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Defining and Measuring Quality in Online Discussions

Alexandru Spatariu, Kendall Hartley, and Lisa D. Bendixen
University of Nevada, Las Vegas

Abstract

In support of research examining relationships between learner characteristics and the quality of online discussions, this paper surveys different methods for evaluating discussions. The paper will present coding methods used in our own research as well as methods used by others interested in quality online discussions. Key topics include what constitutes quality in online discussions and how that quality can be measured?

With the rapid evolution of communication technologies, distance education is becoming more prevalent in postsecondary settings. According to the U.S. Department of Education (2003), 89% of public, four-year institutions offered distance education courses during the 2000–2001 academic year. Of those offering distance education courses, 90% offered Internet courses.

Online discussions, as a component of Internet courses, have become common activities in postsecondary education. While many embrace these activities, we currently know very little about the intricacies involved. In some ways these online discussions mirror face-to-face discussions. For example, norms about conversation shifts and turn taking exist in both face-to-face and online discussions (Palloff & Pratt, 2001). In addition, much like face-to-face discussions, students engaged in online dialogue will attempt to find common ground before providing counterarguments (Nussbaum, Hartley, Sinatra, Reynolds, & Bendixen, 2002). However, there are clearly some characteristics in online discussions that make them unique and worthy of investigation.

Online discussions are a relatively recent phenomenon in post secondary education. While classroom discussions have been addressed extensively, much less is known about online discussions. Many of the existing questions about online discussions revolve around a desire to generate *worthwhile* discussions. What is meant by worthwhile is difficult to determine. At its most basic level, one could surmise that worthwhile discussions are *those that contribute to meeting course goals*. However, when it comes to identifying general principles for conducting discussions, this definition is not especially helpful. In our own research, we have struggled extensively with how to ascertain the quality of online discussions—a necessary precursor to research related to improving these discussions.

In support of research in the area of asynchronous learning, we have conducted a literature review to identify different approaches to identifying quality in online discussions. While the number of articles reviewed is extensive, this does not represent

an exhaustive collection of the literature regarding online discussions. Rather, this collection is a purposeful sampling of the literature that attempts to identify and review common methodologies and quality conceptualizations as they relate to online discussions.

Analyzing Online Discussions

The studies reviewed can be classified according to the general methodological approach utilized in their analysis of online discussions. The reviewed studies are loosely classified according to the construct(s) that are purportedly being measured. Four general categories are common: (a) levels of disagreement, (b) argument structure analysis, (c) interaction based, and (d) content analysis. As with any attempts at classification, these categories are imperfect. Most notably, several of the frameworks described attempt to measure multiple constructs and thus could be included in multiple categories. Each of these methodologies and representative studies will be described below.

Levels of Disagreement

Online discussions that engage the participants in debates (preferably civil) or arguments are frequently seen as productive. Thus, one approach to identifying quality discussions is to code messages according to the level of disagreement that is exhibited in relation to the original posting. Nussbaum and colleagues (2002) used such a coding system when analyzing the participation of students in an online discussion for an introductory educational psychology course. The coding system was based in part on a coding system used by Marttunen (1998) to analyze e-mail messages (see Table 1). The initial coding system rated messages from 1 to 4. The rating 1 represented a response that simply agreed with the previous posting and offered no new information. A 2 also represented agreement, but in addition offered some new information to the topic. A 3 was assigned to a posting that offered a qualified disagreement. For example, students would frequently respond with statements such as "I see what you are saying, but . . ." or "I agree with you, however . . ." and then follow up with a disagreement. These can be viewed as efforts to establish common ground and thus seem less confrontational (Nussbaum et al., 2002). A code of 4 was then assigned to a posting that exhibited outright disagreement.

Table 1

Levels of Disagreement

The initial coding system rated messages from one to four (Nussbaum et al 2002).

