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International Journal of Computer-Supported Collaborative Learning https://doi.org/10.1007/s11412-019-09303-4

Socio-cognitive openness in online knowledge building discourse: does openness keep conversations going?

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Received: 24 August 2018 / Accepted: 3 June 2019 © The Author(s) 2019

Abstract

This study describes the socio-cognitive dynamics of collaborative online knowledge-13building discourse among Dutch Master of Education students from the perspective of 14openness. A socio-cognitive openness framework consisting of four social and four 15cognitive components was used to analyze contributions to online collective knowledge 16 building processes in two Knowledge Forum® databases. Analysis revealed that the 17contributions express a moderate level of openness, with higher social than cognitive 18 openness. Three cognitive indicators of openness were positively associated with 19follow-up, while the social indicators of openness appeared to have no bearings on 20follow-up. Findings also suggested that teachers' contributions were more social in 21 nature and had less follow-up compared to students' contributions. From the perspec-22tive of openness, the discourse acts of building knowledge and expressing uncertainty 23appear to be key in keeping knowledge building discourse going, in particular through 24 linking new knowledge claims to previous claims and simultaneously inviting others to 25refine the contributed claim. 26

Keywords Expression of uncertainty · Follow-up · Knowledge building communities ·	27
Knowledge building discourse acts · Socio-cognitive openness	28
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Introduction

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In higher education, there is increasing interest in collaborative learning and knowledge building 31(within) communities (Garrison et al. 2010; Love 2012). Knowledge building in educational settings 32 is conceptually comparable to knowledge creation in innovative organizations, but involves not only 33 generating new ideas, but also the further development of ideas within the community (Bereiter and 34Scardamalia 2014). Community knowledge creation is seen as beneficial in helping students 35develop ways of thinking and the skills necessary to flexibly adapt to changes in our society, and 36 also to develop ideas and insights as a basis for innovation (Paavola and Hakkarainen 2005). Online 37 collaboration tools are widely accepted and integrated in educational practices to facilitate computer 38 supported collaborative learning (CSCL) and online knowledge building. Knowledge building 39 communities vary in size and scope: collaboration can be limited to fixed, small groups that work 40 on different subjects, but building knowledge collaboratively can also be the responsibility of an 41 entire community in which varying combinations of groups engage in a continuous, dynamic 42 collaboration process (Zhang et al. 2009). 43

Knowledge creation is viewed as a social process among innovative communities in the 44 pursuit of new knowledge which is built by the members of a community in interaction with 45each other through shared objects (Paavola et al. 2004; Stahl 2012). According to van Aalst 46(2009), knowledge creation is the mode of discourse representing a higher level of intellectual 47 effort by community members than knowledge sharing (i.e., merely presenting pieces of 48knowledge) or knowledge construction (i.e. bringing together established knowledge in the 49domain). At one level, knowledge creation involves the development of shared objects needed 50to create new knowledge (i.e., ideas, theories, explanations, and justifications), while at another 51level it evaluates the knowledge advances and social issues in the community. 52

The socio-cognitive nature of community knowledge building

In CSCL research, the term *community* is often taken for granted (Barab 2003; Wise and Schwarz 542017), which complicates the distinction between a group of collaborating learners and a knowledge 55building community. This study uses five features of a knowledge building community, based on 56previously reported characteristics of a knowledge building community (Hong and Sullivan 2009; 57Scardamalia and Bereiter 2006; Zhang et al. 2009) and of a community of practice (Barab 2003; 58Barab and Duffy 2000). First, a knowledge building community is characterised by the orientation 59towards knowledge development as a collective effort. Second, a knowledge building community is 60 recognised by discourse in which understanding emerges from the collective practice of idea 61 development using authoritative sources originating from outside the community. Third, the 62 discourse is facilitated by an environment which is appropriate for community knowledge building. 63 Fourth, a community culture (i.e. common goals, meanings and practices) emerges as a result of 64 social negotiation as the community develops. Last, a sense of purpose and awareness of self will 65gradually develop at both the individual and the community level. Whether or not a group of learners 66 evolves into a community will eventually become evident in the knowledge building process. Barab 67 (2003) for instance has noted that "one cannot simply design community for another, but rather 68 community is something that must evolve with a group around their particular needs and for 69 purposes that they value as meaningful" (p.199). 70

Building knowledge as a community requires more than the division of labor between community members working on a task. Collaboration in knowledge building is a complex activity, aiming at the collective improvement of ideas in a process of socio-cognitive collaboration. Cress and 73

Kimmerle (2008), for instance, state that in collaborative knowledge building, "social systems 74 depend on cognitive systems, because there would be no communication without cognitions" (p. 75109). They argue that the social and cognitive systems involved in collaborative knowledge building 76operate separately, but are also interconnected in that they influence each other and develop together 77 into more complex systems over time. Scardamalia (2002) addresses both aspects of collaborative 78 knowledge building in a system of twelve principles describing the socio-cognitive dynamics of 79knowledge building, departing from the viewpoint that every member's idea is valuable and that the 80 community will evaluate these ideas and generate new insights through discourse, with the 81 constructive use of authoritative sources. As a result, creative solutions will be generated for the 82 community's self-defined problems. This implies that community members should adopt a "design 83 thinking mindset" (Bereiter and Scardamalia 2014), in which taking knowledge for granted is 84 replaced by a joint effort to critically question established knowledge, adopt an open attitude towards 85 new ideas and reach a thorough understanding by the meaning-making process which evolves in the 86 discourse (de Jong 2015). The interrelatedness of social and cognitive aspects of knowledge 87 construction processes is reflected in the discourse of the community, so the analysis of contributions 88 to such discourse aids the mapping of the socio-cognitive dynamics of online knowledge building 89 (Howley et al. 2011). 90

Factors that influence online knowledge building discourse

Online knowledge building conversations vary greatly in the level of discourse and the associated92knowledge yield, ranging from mere fact-oriented knowledge sharing, to more elaborative under-93standing in knowledge construction and eventually to knowledge creation, in which continuous94elaboration results in idea improvement. Discourse patterns reflecting the lowest level of knowledge95sharing are observed much more frequently than patterns reflecting the higher level modes (Fu et al.962016; van Aalst 2009). This indicates that realizing a thorough and effective knowledge building97discourse is a demanding joint practice which cannot be taken for granted.98

Sustainable online interaction and participation are crucial for knowledge building. Limited 99 participation and fragmented conversations make the construction of collective knowledge 100 virtually impossible. Previous studies have reported several factors influencing participation 101 and continuation, amongst which are the organization and facilitation of courses, characteris-102tics of participants, and the discourse itself. For example, Cacciamani et al. (2012) found that 103higher participation is associated with a more critical evaluation of the knowledge itself and of 104the knowledge-building activities in the community. Beneficial for participation are a clear 105organization and facilitation of the discourse (Dennen 2005), with clear expectations about 106participation. In addition, students must consider the knowledge subjects as relevant, and feel 107free to bring in different perspectives (Cacciamani et al. 2012). