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Content Analysis of Computer Conferencing Transcripts

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Abstract

As conferencing tools become an increasingly common feature in students' experience, tutors need to have an understanding of how these tools facilitate the formation and maintenance of collaborative learning communities. Inevitably the pursuit of this understanding requires some form of analysis of the interactions involved. This analysis of the written transcripts, created by students during computer mediated conferencing (CMC), invariably takes the form of a systematic content analysis. For small-scale work the analysis can be undertaken manually but when the volume is large, as might arise from courses delivered wholly online or in a blended learning approach for example, some form of automated content analysis comes into its own. Whether analysed quantitatively or qualitatively, there is much to commend this type of approach by higher education tutors wishing to assess the progress of their students and improve their understanding of how students learn through computer conferencing technology. On the basis that tutors need to have an awareness of the advantages and limitations of such tools, this paper examines the content analysis approaches currently available.

The research of Howell-Richardson & Mellar (1996), on analysing patterns of participation amongst students within computer conferencing courses, provided an interesting contemporary snap-shot of the methodological considerations in this relatively new aspect of e-learning research. Rourke, Anderson, Garrison & Archer (2003) enhanced the area of study with a systematic and rigorous exploration of the field covering the period 1990-2000. Their survey covered 19 commonly referenced studies and focused on the units of analysis, variables studied, reliability and research designs. They identified five main units of analysis that have generally been used in computer conferencing research, namely: proposition, sentence, paragraph, thematic and message units.

However, it is clear from the literature that considerable debate continues to surround the different frameworks proposed for the analysis of computer conferencing transcripts. This debate generally focuses on the appropriateness of the methodology and the representation of interaction patterns and learning processes. In this paper we propose to extend Rourke *et al.*'s study to cover a wider range of methodological models. Specifically we examine the merits and demerits of these models as exemplified in a selection of influential conferencing analysis studies.

Key words: computer-mediated communication; collaborative learning; learning communities; pedagogical issues

Introduction

The need for a content analysis approach to computer mediated conferencing (CMC) postings has been commonly recognized by the literature, with Mason (1992) and Kuehn (1994) being just some of the early advocates. Content analysis can be defined as a set of research procedures that include collecting samples of representative text, devising reliable and valid rules for categorising segments of the text and identifying and defining the target variables (Anderson, Rourke, Garrison & Archer, 2001). It is a systematic, reliable way of coding content into a theoretically meaningful set of mutually exclusive categories. As Henri (1992) has argued, content analysis provides an opportunity to reach a better understanding of learning in a CMC environment since it can help to clarify the students' cognitive processes and ways of handling information during studies. Assessing the quality of interactions and the quality of the learning experience in a CMC environment has been one of the enduring aims of this field.

Romiszowski & Mason (2004) have reported on the popular trend of regarding CMC technologies as increasingly important components of online educational environments. Being text-based, the online forum also provides a unique opportunity to conduct learning research as they have the potential to make thinking and reasoning visible to both participants and researchers. However, the utilization of CMC in education has arguably outstripped the development of appropriate theory.

One of the earliest theoretical approaches, which now underpins much of recent content analysis techniques, was developed long before CMC came to the fore. Introduced by Bales (1950), 'interaction process analysis' it was a type of very basic content analysis. At the heart of the method was a means of classifying behaviour act by act, as it occurred in small face-to-face groups. Using series of analysis methods, the data yielded indices that were descriptive of group processes and, derivatively, of factors influencing those processes.

Interactivity has long been the focus of a wide variety of studies, and Harasim (1989) has described it as the most striking characteristic of CMC and the one factor with the

greatest potential to impact learning. Jordan & Henderson (1995) have described interaction analysis as an interdisciplinary method of investigating the interaction of human beings with each other and with objects in their environment. Garfinkel (2001) observes that interaction-analytic studies see learning as a distributed, ongoing, social process, in which evidence that learning is occurring or has occurred must be found in understanding the ways in which people collaboratively do learning and recognise learning as having occurred.