One represented a response that simply agreed with the previous posting and offered no new	Two also represented agreement and also offered some new information to the	Three was assigned to a posting that offered a qualified disagreement.	Four was assigned to a posting that exhibited outright disagreement.

information.	topic.		

The Nussbaum et al. (2002) study investigated the relationships between personality variables such as anxiety and extraversion and students' postings to an online discussion forum. Thus, the chosen coding scheme allowed the authors to describe interactions based upon observed willingness of students to disagree with their peers. The coding scheme did little, however, to describe the discussion beyond disagreement. For example, the coding scheme did not identify any message characteristics related to content appropriateness or support for positions.

Argument Structure Analysis

Efforts to improve the levels of disagreement could attempt to better describe the message by including some measure of argument quality. This could include identification of supporting statements for positions taken in a message. Argument analysis helps in identifying a student's point of view and supplies information not stated in the message. Four argument structure analysis methodologies have been identified and described (see Table 2).

Table 2

Argument Structure Analysis

1. General model considers four types or arguments according to the degree of complexity in their structure (Inch & Warnick, 2002).

Type I or simple if they consist of one premise and one claim.	Type II if they consist of one claim and multiple premises.	Type III if there are proven claims as evidence for unproven claims.	Type IV or complex if they consist of multiple premises and multiple claims.

2. Toulmin model requires the analyst to identify and supply unstated inferences and the principles supporting them. This model identifies six argument parts (described in Inch & Warnick, 2002).

Part 1: Data. Functions as grounds for the claim; data are the same with the evidence.	Part 2: Claim. Functions as expressed opinion or conclusion.	Part 3: Warrant. Functions as links between data and claim.	Part 4: Backing. Functions as facts supporting the warrant qualifier.	Part 5: Qualifier. Represented by adverbs (e.g., probably) and it modifies the claim.	Part 6: Reservation. States the circumstances that undermine the argument.

3. Bendixen et al. (2003) model coded idea units in WebCT messages and rated them; messages also received a holistic score.

E- negative evidence: beliefs, opinions, speculations.	E+ positive evidence: established, supported facts and/or causal logical reasoning.	NS if statements are redundant, non-related, or incomprehensible.
Holistic 1: Posting that consisted of isolated statements.	Holistic 2: Posting missing one of the following: clear argument, supporting evidence, or conclusion.	Holistic 3: Posting that had all of these components: clear argument, supporting evidence, and conclusion.

4. Combination of argument and content analysis; messages were classified in terms of information exchange (Veerman et al., 1999).

Focus: Meaning and use of concepts.	Argumentative moves: Checks, challenges, & counters.	Constructive activities: addition, explanation, trans-formation, info evaluation.

Inch and Warnick (2002) describe two methods for analyzing and describing argument structure. The first method is referred to as the general model. According to this model there are four types of arguments. These differ in terms of the degree of complexity in their structure. Complexity is quantified by examining the number of statements in each message and the relationship(s) among them. For example, arguments can be classified as Type I or simple if they consist of one premise and one claim (e.g., "You should study harder because you received low grades"), Type II if they consist of one claim and multiple premises, Type III if there are proven claims as evidence for unproven claims, and Type IV or complex if they consist of multiple premises and multiple claims linked in various ways. Messages are diagramed in order to better understand how premises and claims relate to each other. One challenge this model presents is differentiating between premises and claims. Inch and Warnick (2002) define premises as "the most readily verifiable and least arguable statements in the argument" (p. 298). Argument analysis in the general model (as described by Inch & Warnick, 2002) consists of five steps:

1. Determine the general meaning by reading the message once or twice.
2. Number the statements in the argument by numbering complete thought units or ideas.
3. Identify the argument's main claim.
4. Construct a diagram of the argument.
5. Criticize the argument by evaluating evidence and reasoning. (p. 309)

When using the general model one can only emphasize premises that are explicitly stated. The drawback of this approach is that it does not capture unstated inferences and assumptions of an argument.

