

# Pre-Print

## **Collaborative Argumentation in Learning Resource Evaluation**

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### Abstract

LORI (learning object review instrument) is an evaluation framework designed to support collaborative critique of multimedia learning resources. In this chapter, the interactions among reviewers using LORI are framed as a form of collaborative argumentation. Research on collaborative evaluation of learning resources has found that reviewers' quality ratings tend to converge as a result of their interactions. Also, novice instructional designers have reported that collaborative evaluation is valuable preparation for undertaking resource design projects. The authors reason that collaborative evaluation is effective as a professional development method to the degree that it sustains argumentation about the application of evidence-based design principles.

### **Collaborative Argumentation in Learning Resource Evaluation and Design**

There are several reasons why producing high quality multimedia learning resources is challenging. Many types of media, media features, and design models are available to resource developers, yet there are few standards that can guide selecting them. Relevant research on multimedia learning has expanded, yet many developers are unaware of its full scope and value. Personnel are available who specialize in media development, instructional design, usability design, subject knowledge, and teaching, yet they are rarely coordinated so that their expertise can be effectively brought to bear. Learners usually have opinions about the resources they use, yet their opinions are rarely heard by developers.

The challenge is seen most clearly when design decisions are informed by conflicting recommendations from different specializations. Decisions about text layout are a case in point. Psychologists and educational researchers who have studied readers using computer screens to read text with a fixed number of alphabetic characters per line have observed that more characters per line (possibly up to 100) may be optimal for rapid reading, but that as few as 40 or 50 characters per line may be optimal for reading comfort and comprehension (Dyson, 2004). Ling and van Schaik (2006, p. 403) concluded that “longer line lengths should be used when information is presented that needs to be scanned quickly.... [and] shorter line lengths should be used when text is to be read more thoroughly, rather than skimmed.” Specialists familiar with this research who are designing the text components of a resource to be used for a defined learning activity might choose a fixed line length of, say, 70 characters. On the other hand, many Web developers advocate a “liquid design” for Web pages in which the number of characters per line varies according to the width of the browser window, character size, and presence of images (Weiss, 2006). They argue that readers can resize the browser window to the optimal width for normal reading, or to a much wider width that minimizes scrolling when scanning through a large document. Because neither fixed nor liquid approaches to line length is likely to be the best choice in all design situations, an analysis of how specific circumstances play into the decision seems necessary, and that process requires knowledge of both the fixed length and flexible length strategies. Finding the best design solutions and evaluating existing designs requires an exchange of specialist knowledge in relation to situated learner needs. The nature and requirements of this exchange are the concern of the present chapter.

Any approach to ensuring quality in learning objects that is built around rigid standards for technologies or implementation will quickly become obsolete. Instead, what is needed is a system for evaluating learning objects that applies design principles, recognizes that the best way to operationalize these principles will change from context to context, and has a mechanism for continued interpretation and clarification of how these principles relate to specific learning objects. We maintain that continued interpretation of quality standards requires reasoned discussion or argumentation among learning object stakeholders – media developers, instructional designers, instructors, students, and so on – and that this argumentation can also serve as a form of professional development for the stakeholders. Such dialogue provides the opportunity for professionals and students to test their ideas and see the views of other stakeholders who may be approaching the same object from different professional perspectives.

The purpose of this chapter is to present theory and evidence that collaborative argumentation can be a powerful method for the design and evaluation of multimedia learning resources. We describe how a model of collaborative argumentation that we have developed, convergent participation, has been used to evaluate learning resources and provide professional development for learning resource designers. Before taking up this main theme we introduce an

instrument for evaluating multimedia learning resources that offers substantive guidance to collaborating reviewers.

#### LORI: An Evaluation Framework

The Learning Object Review Instrument (LORI) is an evaluation framework for multimedia learning resources (Nesbit, Belfer, & Leacock, 2004). Individual LORI reviews of a learning object are published as Web pages on the eLearning Research and Assessment (eLera) website (<http://www.lera.net>). The reviews for an object can be aggregated, allowing users to search for objects by quality ratings. Table 1 provides an overview of the nine items in LORI.

