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ABSTRACT

A "cognote" system was developed for coding electronic discussion groups and promoting critical thinking. Previous literature has provided an account of the strategy as applied to several academic settings. This paper addresses the research around establishing the inter-rater reliability of the cognote system. The findings suggest three indicators of reliability: (1) raters assign similar grades to student's discussion group contributions; (2) raters predominantly assign the same cognotes to student's discussion group contributions; and (3) raters are selecting in excess of 50% of the same text in assigning the same cognotes. (Contains 18 references.) (AEF)

INTER-RATER RELIABILITY OF AN ELECTRONIC DISCUSSION

Inter-rater Reliability of an Electronic Discussion Coding System

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Abstract

A "cognote" system has been developed for coding electronic discussion groups and promoting critical thinking. Previous literature has provided an account of the strategy as applied to several academic settings. This paper addresses the research around establishing the inter-rater reliability of the cognote system. The findings suggest three indicators of reliability namely: 1) that raters assign similar grades to student's discussion group contributions, 2) that raters predominantly assign the same cognotes to student's discussion group contributions and 3) that raters are selecting in excess of 50% of the same text in assigning the same cognotes.

Inter-rater Reliability of an Electronic Discussion Coding System

Constructivist learning environments are sought after by teachers of both face-to-face courses and internet-delivered instruction. The notion that learners best engage new ideas by negotiating meaning with peers in their learning group, is widely promoted by proponents of social constructivism (Bonk & Cunningham, 1998; Duffy & Cunningham, 1996; Newman, Griffin & Cole, 1989; Scardamalia, & Bereiter, 1994; Vygotsky, 1978, 1989)

Electronic discussion is arguably the single most powerful tool for building learning communities in online learning. The success of electronic discussion in responding to this challenge, may hinge on the choices the instructor makes around assessment (MacKinnon, 2000). The range of strategies include: 1) an open forum with no assessment and little instructor participation, 2) grading based solely on participation, 3) scoring rubrics that value addition of new ideas or responses to existing postings and 4) analytical rubrics that value higher-order discussion. Traditionally, instructors have found that the less-structured open forums have a tendency to foster less productive discussion yet allow for a certain spontaneity in students contributions.

Coding Electronic Discussion for Critical Thinking

Most recently the cognote system has been developed (MacKinnon & Aylward, 2000) for application to electronic discussion. The cognotes are a series of icons that represent distinct argumentation styles (see Table 1). Using Microsoft Word macros, these codes can be assigned to student's captured discussions thereby providing feedback and acting as "critical thinking prompts". The coded discussion is returned to students by email attachment. Because the experience has been prefaced with a set of class coding exercises, students readily recognise the cuing that the cognotes imply. The codes each have a grade associated with them depending on

the level of cognitive engagement they represent. Students accumulate grades up to maximum set by the instructor. Prior to the next discussion, students have the benefit of reflecting on their past discussion patterns and making improvements in their argumentation styles. This approach was taken based on the research that suggests that metacognitive exercises can promote academic learning (Paris & Winograd, 1990; White & Mitchell, 1994).

The Nature of the Codes

In order to design a system for practical use, the instructor must first decide which discussion patterns are most valued. This research was designed around nine categories of discussion based on hard copy student journal coding (Knight, 1990). These categories include:

- Acknowledgement of opinions ("That's a very good point.");
- Questions ("What could you do to protect the child's self-esteem?");
- Compare ("I've seen evidence that students behave the same in Art Class and Physical education.");
- Contrast ("That classroom management situation is quite different because of the setting ...");
- Evaluation ("In my opinion that argument holds little credence.");
- Idea to example ("Examples of irony in Shakespeare's MacBeth are...);
- Example to idea ("The main theme of the novel "Barometer Rising" is ...);
- Clarification/elaboration ("I think what I am hearing is that your concerned about gender differences, but I am wondering whether another factor may be their age.");
- Cause and effect. ("The impact of that behaviour is of course reduced instructional time.")

The category of discussion is associated with a simple representative graphic called a cognote. The graphic was created as a symbol for a toolbar in Microsoft Word®. The electronic discussion was copied from an html environment into Microsoft Word®. In Word, a toolbar wass prepared that included all of the cognotes. This constituted a template into which students captured discussions could be copied and then coded. A macro (prepared in Microsoft Word®) was then written that assigned a cognote to highlighted text within the document. The document was then saved with the cognotes in place and subsequently returned to the electronic discussion participant.