However, despite a wide range of content analysis methods having been developed in the last decade, Bereiter & Scardamalia (2000) have argued that many researchers typically strive for exhaustive classification, using some predetermined scheme, and doing so simply to avoid missing out on anything. In contrast, they argue that taking the approach of asking “what is interesting here” is superior to an exhaustive classification scheme, providing there is a sufficiently well-developed conceptual framework within which to judge what is interesting. They urge researchers to be less concerned about coding, to stand back from their data, to ask themselves questions relating to the issues of interest and then to pursue the most interesting observations until they begin to yield insights.

The literature reveals that, typically, analysis of computer conferencing proceeds at a number of different levels, including measurement of the frequency and patterns of interaction, e.g. counting messages and participation rates; and categorization of messages and message content. Arguably none of these allow analysis of how collaborative learning takes place, but a combination of detailed interaction and content can significantly contribute to such analysis.

Participation analysis techniques are also useful in determining how actively and for how long participants have been engaged in a CMC session (Gunawardena, Lowe & Anderson, 1997). There is the potential to yield information on the construction of knowledge by participants or the quality of learning that has taken place. Mason (1992) has argued that, in the past, the most common methods for assessing the content and outcomes of online forums have been limited to frequency counts, message maps

showing numbers of replies and message chains, and other similar quantitative measures. One notable exception to this was Henri's (1992) work, arguably one of the most influential and sophisticated cognitive analysis models for online interaction. It examines the quality of online postings by focusing on four dimensions: social, interactive, metacognitive and cognitive. Influenced by this, researchers have been prompted to take up more challenging methods of content analysis in order to answer crucial questions related to social negotiation of meaning in CMC. Since then it has been a more common practice to perform different forms of semantic analysis in order to assess any meaning resulting from the online discussions. Given the centrality of the discussion forum to the online classroom of today, both researchers and practitioners have a stake in examining the characteristics and content of online discussions.

In terms of process, many content analyses of computer conferencing discussions can arguably be reduced to five basic steps. The first is to decide on the construct(s) to study and this is followed by selecting appropriate and representative samples of the type of communication that has been targeted for study. Using the conferencing software itself, the third step is to compile selections of transcripts or even entire transcripts into text files. The fourth step is to create an appropriate protocol for identifying and categorizing the target variables. Finally, it is necessary to code the transcript data by describing the target variables or by identifying relationships between variables. Using a content analysis system such as nVivo, Atlas or MAXqda2 the results can then be interpreted directly or after appropriate statistical analysis.

Trends in CMC Analysis: Swings and Roundabouts

The goal of online interactions has been to promote critical thinking, meaningful problem solving and knowledge construction (Marra, 2006). Jordan & Henderson (1995) have explained interaction analysis as an interdisciplinary method of investigating the interaction of human beings with each other and with objects in their environment. They observe that interaction-analytic studies see learning as a distributed, ongoing social process. Hiltz (1990) has described analysis of computer conferencing along four

dimensions: characteristics inherent to the technology; social and psychological characteristics of users; characteristics of groups adopting the technology and the interaction of all of the preceding factors. More recently, Fulford & Sakaguchi (2001) have constructed five methods of analysing the content of asynchronous discourse postings: by participants, form, content, reference to participants and function of the communication.

Following Mason's (1992) critique of the usefulness of quantitative analysis of CMC discussions, one of the developments that emerged was the use of graphical presentation of the structure and content of interaction such as "message maps". Levin, Kim & Riel (1990) had previously described a method that graphically displayed the interrelationships in sets of messages submitted to a conference – portraying the multi-threaded nature of conference interaction. Blake & Rapanetti (2001) also adopted a pictorial representation of the computer conference in the form of a directed graph or interaction map.

Several studies have indicated the potential for impact of CMC forums on meaningful learning. Studies by Newman, Webb & Cochrane (1995) and Bullen (1998), for example, reported on observations and identification of students' engagement in the process of critical thinking. Marttunen (1997), in the context of Finnish undergraduate education, used content analysis to focus on the level of argumentation and counter-argumentation in the messages and reported positive levels of both. Jonassen & Kwon (2001) recounted positive outcomes of online participation in a comparison of face-to-face (F2F) and CMC during group problem-solving activities. In their study, there were more task-related messages in the CMC group interactions than in the F2F group and their decision-making patterns were more sophisticated than that of the F2F group. Studies by Zhu (1996) and Gunawardena *et al.* (1997) illustrate the social construction of knowledge by students while Resta (1995) and Bereiter & Scardamalia (1996) have also shown how online discussions support collaborative learning.