Table 1. *Items in LORI 1.5*

Item	Brief Description
Content quality	Veracity, accuracy, balanced presentation of ideas, and appropriate level of detail
Learning goal alignment	Alignment among learning goals, activities, assessments, and learner characteristics
Feedback and adaptation	Adaptive content or feedback driven by differential learner input or learner modeling
Motivation	Ability to motivate and interest an identified population of learners
Presentation design	Design of visual and auditory information for enhanced learning and efficient mental processing
Interaction usability	Ease of navigation, predictability of the user interface, and the quality of the interface help features
Accessibility	Design of controls and presentation formats to accommodate disabled and mobile learners
Reusability	Ability to use in varying learning contexts and with learners from different backgrounds
Standards compliance	Adherence to international technical standards and specifications

LORI has been designed as a heuristic evaluation tool. As such, it does not contain exhaustive detailed checklists and does not address every possible eventuality in learning object design. Rather, LORI identifies nine critical dimensions of quality, spanning pedagogical concerns, technological issues, and user experience factors (Leacock & Nesbit, 2007). Evaluators provide ratings for each item on a 1 to 5 scale, and may also include additional text comments on each item. The LORI Manual (Nesbit, Belfer, & Leacock, 2004) provides more detailed information on how to interpret each of the nine items, including more detailed descriptions and examples of factors that might lead one to assign a learning object a one, a three, or a five on a given item (see Figure 1 for an example). Evaluators also have access to this information when conducting online reviews on the eLera website.



content quality. Goal alignment is a second feature that may be more neglected in multimedia resources than print textbooks. We believe that learning resource designers and evaluators should be aware of the benefits of close alignment across learning goals, learning activities, and assessments (e.g., Cohen, 1987).

The next three items – feedback and adaptation, motivation, and presentation design -- focus on established areas of instructional design. The feedback and adaptation item asks whether the object tailors the learning environment to the individual learner's characteristics and needs and provides feedback that is dependent on the learner's input. Feedback and adaptation has long been understood by instructional designers as an important goal for educational technology, whether manifested as simple knowledge of results on quiz items, or as adaptation of the learning environment to a sophisticated model of the learner (Park, 1996). The motivation item asks whether the object encourages learners to invest effort in working with and learning from the object. This item encourages raters to distinguish between objects that attempt to motivate by superficial complexity (Squires & Preece, 1999), such as flashing graphics, and those that engage learners existing interests and develop new ones. The presentation design item asks whether the object communicates information clearly. It draws evidence-based principles from the field of multimedia learning (Mayer & Moreno, 2003; Parrish, 2004) and established conventions for multimedia design (e.g. Pearson & van Schaik, 2003). The presentation design item also references established stylistic conventions for clearly and concisely communicating information through graphical displays (Tufte, 1997) and writing (Strunk, Osgood, & Angell, 2000).

Two items, interaction usability and accessibility, relate to learners' experience as software users. The interaction usability item assesses interface transparency; that is, how effortlessly and efficiently users can operate links, controls, and menus to navigate through the object. It is important to distinguish between the challenges posed by the interface, which incur extrinsic cognitive load, and those posed by the instructional content, which may be germane to the learning goals. Any errors a student makes should be related to learning the content, not to navigational difficulties (Laurillard, Stratfold, Luckin, Plowman, & Taylor, 2000; Mayes & Fowler, 1999; Norman, 1998; Nielsen, 1994; Parlangeli, Marchigiani, & Bagnara, 1999; Squires & Preece, 1999). In LORI, interaction usability is treated separately from concerns about how learners perceive and interact with the learning content. The accessibility item invites reviewers to consider the important issue of how objects can be designed to take into account differing abilities to access content. For example, Paciello (2000) observed that the increasing prevalence of graphical user interfaces has produced a situation in which "blind users find the Web increasingly difficult to access, navigate, and interpret. People who are deaf and hard of hearing are served Web content that includes audio but does not contain captioning or text transcripts" (Preface: Who are you?). The Web Content Accessibility Guidelines established by the World Wide Web Consortium (1999) provide useful information on how Web pages can be designed to offer consistent meaning when accessed through a range of browsers, assistive technologies, and input devices.