Another approach to argument analysis that Inch and Warnick describe (2002) utilizes the Toulmin model. This requires the analyst to identify and supply unstated inferences and the principles supporting them. Toulmin views arguments as field dependent; consequently, they should be looked upon as organisms which means different parts have their own functions and are related to a claim.

The Toulmin model identifies six argument parts with different functions:

1. Data which function as grounds for a claim; data are the same as evidence.
2. A claim which functions as an expressed opinion or conclusion.
3. A warrant which functions as links between data and claims.
4. Backing which functions as facts supporting a warrant.
5. A qualifier which is represented by adverbs such as probably and certainly, and modifies the claim and indicates the degree of strength attributed to the claim.
6. Reservation which states the circumstances that undermine the argument. (p. 311)

The Toulmin model emphasizes the roles and functions of each statement rather than just showing how they relate to each other, as in the general model by Inch and Warnick (2002). The Toulmin model is more difficult to apply to arguments than the general model because of the attention that must be paid to the function that statements have.

A related argument structure approach is used by Bendixen, Hartley, Sas, and Spatariu (2003), who coded idea units in WebCT messages and rated them as positive evidence, negative evidence, and non-scored. Students had to find answers to dilemmas and support for evidence, which generated discussions. This method consists of the following steps:

1. Read posting for meaning and number all statements.
2. Combine and/or split statements into obvious idea units if necessary.
3. Identify main claim(s).
4. Rate remaining idea units as:
   a. negative evidence (E-) if it consists of beliefs, opinions, or speculations.
   b. positive evidence (E+) if it consists of established, supported facts and/or causal logical reasoning.
   c. non-scored if statements are redundant, unrelated, or incomprehensible.

To assess the overall quality of each argument, each posting receives a holistic score as well. A holistic score of 1 was attributed to a posting that consisted of isolated statements. A holistic score of 2 was attributed to a posting missing one of the following: clear argument, supporting evidence, or conclusion (stated or implied). A holistic score of 3 was attributed to a posting that had all of these components: clear argument, supporting evidence, and conclusion (stated or implied). This coding system was used to analyze the argument structure of students' responses to dilemmas in an educational psychology WebCT course.

This simplified version of the general method was viewed as a valid measurement of the quality of the argument structure without the difficulties inherent in determining implied claims and premises.

The final method we will describe here is a combination of what we have referred to as argument analysis and content analysis. This methodology reflects a belief that quality online discussions are reflected in a dialogue that includes argumentative moves and constructive activities. The postings are viewed here, as in the previously described techniques, as individual statements rather than a holistic view of the dialogue.

Veerman, Andriessen, and Kanselaar (1999) analyzed discussions that occurred in three different online tools (synchronous: Netmeeting and Allaire Forum; asynchronous: Belvedere). Students participated in identical activities using the three different tools for posting messages. Three types of messages were classified in terms of information exchange: (a) focus (meaning and concepts), (b) argumentation (checks, challenges, and counters), and (c) constructive activities (addition, explanation, transformation, and evaluation). Belvedere discussions were found to be the most argumentative while Netmeeting discussions had fewer counterarguments. The Allaire Forum discussions contained the least amount of counterarguments. Most constructive activities occurred in asynchronous discussions. Very few constructive activities occurred in synchronous discussions.

Interaction-based Coding

A fundamental difference between interaction coding and the methods described above is the emphasis on the message as a part of a larger discussion. It may seem

obvious that interaction is an important component of a discussion but it is not always present in studies of online discussions. Three interaction based methodologies have been identified and described (see Table 3).

Table 3

Interaction-based Coding

1. Five exchange categories were developed. Postings coded according to level of relatedness and agreement (Schaeffer et al., 2002).