Doubts about CMC's impact on higher order thinking skills have been raised by Garrison *et al.* (2000) while Anderson has argued (2005) that although he has been involved in transcript analysis, he finds it difficult to justify it in terms of current or even future impact on teaching and learning. The work is very labour intensive, has both reliability and validity challenges and, he argues, has to date had almost no impact on practice. Whilst agreeing with Anderson that current research stemming from the content analysis of CMC discussions is generally lacking in practical value and application, Jeong (2005) believes that the methods of interaction or event sequence analysis does allow us to examine how various factors affect two main areas. These are the likelihood that students will respond to certain types of messages depending on what is said, who says it, when it is said, and how it is said. Secondly, it allows the examination of the types of responses that are most likely to lead to the desired outcomes or improvements in group performance. At the same time, there is a need to focus study on online discussions within a specific task or objectives (e.g. debate or argumentation, brainstorming, problem-solving, etc.) and using event sequence analysis requires this.

Influential Studies: Past and Present

The earliest cited influential studies in the field of interaction were by Bales (1950) and Flanders (1970). The former investigated small group interaction processes, with an aim to distinguish between task-oriented contributions and the 'socio-emotive' element used by tutors to maintain student motivation. The latter study sought to investigate patterns of verbal interactions between teachers and students in the face-to-face classroom. In 1975, Sinclair and Coulthard reproduced this study with the same goal. All three of these early studies were descriptive in design and used units of speech for analyses.

With the advent of Internet technology in the 1990s, educational research began to focus on CMC. In a descriptive study with 80 undergraduate education students, Ahern, Peck & Laycock (1992) used messages as the unit of analysis to examine interaction and the complexity of response between students. It was not until the late 1990s that thematic analysis began to emerge as the unit of choice for analysis of CMC and, as was mentioned above, a study by Henri (1992) proved seminal in promoting it as the way

forward. Proposing five key areas for investigation, using themes for analysis, made this a comprehensive and much cited study. Participation was deconstructed into rate, timing and duration of messages; interactivity was explored for explicit and implicit interaction; social events were categorized as dialogue unrelated to problem content; cognitive effects included clarifications, making inferences, judgment and strategies; and metacognitive events were deconstructed into knowledge (person, task, strategy) and skill (evaluation, planning, regulation, self-awareness).

The mid to late 1990s witnessed a range of descriptive and quasi-experimental studies using both message and thematic units of analysis. Mower (1996), McDonald (1998) and Blanchette (1999) explored interaction, the latter conducting a descriptive and quasi-experimental study with 17 participants on a graduate degree programme. This study scrutinized the linguistic variation in the online discussions, in particular looking at syntactic structure, cognitive functions, pedagogical features, and communicative characteristics of questions. Hillman (1999) sought to compare face-to-face and CMC interactions with students through an exploration of patterns of interaction. Critical thinking was a common area for investigation at this time, with studies by Newman *et al.* (1997), Marttunen (1997, 1998) and Weiss & Morrison (1998) focusing on levels of analytical thinking, argumentation and counter-argumentation, and levels of understanding and correcting misunderstandings respectively. Bullen's (1998) study with 18 students on an undergraduate computer information systems course was also designed to investigate levels of participation and critical thinking amongst students. Knowledge construction was also a popular variable for analysis and descriptive studies by Zhu (1996) and Kanuka & Anderson (1998) explored the construction of knowledge in group settings.

From 2000, interest in levels of participation, interaction and critical thinking began to emerge again in a series of descriptive studies. They were notable for choosing to adopt different units of analysis: Fahy *et al.* (2000), for example, used the sentence; Garrison, Anderson & Archer (2000) used the whole message; and Hara, Bonk & Angeli (2000) used the paragraph. As previously noted, Rourke, Anderson, Garrison, Archer (1999);

2001) progressed the field with a concentrated exploration of social interaction amongst students in the online environment. Since 2000, however, a number of new approaches to analysing CMC discussions have also emerged, some quantitative and some qualitative. A synopsis of these is offered in Table 1, with the main criterion for inclusion being their citation by a number of other studies focusing on the design and implementation of content analysis in a variety of contexts in higher education. The table aims to enable readers to identify characteristics of the studies that most meet their needs or preferred methods.