The final two LORI items, reusability and standards compliance, address managerial and technical matters that support the users' experience. The reusability item addresses one of the purported benefits of using learning objects: the ability for one development team to create a resource that can be reused by learners across many different courses and contexts (Harden, 2005; Hirumi, 2005; Koppi, Bogle, & Bogle, 2005). Finally, standards compliance addresses the need for consistent approaches to learning object metadata creation and use (Duval & Hodgins, 2006; McClelland, 2003). Metadata (data about data) is the information that users actually search

when looking for learning objects. Several organizations have been actively developing and promoting usable metadata standards (CanCore, see Friesen & Fisher, 2003; Dublin Core, 1999; IEEE LOM, 2002; IMS, 2002; 2005; and SCORM, see Advanced Distributed Learning, 2003 for examples). Sampson and Karampiperis (2004) sum up the benefits of a consistent approach to metadata creation and use: “*searching* becomes more specific and in-depth; *managing* becomes simpler and uniform; and *sharing* becomes more efficient and accurate” (p. 207).

LORI spans quality issues that are often considered the responsibility of different stakeholders, and its scope is so wide that few professionals charged with developing learning multimedia resources have detailed knowledge of all that it covers. Wherever subjective judgments of quality are applied, as they must be in using LORI, evaluations are only as good as the knowledge of the evaluators. Clearly then, the problem of advancing quality evaluation extends beyond merely translating design knowledge into evaluative criteria, and overlaps significantly with problems of educating novice designers and broadening the knowledge of practicing design professionals. Next we consider how the process of evaluation can contribute to the education of designers.

### Evaluate to Learn

Multimedia learning resources are designed objects. As such, knowledge about how to construct them delineates a design discipline that belongs, along with engineering, computing science, architecture, among the “sciences of the artificial” described by Simon (1996). With contributions from cognitive science, educational psychology, and relevant areas of educational research, a design science has emerged that advances theories, principles and prescriptions for designing multimedia learning resources. The science informs a practice that must intentionally and reflectively bend theory to the exigencies of the situation in which the resources are used (Schon, 1983).

Educational programs for instructional designers typically present curricula in which the novice designer learns some of the theory, history and tools of the field, and is soon engaged in design projects. Of course, in the design sciences, “designing to learn” (Hmelo, Holton & Kolodner, 2000) is not an innovative instructional strategy, but instead a traditional and widely practiced method that is rightly regarded as a core element in design education. Designing and developing a complete learning resource can take more time than is available within a single course. As a result students may be assigned projects that are reduced in some way; perhaps only the design stage is completed, or only a portion of the planned content is implemented. When a student devotes much of her learning time to a single project, depending on the nature of that project, she may not have opportunity to comprehensively practice the design knowledge developed in a course. Further, design projects are often conducted individually, whether for purposes of individual evaluation, to meet unique student interests, or to allow students to design for the needs of their workplace. This can mean that students have few opportunities to discuss in detail the rationale for their design decisions.

Collaborative evaluation of learning resources can effectively complement design projects in professional development and graduate courses that teach learning resource design. The main advantage of evaluate-to-learn as an instructional strategy is that a learning object can be critiqued in less than an hour, allowing students to evaluate many cases within a single course or allowing professionals to complete evaluations within a workshop or as part of regular design work. Because real, fully developed learning resources can be evaluated, this form of case-based

learning can compensate for authenticity that is lost when design projects must be scaled down to fit an academic term.