–2 (*counter*): opposition to an earlier point and introduction of a new element.	–1 (*challenge*): opposition to an earlier point without the introduction of a new element.	0 (*unrelated*): no clear reference to any other posting.	+1 (*acceptance*): support of an earlier posting without introduction of a new element.	+2 (*enhancement*): support of an earlier posting and introduction of a new element.

2. Multiple perspective takings are analyzed in messages. Two different classifications of messages were used (Järvelä and Häkkinen 2002).

Stage 0: egocentric stage. Students present very subjective and egocentric opinions. Discussions do not advance.	Stage 1: Subjective role-taking stage. Students discriminate in between subjective perspectives and others' perspectives. Discussions still do not advance.	Stage 2: Reciprocal perspective-taking stage. Students acknowledge the value of others' perspectives. Discussions advance but still not enough perspectives present.	Stage 3: Mutual perspective-taking stage. Students are able to coordinate perspectives of self and others. Discussions progress from mutual experiences to more elaborated debate.	Stage 4: Societal-symbolic perspective stage. Students conceptualize subjective perspectives. Discussions demonstrate capacity of abstracting multiple mutual perspectives.

Low-level discussions: Mainly separate comments and opinions.	Progressive discussions: generalizations and some joint knowledge building; some cross-references; not theory based.	High-level discussions: shared, theory-based discussions; involving new points or questions; rich cross-referencing typical.

3. Social network analysis; three dimensional (Nurmela et al., 1999).

(1) identify central contributors in the computer-supported cooperative learning environment.	(2) study the connections among them.	(3) study the structure of all documents.

A coding system based on Marttunen's study was used by Schaeffer, McGrady, Bhargava, and Engel (2002). They analyzed online debate activity in a policy analysis course. The purpose of the online debate forum was to promote cooperation, to encourage reflection on policy issues, and to progress students' ability to make convincing arguments. The coding category "type of exchange" was created to capture the nature of the student interactions in the discussions. The variable is based on Veerman, Andriessen, and Kanslaar's (1999) "categories of information exchange." These included whether a post was related to a previous post, and if so, whether it was agreeing or disagreeing. It also included whether it introduced a new element or simply revisited old ideas. Exchange categories were also developed by Schaeffer et al. (2002). These categories included (a) counter, implicit or explicit opposition to an earlier point and introducing a new element; (b) challenge, same as counter without the introduction of a new element; (c) unrelated, no obvious reference to any other posting; (d) acceptance, implicit or explicit support of an earlier posting without introducing a new element; and (e) enhancement, implicit or explicit support of an earlier posting and introducing a new element.

Järvelä and Häkkinen (2002) describe an additional method for analyzing the level of interaction. This method is based on Selman's (1980) sociocognitive construct of perspective taking. This framework is one of those that are difficult to classify since multiple perspective takings are analyzed in messages. Järvelä and Häkkinen described students postings in a Web-based discussion as reflecting a range of perspectives that progress from stage 0 (*egocentric*) through 1 (*subjective role taking*), 2 (*reciprocal role taking*), 3 (*mutual perspective*), and finally stage 4 (*a "societal-symbolic perspective"*). Järvelä and Häkkinen also include a classification that is less dependent upon perspective taking. These holistic categories described discussions as (a) high-level discussions, or shared and theory-based discussions; (b) progressive discussions, or generalizations and some joint knowledge building; and (c) low-level discussions involving mainly separate comments and opinions.

Social network analysis is another form of interaction analysis that is commonly found in the asynchronous learning literature. Nurmela, Lehtinen, & Palonen (1999) used this type of analysis to evaluate the social level structures and processes in a computer supported collaborative learning environment. Students worked in pairs in an educational psychology course using WorkMates4. The program allows students to exchange information through documents, comments, and questions. It also allows inserting links to other documents and marking them as "for" or "against." WorkMates4 keeps track of users' actions in a file. Data collected this way was used for observing document construction and communication structure. One important aspect of social interaction is cohesion which refers to direct interaction among students. Three directions were analyzed: (a) identification of contributors in the computer-supported collaborative learning environment, (b) analysis of connections among them, and (c) analysis of the structure of documents created by contributors. Results indicate that reading was clearly the largest (85%) document action. Three other types of document actions were also identified: finished making a new document, finished editing a document, and added a comment, question, or link to a document.