Instructor Coding

The first coding study (Aylward & MacKinnon, 1999) involved three successive two-week electronic discussions on gender issues in science education. The instructor coded student's work and returned it in between each session. In the first electronic discussion, students accessed many of the lower-level discussion patterns (i.e. 1 point in value rather than 2). However, over the three electronic discussions it was clear (see Figure 1) that students were participating in more substantive ways by accessing higher-order participation strategies with a concomitant decrease in volume of writing. Transferability of these skills to other less-structured electronic discussions remains an interesting question that is currently being investigated (Pelletier, MacKinnon & Brown, 2002).

Student Coding

A second study was undertaken (MacKinnon& Bellefontaine, 2000) involving students in a Middle School teacher education course. In this setting, students were asked to code each other's work as they both participated in and coordinated an electronic discussion. Students participated in preliminary coding exercises that introduced the cognotes and the technology to

them. Each student (n=30) had their electronic discussion coded and returned by three other students (the coordinators of their discussion) in their class. This process was repeated in three successive electronic discussions around a middle school case study. Individual raters had no indication of what the other raters had assigned as a grade to a particular student's electronic discussion contribution. The coordinators of the electronic discussion had a vested interest in promoting substantive electronic discussion. They were required to capture electronic discussion quotes and embed them in a case study report. In follow-up focus group interviews, students identified this process as a constructive exercise.

Generalizability to Other Settings

The coding system has been assessed in several teacher education settings including science education, middle school education, physical education and inclusive education (MacKinnon, Pelletier & Brown, 2002). It remains to be seen whether cognotes can be used in other subject areas, however a more important question has emerged from the second study (MacKinnon & Bellefontaine, 2000). Assuming students are prepared to assign codes (based on a tutorial session), can we be sure that students will access and assign the cognotes to their peers work in the same way? The cognotes are essentially an analytical rubric and therefore inter-rater reliability is a concern. The data to answer this question is available from the middle school course research.

Do Students Code the Same?

Prior to coding their peers work, students are provided with representative text and "mock discussions". In the exercise, the students have an opportunity to compare their assigned codes to those of their peers and the instructor. The group reaches a consensual understanding of the cognote implications (for those particular exercises) in an effort to promote reliability.

In this study there were 30 students in a Middle School education course. Each of these students was involved in three successive and independent electronic discussions. Each student's discussion was captured and coded by three other students. Students (raters) assigned a grade (out of ten) to each of three participants in a designated electronic discussion. Figure 2 shows a random sample (n=15) of total grades for a single discussion. In this typical sample, it is evident (see also Table 2) that the total grade for each student, being assigned by three independent raters, is within one grade in most instances. It is quite reassuring that the standard deviation in the case of this sample and the larger sample (n=30) is relatively small (sd=0.58). This would suggest that raters are assigning very near the same grade to the same captured discussion, however this does not mean they are necessarily assigning the same codes to arrive at that total grade.

To answer this question requires a closer discourse analysis (Cazden, 1988; Edwards & Westgate, 1994; Lemke, 1997, Young, 1992) of the empirical coding captures. From the most global perspective, one can simply analyse which codes are being assigned in the total discussion and compare that across the three raters. That analysis follows.

Patterns in Assigning Codes: Problem Areas.

Table 2 shows a sample of the cognotes assigned for fifteen students in a single electronic discussion, the third session of three consecutive electronic discussions. The data for all thirty students was tabulated in a similar manner and analysed for patterns.

The following characteristics seemed most prominent in the data:

1. Students at times seem to have trouble distinguishing the inductive versus deductive thinking pattern.
2. A contribution which amounted to "posing a question" was never ambiguous.

3. In the instance of compare or contrast discussion patterns there was rarely ambiguity.
4. The evaluation icon represent an unsubstantiated opinion. This sometimes was confused with a cause & effect pattern.

The problems of consensual assignment of cognotes has since been addressed in preliminary exercises which emphasize the aforementioned ambiguities. In the case of inductive versus deductive patterns, informal member checks established that this was simply a "which is which" problem with students, thus simply requiring a reiteration of the definitions with accompanying examples. In the case of the evaluation icon, some students had the misconception that this cognote implied the "weighing" of perspectives followed by an informed judgement. This understanding could then in turn be easily confused with cause and effect. In informal interviews it became clear that the misconception arose because of the choice of icon graphic. To this end the icon has since been changed to better reflect the implied "unsubstantiated opinion" category.

Given that the amount of coding assignment ambiguity is relatively small (primarily due to the preliminary comprehensive practise exercises), attention was then turned to the highlighted text itself. The question emerges, whether the cognotes are being assigned to exactly the same portions of text in the discussion.