### Collaborative Argumentation

Collaborative argumentation differs from the common understanding of argumentation as personally invested debate or persuasive rhetoric and is antithetical to the sense of argumentation as verbal conflict or quarrelling (Andriessen, 2006). Andriessen claims that collaborative argumentation is the essence of discourse in science, and the means by which competing theories are assessed against data and the scientific community finds agreement. Even more broadly, collaborative argumentation can be viewed as a decision-making process used in many professional fields such as medicine, engineering and business. It is a form of productive critical thinking characterized by evaluation of claims and supporting evidence, consideration of alternatives, weighing of cost and benefits, and exploration of implications.

Researchers in the learning sciences have proposed that argumentation, particularly collaborative argumentation, can be a highly effective instructional strategy (Andriessen, 2006; Chinn, 2006). Argumentation may help learners to understand course content, enhance their interest and motivation, and improve performance on problem solving tasks (Chinn, 2006). In a study by Wiley and Voss (1999), students who wrote arguments about historical demographic changes in Ireland showed deeper understanding of the causes of demographic change than students who wrote summaries or explanations. Chinn, Anderson and Waggoner (2001) found that sixth grade students were more motivationally engaged in argumentative discussions of stories than in traditional recitation discussion of the stories. In a review of the psychological literature on problem solving, Arkes (1991) concluded that people's problem solving performance is enhanced when they are instructed to generate counterarguments or alternative reasons.

Although little evidence is available about the effects of argumentation in the workplace, there is no reason to assume that its benefits for learning, motivation and performance are restricted to formal educational settings. The collaborative argumentation process, whereby participants make their reasoning and knowledge explicit and co-elaborate their understanding of problems and situations, is likely an effective form of learning in organizations and professions. As with narrative (see Brown & Duguid, 1991), collaborative argumentation may be one of the activities that comprises cognitive apprenticeship.

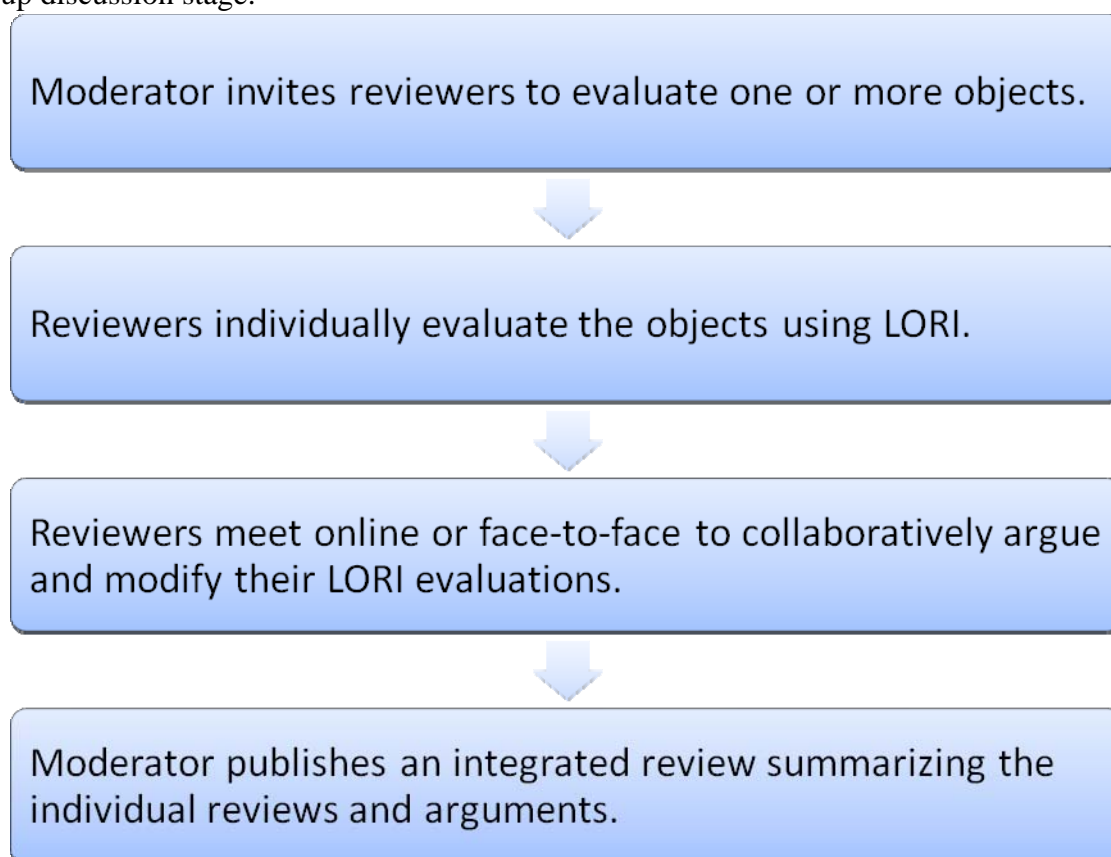
The nature of collaborative argumentation may depend on whether the participants bring shared knowledge and fill similar roles in an organization or project, or specialize in different disciplines and fill different roles. Participants from similar backgrounds often share a great deal of background knowledge that remains implicit throughout a discursive interaction. In this case, the participants are likely to develop a complex set of claims, points of evidence, and counterarguments cognate to the shared knowledge. For example, three Web developers collaborating on a learning object project may generate richly detailed arguments about image formats, but have relatively little to say about learning goals. On the other hand, when the participants have differentiated expertise, the discussion may become simply an exchange of explanations rather than collaborative argumentation. For example, the subject matter expert may explain a misconception held by novices, the instructional designer may explain why a diagram might overcome the misconception, and the Web developer may explain how the diagram will be implemented. Although an explanatory discussion of this type has the needed breadth, it lacks the depth offered by collaborative argumentation in which claims are expected to be challenged

