

Finding Patterns of Argumentation Processes in Knowledge Building Discourse

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Abstract: This paper reports the analysis of the online discourse of students on an online platform in a Hong Kong primary school. A framework is adopted to identify the relationship of argumentation and knowledge building discourse, which integrates a category of argumentative speech acts. This paper puts emphasis on the effect of argumentation in knowledge building processes, and provides insight on patterns in secondary students' online threaded discussions. It is found that argumentation process is regarded to play an effective role in the process of collaborative knowledge building, at least in the first couple of notes in a sustained thread.

Keywords: argumentation, knowledge building, automatic coding

1. Background

While the importance of argumentation has been highlighted in the theory of problem solving, the role of argumentation is seldom involved as an aspect in assessing the quality of knowledge building. Scardamalia and Bereiter [1] state that knowledge building discourse is a commitment to progress, to seek common understanding other than simple agreement, to expand the basic facts. They regard the argumentation and debates in students' discussion as superficial mode which is inaccessible to progressive knowledge building. Knowledge building is considered to take on more constructive and progressive character [2]. In this study, argumentation process is regarded to play an effective role in the process of collaborative knowledge building, at least in the first couple of notes in a sustained thread.

According to some previous literature, argumentation is defined to include activities such as giving reasons, persuading, convincing, or demonstrating a point of view [2]. In order to scaffold collaborative argumentation in CSCL context, there is a need to classify the "speech act" and label each note of students to a specific model of the argumentation process. van Boxtel[4] developed a coding scheme for characterizing students' face-to-face communicative activities, which has also been successfully adopted in a computer-mediated collaborative learning environment [5] (Saab, van Joolingen, & van Hout-Wolters, 2005). van Boxtel's categorizational model of argumentation includes continuation, reason, condition, consequence/conclusion, disjunctive, counter (i.e. rebuttal), and evaluation. Law and her team have modified the van Boxtel's coding scheme and put forward a framework that denotes argumentation discourse markers by identify some important lexical terms. Two categories, continuation disjunctive, and evaluation in the original coding system were removed due to the difficulty in machine processing and ambiguity in colloquial representation. Three new categories which were frequent emergent in the experimental data : (a). "I think", "I agree", or "We should" to

state claims, (b) “Why”, “What”, and “How” to ask Question, and (c) “Also” or “Besides” to indicate the cohesion of the argument (See Table 1 for examples).

Table 1. Categories of argumentative speech acts and the associated discourse markers

Category	Discourse Markers	Rules and Samples
Reason	because, since	Because Since ... or ... because since... Eg. <i>Since</i> it is unclear how global warming will affect climate on a regional or local scale, ...
Condition	if	If ... or ... (,) if... Eg. ...but we all know that there would be many problems <i>if</i> global warming is not solved
Consequence	then, thus, so, therefore	So Then Thus Therefore ... or ... so then thus therefore ... eg <i>So</i> I do not agree with you.
Contrast	but, though, although, however, even, otherwise	But Though Although However Even Otherwise,... Or ... but though although however even otherwise ... Eg. <i>But</i> we need to mention that because of the ozone layer, global warning occurs.
Elaboration	moreover, such as	Moreover Such as... or ... moreover such as ... Eg. ... we need to use woods to produce some IMPORTANT products , <i>such as</i> paper , table ect
Claim	I think, I agree, We should	I think... I agree... We should <actions> Eg. <i>I think</i> UV is a type of radiation what we have learnt in physical.
Question	What, Why, How	What {is are} <noun_description>? What's the definition of <noun_description>? Why {can do does} <clause_description>? Why <verb_description> <noun_description>? Why can spaceflight help humans develop a better world? How to <verb_description> <phrase_description>? How {do did can could}<clause_description>? Eg. <i>What</i> do you mean by rising of climate?
Rebuttal	"I don't think", "I don't agree", "we shouldn't"	I don't' think I don't agree we shouldn't... Eg. <i>I don't think</i> global warming is just only a probelm.

2. Method

2.1 Evaluation of coding results

The automatic coding with argumentative markers is examined mainly by two criteria, which are precision and recall rate.

$$\text{Definition1. Precision} = \frac{\text{The number of correct auto coding}}{\text{The total number of auto coding}}$$

$$\text{Definition2. Recall rate} = \frac{\text{The number of correct auto coding}}{\text{The total number of manual coding}}$$

Besides, we can also calculate the number of the records of each sort of coding that have been manually coded. By this way the mechanism of auto-coding system can be optimized.

2.2 Design

The knowledge building activity was a collaborative effort between Teacher A and a teacher from school B (Teacher B). These two teachers had been actively involved in a Knowledge Building Teacher Network which was set up by the Centre for Information Technology at the University of Hong Kong. The two teachers agreed to arrange for their students to conduct knowledge building activities on the topic of global warming. This online discussion took place over a period of about 6 weeks. For school A, the activities involved the same class of grade 9 students. For school B, it involved 34 students from three classes of grade 7 who volunteered to take part in this activity as extra-curricular learning (these students had some level of prior exposure to working with KF). The teachers did not pose specific questions on global warming for the students to work on. Students generated altogether 193 notes.