Are Students Coding the Same Portions of Text

This is clearly a very difficult question to answer except by inspection and comparison. The following approach was taken in order to provide a cursory glimpse of the trends that may be emerging. In a single electronic discussion, each student's work was coded by three raters. For a random sample of ten students, the coding of their contributions was analysed in a particular way.

Assume one is to examine a single student's contributions. More specifically let us look at rater one's first highlighted entry and consider the start and end of the text (hereafter SET) for which they assigned a particular cognote. We then compare this to the second rater's SET for the first highlighted entry. We look for overlap in the SET's selected and attempt to quantify this. To avoid a so-called mismatch, a decision was made to only consider SET comparisons when the cognote was identical for SETs that were considered overlapping (see Figure 3). One way of flagging the overlap is to count the number of sentences that indeed are part of the over lap compared to those that aren't. In Figure 3 then, one would count two sentences of overlap compared to two sentences excluded.

This rudimentary approach generated the average values shown in Table 3. All values are rounded to the nearest whole number. Admittedly there are inherent problems with choosing to quantify the overlap in this way. Nonetheless the data serves as a point of discussion if not rigorously generalisable.

In this random sample of ten students from a single electronic discussion, it appears as though the raters are coding at least 50% of the same text blocks (SETs) with some consistency.

What can we say overall?

The above study suggests the following:

1) Student raters when posed with the task of coding an electronic discussion using the cognote system, will typically generate grades within one mark of one another for the identical coded text.
2) Raters, after three consecutive electronic discussions, tend to assign the same cognotes to student's contributions with the exception of a lingering confusion between (a) inductive

and deductive thinking patterns and (b) the evaluation and cause and effect categories. These ambiguities were also addressed and corroborated in focus group sessions.

3) A rudimentary analysis of the textual discourse suggests that raters tend to code at least 50% of the same text for the equivalent cognote category.

The study above attempts to establish that there is some measure of reliability in the use of the cognote system to evaluate electronic discussion. There is no doubt that more complete discourse analysis of the SET data can lend additional support for the cognote reliability. The challenge remains to develop valid research techniques for analysis of this unique data format.

Implications for Further Work

The cognotes have been used in a variety of subject areas with a notable improvement in electronic discussion contributions. The reliability of the instrument can be addressed more analytically, however early indications are that, raters tend to use the same cognotes to assess a discussion item and in turn arrive at a similar grade for the participant.

All of the studies to date have involved asynchronous discussion connected with a face-to-face course. The obvious extension of this tool is to investigate truly online environments. Because good discussion is paramount to online learning, it would seem that the cognotes could have great potential in this educational venue.

In an effort to promote critical thinking, this investigator chose a particular group of higher-order discussion patterns. It is quite possible that additional cognotes are necessary. Qualitative interviews of raters should confirm whether this range of cognotes was sufficient to account for all categories of discussion patterns. Conversely there may be sufficient overlap in some cognotes such that fewer cognotes categories would suffice. In early studies it was evident that students needed time to become accustomed to the variety of cognotes and the way in which

the cognotes manifested themselves in real discussions. Fewer cognotes may help students to "learn" the system more quickly. Again, further interviews with raters should establish whether this is a viable concern.

Arguably the success of the cognote system is only truly recognised when the model is embedded in a constructive exercise. When the students recognise that good discussion will impact their work in some tangible way, the vested interest impacts the learning. Using the cognotes has proven to promote critical thinking patterns either through sheer practise or the fact that a grade is assigned to the work. As this tool is used in more settings it should become clear whether students retain the process skills which they acquire through use of the cognotes.

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Table 1

Cognote Icons and Critical Thinking Cues

Specific Interaction	Grade	Coding Icon
Acknowledgement of Opinions (evidence of participation)	1	
Question (thoughtful query)	1	
Compare (similarity, analogy)	2	
Contrast (distinction, discriminate)	2	
Evaluation (unsubstantiated opinion/judgement)	1	
Idea to Example (deduction, analogy)	2	
Example to Idea (induction, conclusion)	2	
Clarification. Elaboration (reiterating a point, building on a point)	2	
Cause & Effect (inference, consequence)	2	
Off-Topic/ Faulty Reasoning (entry inappropriate)	0	