For example, the first column shows that the studies have crossed several disciplines including business, computing, teacher education and psychology. In most cases the sample size is small to medium (max. 90). The majority of the studies (Aviv, Erlich, Ravid & Geva, 2003; Blake & Rapanati, 2001; Craig *et al.*, 2000; Hammond & Wiriyapinit, 2005; McKenzie & Murphy, 2000 and Murphy & Ciszewska-Carr, 2005) focus on the message as the unit of analysis with Aviv *et al.* (2003) and Murphy & Ciszewska-Carr of particular interest inasmuch as they offer message categorization: physical, syntactical, referential, propositional and thematic in the former, and semantic and syntactic in the latter. Curtis & Lawson (2001), Ham & Davey (2005), LePage & Robinson (2005) and Pena-Shaff, Altman & Stephenson (2005) focus on thematic approaches. For those willing to try more macro approaches, the study by Gilbert & Dabbagh (2005) focuses on single and cross-course units of analysis while Riley (2006) uses numerical frequency of participation and types of talk.

Perhaps more pertinent for prospective and existing researchers is the fourth column, covering the variables studied. The variety is predictably more pronounced than the units of analysis might suggest. For example, the studies carried out by Hammond & Wiriyapinit (2005), LePage & Robinson (2005) and McKenzie & Murphy (2000) concentrate on participation, while Craig *et al.* (2000), Curtis & Lawson (2001) and Riley (2006) focus on aspects of reasoning and collaborative working. Knowledge construction is the main aspect of the studies by Aviv *et al.* (2003) and Pena-Shaff *et al.* (2005) while Blake & Rapanati (2001), Gilbert & Dabbagh (2005) and Ham & Davey (2005) address

interaction and dialogue. The fifth column demonstrates the range of methodologies on offer among the studies, including case study, action research and basic description. The various attributes of the studies above, and a selection of 19 studies covered by the Rourke *et al.* (2003) review, will be developed further in the next sections.

The contents of Table 1 evidence the fact that a wide range of models and frameworks for classifying the output of discussion forums, each supporting a theoretical perspective, have been discussed in the literature. Wilson & Whitelock (1998), for example, had proposed a model that analyses a range of student interactions in an asynchronous online discussion environment and ascribes each to knowledge, motivation or social dimensions. The seminal framework, developed by Henri (1992) and mentioned earlier, proposed four dimensions of analysis: social, interactive, metacognitive and cognitive. There has been criticism of this model suggesting that the “limitation of Henri's method of analysis is that it was designed for contexts where there was a strong teacher presence, and is not readily applicable to learner-centred conferencing environments” (McLoughlin & Luca, 1999, p222). However, it is debatable whether this model lessens the role and influence of the tutor.

All the studies outlined in Table 1 have faced methodological challenges in creating and applying valid indicators that reflect the quality and extent of deep and meaningful approaches to learning facilitated in a computer conferencing environment. The challenge for all is to choose indicators that are specific enough to be meaningful, but still broad enough to be usable in the actual analysis of transcripts. The work of Gunawardena *et al.* (1997) is useful in its social constructivist approach that is an elaboration of Henri's work. Their model describes “five phases moving from knowledge sharing to knowledge building” (p414), which can usefully lead to establishing frameworks around communal and cognitive uses of the discussion forum. Garrison *et al.* (2000) have also argued that a further important issue for consideration is that these indicators must be parsimoniously categorized within the main elements of a community of inquiry or group learning situation so that coherence and meaning are clear.

Units of Analysis: Which one should I use?