and supported by evidence. For teams charged with developing learning resources, an important challenge is how to enhance the depth of analysis afforded by collaborative argumentation among team members with differentiated experience and knowledge.

We believe that inviting stakeholders to commit to a set of ratings and supporting explanations in a common evaluation framework, and then discuss the reasons for those ratings in a diverse team will lead to the observed benefits of collaborative argumentation. We call this process convergent participation.

### Convergent Participation

In the convergent participation model, summarized in Figure 2, a moderator may initiate an evaluation process by selecting a group of reviewers and inviting them to evaluate one or more learning objects. Each reviewer uses LORI to complete ratings and comments about the learning object(s). This process happens asynchronously. In the context of a course, the instructor may act as moderator and assign students to review objects over a period of a few days. Once each reviewer has individually evaluated the object, the moderator convenes the group to discuss the ratings. This discussion typically happens in an online synchronous meeting, but has also been successfully conducted in a face-to-face setting. In some contexts, the moderator may invite reviewers who have already completed reviews on their own initiative to join the process at the group discussion stage.



*Figure 2.* The convergent participation model.

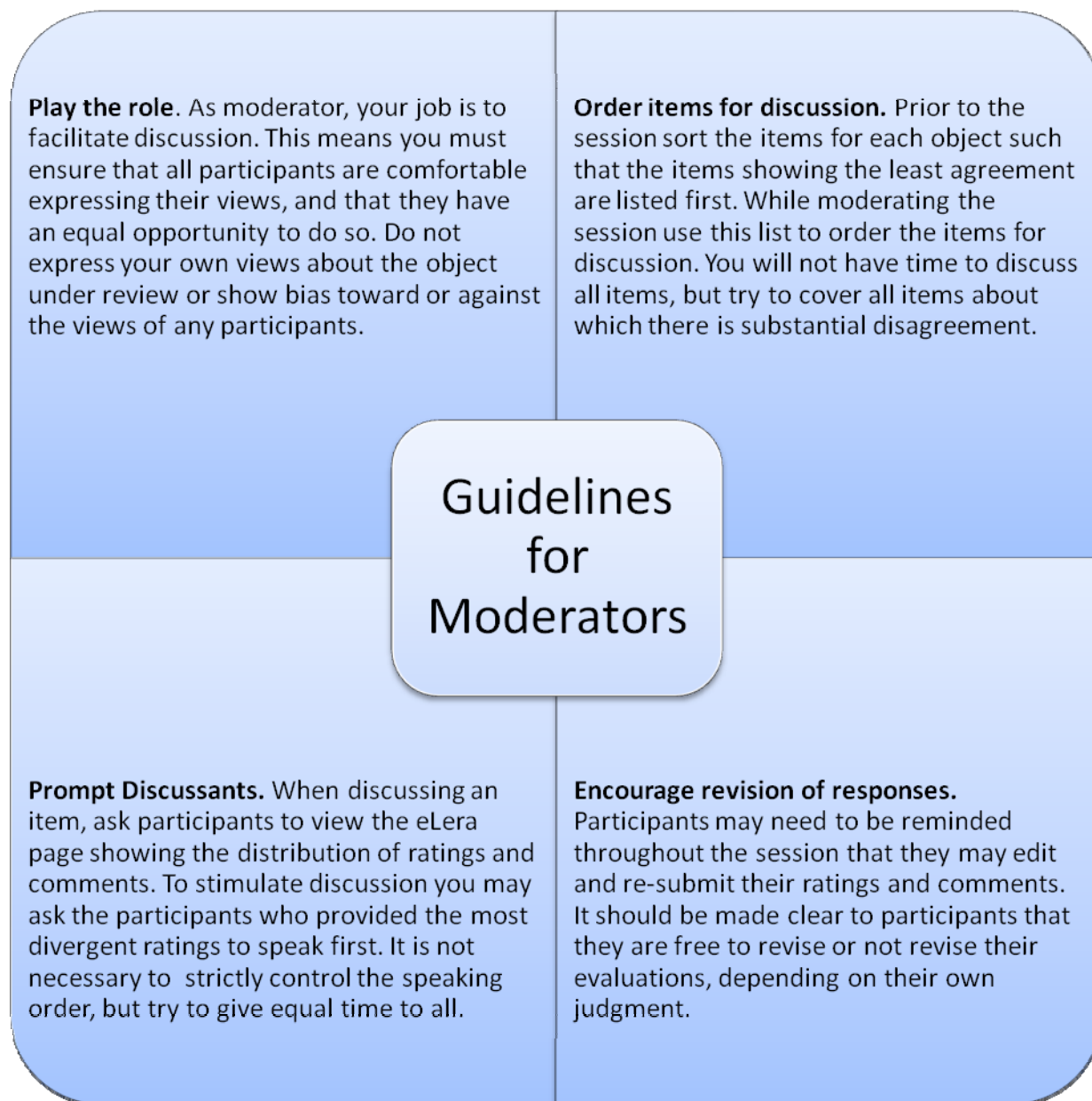
The moderator uses statistical tools within eLera to determine which of the nine LORI items have the most divergent ratings and then instructs the group to start by discussing these items. During the discussion, the moderator encourages reviewers to focus on explaining their reasons

for their ratings and comments. Each reviewer will bring a different perspective and set of claims and evidence in support of their initial ratings. By focusing on the areas of least agreement first, the process encourages reviewers to reevaluate their claims and evidence in light of the alternatives put forward by other group members. Ideally, through collaborative argumentation, the group will come to a shared understanding of the meaning of the item and this will often lead to agreement on a single appropriate rating for the object in question on that item. However, reviewers may decide to keep their divergent ratings. The goal is not to reach a single, common rating of the learning object, but rather to increase each participant's understanding of the reasoning that underlies their judgment about a particular feature of a learning object.

The moderator is responsible for ensuring the discussions stay focused and for moving the group through discussion of as many of the nine items as time allows. Reviewers may choose to modify their individual ratings during the discussion. At the end of the collaborative argumentation phase, the moderator creates and publishes a single evaluation representing the group's rating of the object. Reviewers can also choose not to have their data included with this aggregate evaluation. While this is a relatively new approach, available studies indicate that reviewers do negotiate shared understandings and interpretations within the LORI framework.