Table 2

Coding Distribution Amongst Raters

Student/Coder											Total Grade
1A	1	1	2		1	1					9
1B	1	1	2		2	1					10
1C	1	1	2		1	1					9
2D	2		1		2		1	1			10
2E	1		1		3		1	1			10
2F	1		1		3		1	1			10
3G	2			2	2						8
3H	2			2	1			1			9
3I	2			2	2						8
4J	1	1			3	1		1			9
4K	1	1			3		1	1			9
4L	1	1			3	1		1			9
5M	1		1	1	1			1		1	8
5N	1		1	1	1				1	1	8
5O	2		1	1	1				1		9
6P	1	1	2			1		1			10
6Q	1	1	2			1		1			10
6R	1	1	2			1		1			10
7S	1	1			4				1		8
7T	1	1			3			1			7
7U	1	1			3				1		7
8V	2		1	1	1				1		9
8W	2		1	1	1				1		9
8X	2		1	1	1				1		9
9Y	1			1	2	1		1		1	9
9Z	2			1	2	1		1		1	10
9AA	1			1	2	1		1		1	9
10BB	1				3	2					8
10CC	1				2	2					7
10DD	1				2	2					7
11EE	1	1	1	2	1						9

11FF	1	1	1	2					1	10
11GG	1	1	1	2	1					9
12HH	3	1				1			1	8
12II	2	1					1		1	7
12JJ	3	1				1			1	8
13KK		1	1		1	1		1		8
13LL		1	1				1	1		7
13MM		1	1			1		1		7
14NN	2			1	1	1				7
14OO	2			1	1	1				7
14PP	3			1	1	1				8
15QQ	1	2				2		1		9
15RR		2				2		1		8
15SS		2				2		1		8

Table 3

A Comparison of Raters and SET data

Student	Rater Comparison	Average % Overlap	Student	Rater Comparison	Average % Overlap
1	R1:R2	65	6	R1:R2	78
	R1:R3	60		R1:R3	74
	R2:R3	68		R2:R3	70
2	R1:R2	75	7	R1:R2	80
	R1:R3	77		R1:R3	82
	R2:R3	66		R2:R3	76
3	R1:R2	50	8	R1:R2	61
	R1:R3	75		R1:R3	58
	R2:R3	69		R2:R3	74
4	R1:R2	50	9	R1:R2	66
	R1:R3	50		R1:R3	72
	R2:R3	65		R2:R3	77
5	R1:R2	75	10	R1:R2	56
	R1:R3	77		R1:R3	52
	R2:R3	75		R2:R3	58

Figure Captions

Figure 1. Trends in Electronic Discussion Contributions Over Three Sessions.

Figure 2. Grading Totals for Individual Raters.

Figure 3. Comparing SET's of Two Raters.

Figure 1

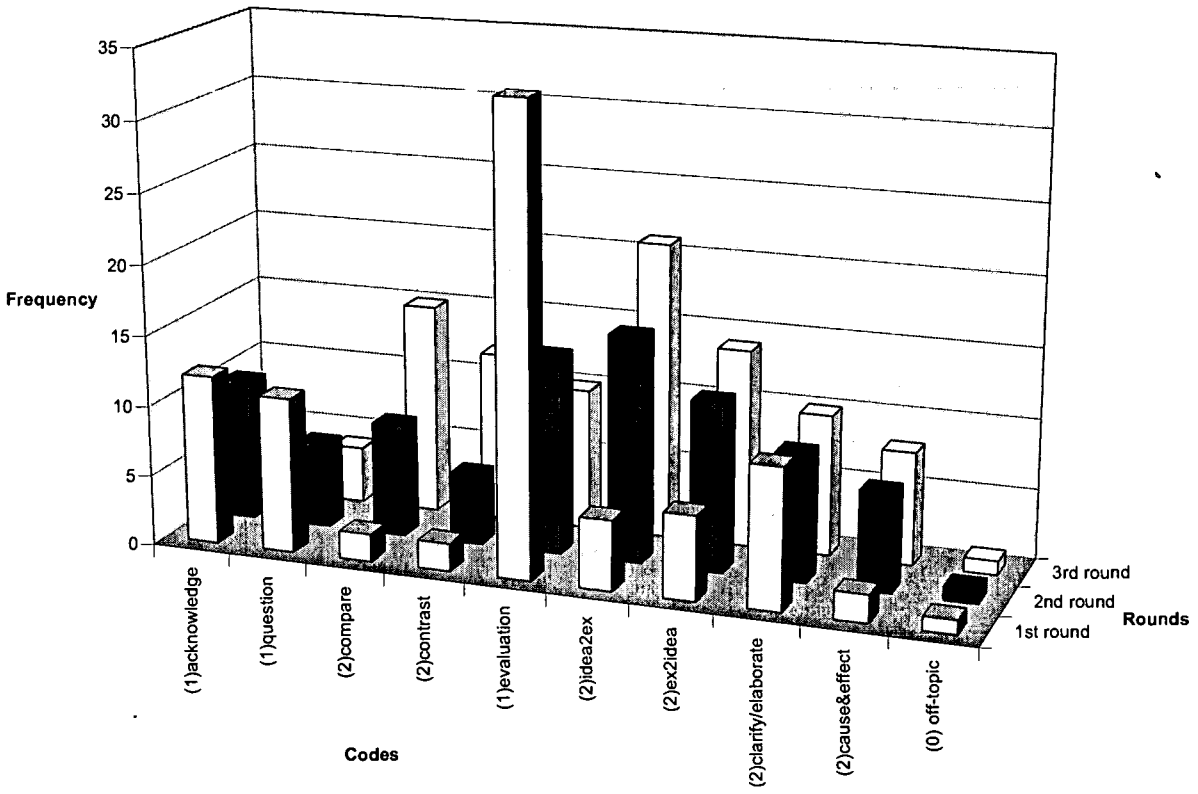
35
30
25
20
15
10
5
0
Frequency
(1)acknowledge
(1)question
(2)compare
(2)contrast
(1)evaluation
(2)idea2ex
(2)ex2idea
(2)clarify/elaborate
(2)cause&effect
(0) off-topic
Codes
3rd round
2nd round
1st round
Rounds