Content Analysis

Others have taken a content-analysis approach to the investigation of quality online discussions. Four content analysis methodologies have been identified and discussed (See Table. 4).

Table 4

Content Analysis

1. Henri (1992) developed an analytical model that highlights five dimensions of the learning process exteriorized in messages.

Participation: compilation of the number of messages or statements transmitted by one person or group.	Social: statement or part of statement not related to formal content of subject matter.	Interaction: chain of connected messages, explicit interaction, implicit interaction, and independent statement.	Cognitive: statement exhibiting knowledge and skills related to the learning process.	Metacognitive: statement related to general knowledge and skills and showing awareness, self-control, and self-regulation of learning.

2. Hara et al. (2002) used two frameworks to examine student interaction: cognitive skills and metacognitive knowledge

Elementary clarification: observing a problem, identify main elements and relationships among them.	In-depth clarification: analyzing and understand a problem and its underlying assumptions.	Inferencing: using induction and deduction, advancing an idea related to propositions already established as true.	Judgment: make decisions, evaluations, and criticisms.	Application of strategies: proposing actions for the implementation of a solution or following through on a decision.

Person: everything that is known about the cognitive characteristics of humans.	Task: all information acquired by a person in terms of the task or different types of tasks; appreciation of the quality of information.	Strategies: means employed to succeed in different cognitive endeavors.

3. Peterson-Lewinson (2002) developed a four dimension content analysis framework to analyze the discussions of students in three forums: readings, methods, and practicum.

Clarification: readings (responds to question), methods (discusses process of learning to teach in concrete	Judgment: readings (states and supports opinions on topic of readings), methods (states and supports opinions of learning experiences in methods classroom), &	Extension: readings (makes connections between readings and/or practicum/methods), methods (makes connections and reorganizes complexities	Application: readings (examination within the context of social/political and personal limitations), methods (complexities of learning to teach within the context of

terms), & practicum (describes what is taking place in practicum classroom).	practicum (states opinions on what is taking place in practicum).	implicated in learning to teach), & practicum (makes connections and recognizes complexities involved with teaching).	social/political and personal limitations), & practicum (multiple views/options of learning and teaching).
4. McKlin et al. (2002) report on the use of neural network software that automatically groups asynchronous messages into cognitive categories.			
(1) all messages were converted into a database.	(2) word counts performed: self-defined and General Inquirer.	(3) a neural network was trained to classify each message in categories.	(4) human-coded messages were compared to those classified by the neural network.

Henri (1992) advocates the identification of five dimensions when reviewing computer mediated communications. The five dimensions are (a) participation, (b) interaction, (c) social, (d) cognitive, and (e) metacognitive. Participation focuses on the amount of activity that occurs related to the content by counting the number of relevant messages. The social dimension refers to communications not related to the course content. Interactive messages make clear connections with other messages. Cognitive (knowledge and learning skills) and metacognitive (self-regulation) messages make each of the respective types of thinking observable.

Hara, Bonk, and Angeli (2002) used a content analysis approach to support the investigation of quality online discussions. The analysis was based largely on Henri's (1992) cognitive and metacognitive dimensions. They analyzed discussions in an online course that involved an instructional method called starter-wrapper technique. Five different dimensions were examined: (a) student participation rates, (b) electronic interaction patterns, (c) social cues within student postings, (d) cognitive and metacognitive aspects of students' postings, and (e) depth of processing ranging from surface to depth. Henri's message interactivity criteria (explicit, implicit, and independent) and Howell-Richardson and Mellar's (1996) visual representation of message interaction (surface to depth) were combined to better capture student interactions.