Vargo, Nesbit, Belfer, & Archambault (2003) conducted a study in which 12 educational technology professionals and university faculty used LORI to evaluate 8 learning objects. The participants were divided into three groups of four reviewers, and the learning objects were divided into sets A and B (four objects per set). Each reviewer individually evaluated all eight objects using LORI. Two days later, each group of four reviewers met for a one-hour moderated online chat session to discuss the objects in set A. During the chat, reviewers had access to a spreadsheet showing their own ratings (identified) and the ratings of the other members of their discussion group (not identified by individual). The moderator was one of the researchers and did not rate any objects. During the online discussion, groups discussed each of the four objects in Set A focusing on the LORI items with the most divergent ratings. Finally, on the fifth day of the study, reviewers re-rated the objects in both sets A and B. Results showed that the inter-rater reliability of the LORI items improved for the objects that were discussed in the online chat but did not improve for the objects in Set B (the baseline set).

Nesbit, Leacock, Xin, & Richards (2004) reported a follow-up study in which eight reviewers (seven elearning professionals and one elearning graduate student) rated five learning objects drawn from the domains of high school science and mathematics. In this study, reviewers first received a two-hour training session on learning objects, LORI, and eLera. The reviewers were allowed two days to rate the five objects independently, and they met again face to face (in two separate groups of four) on day four to discuss their ratings. As in the previous study, the moderator did not complete any evaluations. Figure 3 summarizes the instructions to the moderator for this study. During the discussion, reviewers had access to the eLera website via laptop computers, and they could choose to change their ratings during the session. Results again showed increased reliability after collaborative discussion of the ratings and their meaning. This study also included a questionnaire asking the reviewers for feedback on LORI and the usefulness of the process. They unanimously reported that the convergent participation process was a valuable professional development activity and was relevant to their work.



*Figure 3.* Guidelines for moderators (adapted from Nesbit, Leacock, Xin, & Richards, 2004).

In a later study on the convergent participation model (Richards & Nesbit, 2004), 24 graduate students taking a course on instructional design took part in two audio conferences. After learning about the nine LORI criteria in the first session, the participants independently rated five learning objects using the eLera website. In the second audio conference they compared and discussed their ratings. The students submitted a written reflection on their perception of the learning activity and filled out a follow-up questionnaire 6 to 9 months later. Analysis of the written reflections and questionnaires revealed that students perceived the convergent participation activity to be valuable for learning theoretical concepts and preparing for design projects. They commented that the learning activity provided an appreciation of the complexity of learning object design, and that it “should be mandatory,” “should be an entire course,” and “should be the first thing taught in the course.” Of the 12 students who had

designed learning resources following the course, all indicated that the learning activity had influenced their design practice.

Further research is needed to investigate issues of transfer and impact on professionals' practice and students' achievement of engaging in collaborative argumentation through the convergent participation process. Collaborative argumentation on the ratings of specific learning objects is useful in producing more reliable ratings of those objects, but we believe that the deeper understandings of varying perspectives on objects and LORI items will help participants to take multiple perspectives when rating additional objects and when designing new objects, which in turn will lead to greater reliability in future ratings and a higher overall level of quality in new learning objects.

#### Future Trends in Argumentation for Evaluation and Design

Until now we have investigated the use of convergent participation in graduate education, and in workshops for teachers and educational technology professionals. What broader effects can be expected when the convergent participation model for collaborative evaluation is introduced into a community of learning object developers and users? First, we anticipate that participation in collaborative evaluation will facilitate adoption of quality as a communal goal. Just as there is a recognition of the need for formal approaches to ensuring quality in more traditional publishing domains, such as textbooks and journal articles, community members will become more aware of the need for quality assurance processes in learning objects and will become better informed about the detailed meanings of learning resource quality. We anticipate this will create a demand for higher quality learning resources.