Figure 2

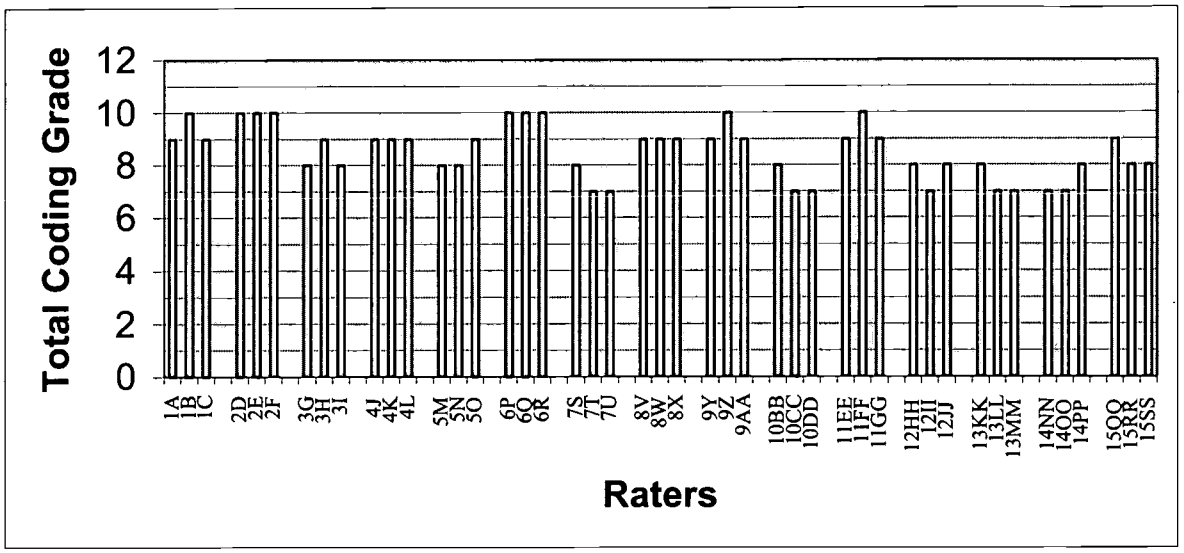
Total Coding Grade
12
10
8
6
4
2
0
1A
1B
1C
2D
2E
2F
3G
3H
3I
4J
4K
4L
5M
5N
5O
6P
6Q
6R
7S
7T
7U
8V
8W
8X
9Y
9Z
9AA
10BB
10CC
10DD
11EE
11FF
11GG
12HH
12II
12JJ
13KK
13LL
13MM
14NN
14OO
14PP
15QQ
15RR
15SS
Raters

Figure 3

Rater One

The principal might consider having a mini in-service in the school to recap what was learned in the summer. This could entail small group discussions on how a successful middle school team works. If all the teachers in the school were involved Janet might not feel victimised. She might begin to see the value of the new philosophy if all her fellow teachers share the same excitement for it.

Rater Two

The principal might consider having a mini in-service in the school to recap what was learned in the summer. This could entail small group discussions on how a successful middle school team works. If all the teachers in the school were involved Janet might not feel victimised. She might begin to see the value of the new philosophy if all her fellow teachers share the same excitement for it.

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