to achievement, the competence variable. The definition of “capacity” includes intellectual abilities (e.g., verbal, mathematical, artistic, and social capabilities), as well as cognitive (e.g., perceiving, remembering, thinking, apprehending, sorting, and utilizing information) and physiological (e.g., perceptual development and motor dexterity) development. Regarding “demographics,” some evaluators like to collect demographic data to apply to their data interpretation. Data shows differences among the learner performances when subjects are categorized on the basis of such variables as age, sex, and cultural background. “Competence” is the result of conscious activity, either a learning experience or another life event. According to Richey (1986), while competence is limited by an individual’s natural capacities, it is influenced by the learner’s attitudes and general profile characteristics. Competence includes prerequisite skills (e.g., information processing skills, basic skills, and content prerequisites) and experiential background (e.g., family, leisure time, social, vocational and educational background).
Business-Focused Formative Evaluation

The formative evaluation of a corporate Web-course management system offering training to branchies in different regions of the country, for example, would focus primarily on the environmental factors such as the climate of the organization at the time, as well as the local settings. There is usually less concern with learner factors.

Learner-Focused Formative Evaluation

The predominant emphasis of formative evaluation has been the educational psychology model, with its emphasis on the learner (Mann, 1993, 1995, 1997). Figure 4 shows the educational psychology model with the focus on the learner factors.

In Web-based educational research, the independent variables include: the capacity and competence of the learner, their attitude, and their demographics. Achievement is the dependent variable, and some error or unexplained part of achievement. Though there are many others, two models will be reviewed with the learner emphasis in this chapter: the Dick and Carey model, and the Alessi and Trollip process.

The Dick and Carey Model

The Dick and Carey model of formative evaluation has six stages (Dick, Carey, & Carey, 2005):

1. Design review
2. Expert review

Figure 4. The MBO model with its focus on the environmental factors

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3. One-to-one
4. Small group
5. Field trials
6. Ongoing evaluation

The first four steps are particularly relevant to Web-based educational research.

**Step 1: Design Reviews**

In a design review, the research will ask the following questions:

- Does the instructional goal match the problem identified in the needs assessment?
- Does the learner and environmental analysis match the audience?
- Does the task analysis include all the prerequisite skills?
- Are the test items reliable and valid, and do they match the objectives?

**Step 2: Expert Review**

In an expert review, an expert reviews the instruction with or without the evaluator present. The experts are usually content or technical experts.

- Is the content accurate and up-to-date?
- Does it present a consistent perspective?
- Are examples, practice exercises and feedback realistic and accurate?
- Is the pedagogy consistent with current instructional theory?
- Is the instruction appropriate to the audience?

*Figure 5. The educational psychology model with the focus on the learner factors*
Step 3: One-to-One Review

In a one-on-one evaluation one learner at a time reviews the instruction with the evaluator and comments upon it.

- Is the message clear?
- What is the impact on learner attitudes, achievement of objectives and goals?

Small Group Try-Out

In the small group evaluation, the evaluator tries out the instruction with a group of learners in an environment similar to that in which it will be used in the “real world” and records their performances and comments.

- Look for the effects caused by the changes made in the one-to-one review.
- Identify any remaining learning problems.

Thesis Research Using Dick and Carey’s Model

Marcia Gasper completed the Ed.D. degree at the University of Pittsburgh in 2003 with a thesis entitled “A Developmental Case Study of the Design and Implementation of a Web-Enhanced Nursing Health Assessment Course” (DAI-A 64/07, p. 2456). The purpose of this study was to design, develop, implement and evaluate a Web-enhanced nursing health assessment course. The design process itself, as guided by Dick and Carey’s systems approach to instructional design model was studied. Strengths and weaknesses of the models are discussed, as well as factors related to choosing a Web Course Development Tool (WCDT), choosing a design model, formulating an evaluation plan, and identifying the role of the course facilitator. Emphasis was placed on formative and summative evaluation. Formative evaluation included expert review, one-to-one evaluation, small group, and field trials. The evaluators were an Instructional Technology Specialist (ITS), a subject-matter expert, faculty, and learners. Data sources included an interview protocol and other tools designed by the author. Content analysis was employed for expert and learner responses to the interview and other evaluation instruments. A course evaluation tool was used to assess learning outcomes, educational practices, and the use of technology for the purpose of benchmarking. Reliability and validity measures were applied to this instrument. Learning outcomes examined include: accessibility, application, connectedness, convenience, satisfaction, and socialization. Educational practices examined include: active and engaged learning, cognitive and creative outcomes, feedback, faculty/student interaction, student/student interaction, and time on task. Factors examined related to the use of technology include productive use of time, technology infrastructure, and prerequisites for using technology. Statistical analysis of coded items of the tool included means (e.g., reported as benchmarks), t-test, and correlations.
The Alessi and Trollip Process

Alessi and Trollip (2001) divide the formative evaluation process into three phases: quality review, pilot testing, and validation. Their three stages correspond to Dick and Carey’s model: one-to-one, small group and the field trial (Dick, Carey, & Carey, 2004). Alessi and Trollip divide the process of formative evaluation into three phases: quality review, pilot testing, and validation for conducting a formative evaluation of multimedia prototype (Alessi & Trollip, 2001).