Hara et al. (2002) expanded the description of cognitive skills proposed by Henri to include elementary clarification, in-depth clarification, inferencing, judgment, and application of strategies. Also, metacognitive communication included personal awareness, task knowledge, and strategic knowledge.

Peterson-Lewinson (2002) used Hara and colleagues' (2002) five dimension content analysis framework to analyze the discussions of students enrolled in a science methods course. The five dimensions were participative, social, interactive, cognitive, and metacognitive. She investigated how the social and interactive dimensions of computer mediated communications influenced the level of cognitive processing

demonstrated through social discourse. Interactions occurred in each group (the class was split in groups) following three discussion forums: Readings, Methods, and Practicum. Henri's indicators of in-depth processing were used to identify reflective thinking as a cognitive process skill.

A distinct form of content analysis uses computer programs to code messages. McKlin, Harmon, Evans, and Jones (2002) report on the use of neural network software automatically grouping asynchronous educational messages into cognitive categories. The methodology consisted of four steps. First, messages were converted into a database. Second, a tool was built to perform two kinds of word counts: self-defined (define specific indicators for each category—integration, suggestion, exploration, etc.) and General Inquirer (general categories of terms). Third, a neural network was trained to classify each message as falling into one of the following categories: triggering event, exploration, integration, resolution, or noncognitive. Fourth, for reliability purposes, human-coded messages were compared to those classified by the neural network.

Most messages ended in the exploration category with very few integration messages. Findings suggest that neural networks can be used to classify messages into cognitive categories. This kind of analysis provides a more complete image of students' cognitive effort in an online learning environment. Thus it allows instructors to make instructional design changes in order to promote cognitive effort.

Considerations

The methodologies described above vary considerably in a number of respects. The clearest distinction is between the primary objectives of the analysis. Our review categories reflect these objectives. Argument structure approaches are interested in the presentation of solid arguments for positions taken in discussions. Levels of interaction approaches are designed to illuminate the amount of cross-referencing or cohesiveness of a particular discussion. In addition to the general goals of the methodology, issues of validity, reliability, and time play an important role in the decision to adopt a particular methodology.

Validity and Reliability

Once the primary objective of the analysis is identified, the next concern is to identify an approach that measures the relevant constructs. For example, if level of disagreements is used as an indicator, the results of the data analysis should provide an accurate depiction of these levels. Nussbaum et al. (2002) used as an example of this approach several levels of disagreement (e.g., outright disagreement, qualified disagreement, qualified agreement, and agreement). Another, probably somewhat less valid approach, would be to classify the posting as simply either agreement or disagreement.

In the above example, one could reasonably assume that the simpler method (agree/disagree) would result in higher inter-rater reliability. With only two categories to choose from, the opportunity for raters to differ is less. This represents a significant trade-off between reliability and validity. We recognize that this is somewhat of an oversimplification. Certainly clear criteria, illustrative indicators, and well-trained raters can result in strong reliability even with a large number of categories.

Time

Another issue that any approach must take into consideration is the time required to apply, develop, and learn the appropriate methodology. Our own research has led us to consider a variety of approaches to best meet our needs. The review of other studies has helped in that we have been able to utilize and adapt the work of others as opposed to developing coding schemes independent of other work. The levels of disagreement analysis would be faster with the simpler approach. In general the levels of disagreement approach would be less time intensive than the argument structure analysis. This is due to the complexity involved and the large number of considerations necessary to accurately model an argument's structure.

Conclusions

While not a comprehensive description of the different coding methods described in the literature, this paper represents an effort to compare and contrast different common coding schemes in such a way that researchers can determine which methods are best suited to their own research. It is worth noting that common methodologies and methods of analysis have the advantage of improving the capacity to make generalized statements based upon multiple studies. This movement towards some standardized framework may occur as a field matures; however, it behooves those completing research in this area to utilize whenever possible techniques that have a record of success.

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