There are different ways of categorizing units of analysis but the classification by Aviv *et al.* (2003) is useful: physical units (messages), syntactical units (words or statements), referential units (messages sent by a particular person), propositional units (identified by having a predefined structure), and thematic units (identified by definitions of various contents). A common type of unit of analysis in an online discussion transcript is the syntactic unit or fixed unit which includes a sentence, paragraph or whole message. These are delineated by graphic conventions such as indentation of a new paragraph, a period at the end of a sentence or a heading preceding a message (Howell-Richardson & Mellar, 1996). Researchers have used all three types of syntactic units and have identified their value in particular contexts. Specifically this is that they are “instantly recognizable” in a text (Rourke *et al.*, 2001, p12) and within transcripts they are both obvious and constant (Fahy, 2001). Hillman (1996) and Fahy *et al.* (2000) have also used the sentence as a unit of analysis. The paragraph is a larger grained unit of analysis and this has been used in studies by Hara *et al.* (2000) and Rourke *et al.* (2001)). Others including Marcelo *et al.* (2002), Khine *et al.* (2003), Aviv *et al.* (2003) and Anderson *et al.* (2001) have used the whole message as a unit of analysis. Clearly, it is the case that of all syntactic units, the boundaries of a message are very clearly defined in any context of computer conferencing. Arguably, this characteristic makes it a reliable tool with which to conduct coding. The objective and unambiguous identification of the syntactic unit in a transcript highlights its reliability for conducting analysis with multiple coders, but it also has several limitations. The first of these is related to identifiability, which is the challenge to a coder of choosing different types of syntactic units. There is a second, very practical, limitation of the syntactic unit, and this relates to its feasibility. The choice of syntactic unit may place impractical demands on coders and the coding process. An example of this is the use of a sentence proving problematic with long and multiple transcripts. Clearly in studies which have a large number of cases to analyse, using the syntactic unit could place a burden on resources.

There is growing use of the thematic unit in content analysis of online discussions, made popular by Henri (1992). Aviv *et al.* (2003) suggest that thematic units are the most

preferable since they are related to the context in which the analysis will be performed. However it is worth bearing in mind the constraints with this unit associated by a number of researchers. The thematic unit has been described as “ill defined” (Howell-Richardson & Mellar (1996, p51), leading to inconsistency in identifying the unit. Fahy *et al.* (2000) have noted the difficulties of identifying units of meaning within discussion transcripts as they are “not discrete or identifiable on the basis of consistent criteria” (p86). The lack of specific criteria for identifying semantic units has a direct impact on reliability, or more specifically, reproducibility in content analysis studies where a unit of meaning has been chosen for analysis. Murphy & Ciszewska-Carr (2005) contrasted results obtained using semantic and syntactic units of analysis in the context of online asynchronous discussions. They recommend that ultimately the choice of unit needs to take into consideration the implications for the particular context of the discussion, and also issues of reliability, feasibility and identifiability in relation to the choice of unit.

Overall the studies reviewed by Rourke *et al.* (2003) and those introduced here, suggest that most existing research has used message analysis, often citing it as a unique method for those researching asynchronous online discussion. However, there is also a tendency to be over-reliant on a single, or dominant, method of data collection.

Conclusion

It has been argued in the literature that analysis of CMC transcripts provides a powerful means for understanding eLearning. Various researchers have developed models and tools to facilitate this analysis. Clearly, there are limitations in using quantitative message analysis alone in that, while it gives a broad overview of group activity in an asynchronous online discussion, it gives no direct insight into the experience of the learners, or their perspective on the nature of the discussions that have taken place. Quantitative overviews should therefore be complemented by content analyses whose value lies in describing the nature and scope of discussion forums.

One lesson from the studies examined in this paper, and arguably holding no surprises for anyone who is familiar with this type of research, is that over-reliance on a single or dominant method of data collection should be avoided if a comprehensive understanding of what is going on is to be achieved. It is important to use a variety of data sources and analysis techniques to meet research objectives. Although transcript or content analysis has its limitations, interesting insights can emerge when combined with focus group interviews and observations. This is particularly the case when one looks closely at the types of learning happening and the types of interactions that participants have. As its essence, content analysis provides a set of data against which learner perceptions may be compared and contrasted. Findings from such different methods of data collection can be examined in respect to consistency or contrast, where a match between findings is sought or where contradictory findings emerge. The potential for a third category, complementarity, is also strengthened by multiple data sources and methods, as findings derived from one method may add a perspective unavailable, or simply not apparent, from the findings that arise from another method. Finally,

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