1. Quality reviews by an instructional design and a subject matter expert
2. A pilot test of the prototype with a student
3. Validation

Stage 1: The Quality Review

The purpose of a quality review is to eliminate correctable errors. Feedback received from the instructional design and subject matter experts provide the recommendations for revision to your prototype and documentation. An exemplary quality review includes:

- The language and grammar used
- The displays and surface features employed
- The use of audio
- The questions and menus
- The subject matter
- The directions and instructions contained in the documentation

The procedure for conducting a quality review is as follows:

- Examine the design of your prototype (Alessi & Trollip).
- Dry-run the flowchart of your prototype (in Alessi & Trollip).
- Check the storyboard and audio script for your prototype (Alessi & Trollip; Mann, 1996, 1997).

Stage 2: The Pilot Test

The purpose of a pilot test is to debug the prototype and documentation, and correct any obvious problems. An exemplary pilot test is conducted with representatives of the target audience using a 7-step procedure:

1. Select a participant.
2. Explain the procedure to him or her.
3. Determine their prior knowledge.
4. Observe him or her using the program.
5. Interview him or her afterwards.
6. Assess their learning.
7. Take notes on how it could be revised.

**Stage 3: The Validation**

The third stage in Alessi and Trollip’s formative evaluation is validation of the lesson in the actual setting. The purpose of the validation is: (1) to verify the results of your pilot test in the real setting, (2) assess the outliers (i.e., those who do really well, those who don’t). An exemplary validation is comprised of the following steps:
1. Consent, relevant background
2. Pre-test
3. Information, equipment check-out
4. Think-aloud practice
5. Work through the prototype
6. Post-test
7. Questionnaire
8. Unstructured interview

**Other Formative Evaluation Thesis Research**

**Remediation software.** In 2004 Anita Kinser wrote a Ph.D. thesis at Pepperdine University entitled “Computer-Assisted Remediation for At-Risk Nursing Students.” The purpose of this research was to develop a Web-based interactive computer-assisted remediation software program that could be effective in increasing program success of at-risk nursing students. Previous research has shown that a lack of adequate study skills and test-taking skills is a major factor in the rising attrition rates for nursing students, with not enough resources available to provide remediation to all who need it. The problem presented suggested the need for an inexpensive, effective remediation program related to study skills and test-taking strategies for nursing students. A three-phase design experiment was used to address the research objectives of: (a) developing an interactive remediation program in a Web-based format for use in assisting at-risk nursing students in improving study and test-taking skills, (b) establishing content validity of the program through alpha testing by faculty with content expertise in teaching and remediation with nursing students and (c) determining student perceptions of helpfulness and ease of use of the tool through a beta test process. The program developed provides assessment and remediation of study skills and test-taking skills specifically aimed at the needs of nursing students in a Web-based format.
Analyses of surveys evaluating the program provided positive results. Evaluation by faculty content experts indicated that the program provides valid assessment and remediation content in a user-friendly manner. Analysis of evaluation survey results from student pilot testers in two separate nursing programs (N = 36) found that the program could be a useful tool to help most nursing students strengthen their study skills and test-taking skills. If the computer-assisted remediation program can provide nursing students with resources to increase their potential for success in the nursing program, it would be a cost-effective alternative method for assisting nursing students and increasing the number of nursing graduates entering the health care work force.

Heuristic formative evaluation. Patrick Devey’s master’s thesis (2002) investigated “The E-volving Practitioner: A Heuristic Formative Evaluation of an Online Course, Based on an Action Research Methodology.” This thesis made use of limited studies, and combined that knowledge to the experience of practitioners in the field, as well as with the feedback from the participants in the e-learning environment, in order to devise a set of successful practices for an undergraduate statistics course offered entirely online. In other words, this research aims to successfully implement practical procedures into a Web-based course in order to make it the best possible experience for everyone involved. In accomplishing these goals, this work could then serve as a resource for other practitioners in the field by providing them not just with recommendations for Web-based courses, but also with concrete, proven, and successful interventions in this particular environment.

Electronic portfolio. Jane Costello’s thesis (2002) focused on an “Evaluation of an Electronic Portfolio Template System.” The design, development and formative evaluation of an Electronic Portfolio Template System for Cycle 1 students in the Quebec Education System is described. The prototype is a Web-based, database-driven process and showcase portfolio container that facilitates portfolio development. This system contains administrator, teacher and student environments. Each of these environments, along with the installation, set-up and documentation process was evaluated. In all, 26 participants evaluated the various environments and processes. Results of all evaluations are presented. The student environment received the most feedback with strengths reported relating to interface design, usability, learnability and aesthetics and weaknesses reported relating to suitability and navigation. Interface design, learnability and aesthetics were reported as strengths while marginal navigation weaknesses were reported in the teacher and administrator environments. Evaluative comments, recommendations for improvement and suggestions for further research are presented.

Quick Checklist

- Obtained a set of online instructional materials and tools in draft form.
- Determined the emphasis in the design of the educational prototype: Ed. Psych., MBO, or sociological (balanced).
- Got written comments from a SME (Subject Matter Expert), and learning psychologist or experienced educator.
• Got two learners to try-out the online materials and tools (Stage one review).
• Found evidence of events of instruction and multimedia learning principles.
• Ran stages 2 and 3 as usual.

References


Mayer, R.E. (2002). Cognitive theory and the design of multimedia instruction: An example of the two-way street between cognition and instruction. New Directions for Teaching and Learning, 89.