Second, as participants become practiced in the use of evidence-based reasoning to support design decisions they will become aware of gaps in their knowledge of relevant research evidence. Consequently, they may become more active in seeking research that bears on their design decisions. We anticipate that participants will eventually become aware of gaps or weaknesses in the available evidence, leading to an increased demand for specific research.

To this point, LORI and the convergent participation model have been used only for summative evaluation. That is, resources have been assessed only after they have been completed and made available through the Internet. A natural adaptation of the model, within a community of resource developers, would be to use it formatively to support design decisions. To use LORI and convergent participation for formative evaluation one would have stakeholders collaboratively review plans and prototypes. Learning object development involves progress through phases, with only certain features developed within a phase. For example, a navigational scheme may be developed in one phase and the audiovisual content may be developed in a subsequent phase. Therefore, a formative adaptation would likely stage the assessment of the quality dimensions to parallel the development of corresponding features of the learning object.

#### Conclusions

The potential for multimedia resources to facilitate learning is still being explored as designers apply new technologies and tools to create objects, and as teachers and learners discover new uses for them. Increases in the quantity and complexity of available learning objects are making issues of quality ever more salient (Liu & Johnson, 2005). Unfortunately, learning object design is often not informed by relevant research in psychology and education, with the result that many objects available online are not of the highest quality possible (Nesbit, Li, & Leacock, 2006; Shavinina & Loraer, 1999). For this reason, we believe it is important that

learning object stakeholders have opportunities to learn relevant theory in a meaningful way and apply it to their practice.

The science of learning object design is not static. Even the most enduring design principles, grounded in theory and evidence, must be adapted to constantly changing learning environments and learner needs. Collaborative argumentation is suitable for adapting design principles because it brings to the fore the differing beliefs and knowledge of diverse stakeholders. However, without appropriate tools, protocols and moderation, attempts at collaborative argumentation may focus on surface level explanations, without reaching the level of deep discussion. Using collaborative argumentation within a convergent participation structure may be an effective means for fostering deep, nuanced understanding of design principles because the process requires participants to explain the reasons for their decisions to apply principles in certain ways.

We believe that quality criteria for learning object evaluation, combined with a structured collaborative argumentation process, can help users to identify existing high quality learning objects and, when used in an educational or professional development context, can also drive improvements in design practice.

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### Key Terms

1. **Convergent participation:** An evaluation protocol in which individuals first rate learning objects independently and then discuss the reasons for their ratings in a structured, moderated discussion. Participants may choose to change their ratings during the group discussion.
2. **Learning by evaluation:** A process in which students learn design principles by critiquing existing objects. In the course of forming and explaining their evaluation students gain a deeper understanding of design principles than they would by only reading about them. Learning by evaluation complements learning by design in which students must create their own objects and may often be distracted by technical matters.
3. **Collaborative argumentation:** A form of productive critical thinking characterized by evaluation of claims and supporting evidence, consideration of alternatives, weighing of cost and benefits, and exploration of implications.
4. **LORI (Learning Object Review Instrument):** A nine-item heuristic quality rating tool for digital learning resources developed by the eLearning Research and Assessment Network (Available from: [www.eler.net](http://www.eler.net)). The nine items are: content quality, learning goal alignment, feedback & adaptation, motivation, presentation design, interaction usability, accessibility, reusability, and standards compliance.
5. **Learning objects:** Digital multimedia learning resources that combine text, images, and other media, are intended for re-use across educational settings, typically require a few minutes to perhaps an hour of a learner's time for initial study and usually focus on one topic or a small set of closely related elements, which could then be integrated with other objects and activities in a particular teaching context to form a full course
6. **eLera (eLearning Research and Assessment Network):** A website featuring web-based tools for evaluating learning resource quality. Members can register the metadata for any learning object and then use evaluation tools within eLera to rate the object individually or collaboratively. The goals of eLera are to (1) improve the quality of online learning resources through better design and evaluation; (2) develop effective pedagogical models that incorporate learning objects (3) help students, teachers, professors, instructional designers and others to select pedagogical models and digital resources that meet their requirements.