2.3 Data analysis

Besides using the computer to automatically label the discourse markers for each notes, scaffolds on KF is also observed as a comparison. In this experiment, 13 scaffolds on KF are set by the teacher to help students advance their understanding of collaborative knowledge building. In order to run the data mining analysis on this set of data, other indicators are also included (See Table 2). Table 3 summarizes the results for the students from the two schools who took part in the online discussion on “Global warming” collaboratively. It can be seen from these results that students in school B had lower levels of engagement than those in school A in terms of the number of arg-markers used.

Table 2. A framework of developing indicators to investigate the relationship between argumentation and knowledge building

Argumentation Markers	Reason ; Condition ; Consequence ; Contrast ; Elaboration ; Claim ; Question ; Rebuttal ; Cohesion
Scaffolds on KF	A better theory; Conclusion; Different Opinion; Evidence; Examples; Examples; My theory; New information; Opinion; Putting our knowledge together; Reasons; Source of Information; This theory cannot explain
Other indicators	- Starting notes from within threads; - 1st built-on notes within threads; - Starting notes from in the non-thread; - 1st built-on notes from in the non-thread; - thread; - non-thread; - School A; - School B

Table 3. The mean number of arg-markers used by students in the two schools of knowledge building work.

Discussion notes analyzed	Total no. of students (N*)	Number of argument markers used by students		
		min	max	mean
School A	29	1	26	10.9
School B	20	0	34	5.4

* This denotes the total number of students who contributed at least one note to the discussion.

There is a tool named “Concept Explorer” (ConExp), which could help to detect the relationships between specific values of categorical variable in a large data sets. The input data here is generated based on the argumentation markers, KF scaffolds and other indicators (See Figure 1).

A	B	C	D	E	F	G	H	I	J	K	L
	Reason	Condition	Consequence	Contrast	Elaboration	Claim	Question	Rebuttal	Cohesion	A better the...	Conclusion
1				X			X				
2				X					X		
3	X		X	X							
4		X	X	X			X		X		
5						X					
6							X				
7											
8						X					
9	X										
10		X									
11		X					X				
12									X		
13						X				X	
14			X					X	X		
15	X		X	X					X		
16			X	X	X	X			X		
17					X		X				
18					X		X				
19											
20			X				X				
21			X				X				
22				X							
23							X				
24		X		X					X		
25											
26	X	X	X	X				X			X
27	X	X	X	X					X		
28			X	X							
29				X			X				
30	X			X			X				
31		X		X			X		X		

Figure 1. Screenshot of using ConExp tool (Ver 1.2) to generate association rules

3. Preliminary findings

The display format of association rule is listed as below:

No<Number of objects, for which premise holds>Premise =[Rule confidence]=><Number of objects, for which premise and conclusion holds> Conclusion

The interesting association rules are chosen by investigate the patterns appeared in the thread/non-thread, starting/1st built-on note in thread/non-thread.

Descriptive information

- (1) <87> Contrast =[80%]=> <70> School A;
- (2) <68> My theory =[90%]=> <61> School A;
- (3) <17> Elaboration =[82%]=> <14> School A;
- (4) <14> New information =[86%]=> <12> School A;
- (5) <37> Contrast, My theory =[92%]=> <34> School A;
- (6) <39> Contrast, Claim =[82%]=> <32> School A;
- (7) <27> Condition, Contrast =[85%]=> <23> School A;

Rules on thread/non-thread

- (8) <24> My theory, thread =[96%]=> <23> School A;
- (9) <44> My theory, non-thread =[86%]=> <38> School A;
- (10) <28> Claim, thread =[82%]=> <23> School A;
- (11) <18> Condition, thread =[89%]=> <16> School A;

- (12) <50> Contrast, non-thread =[82%]=> <41> School A;
 (13) <18> Cohesion, My theory =[83%]=> <15> non-thread;
 (14) <20> Consequence, Claim =[80%]=> <16> non-thread;
 (15) <15> Reason, Consequence =[80%]=> <12> non-thread;
 (16) <16> Condition, Consequence =[81%]=> <13> non-thread;
 (17) <11> Claim, Cohesion =[91%]=> <10> non-thread;
 (18) <11> Consequence, Cohesion =[91%]=> <10> non-thread;
- Rules on the starting and 1st built-on note in thread/non-thread
- (19) <11> Condition, starting note in nonthreads, non-thread =[82%]=> <9> School A;
 (20) <10> Contrast, starting note in nonthreads, non-thread =[90%]=> <9> School A;
 (21) <9> Claim, starting note in nonthreads, non-thread =[89%]=> <8> School A;
 (22) <3> Rebuttal, 1st built-on within threads, thread, School A=[100%]=><3>
 Contrast;
 (23) <2> Reason, 1st built-on within threads, thread, School A=[100%]=> <2>
 Opinion

Summarizing the association rules reported in this session, the rules (1) ~ (7) provide an overview of the frequency of argumentation markers and scaffolds in KF. Students from school A used more argumentation markers than school B, especially contrast, elaboration, claim and condition. The rules (8) and (9), indicate that the students like to demonstrate their note as “My theory” by using scaffolds in KF. It also can be deduced from the facts listed above that claim and condition always co-occur in a sustained thread, while consequence, claim and cohesion always appeared in non-thread notes. Non-thread notes always start with condition, claim, and contrast. And the starting note within thread is rebuttal, contrast or reason.

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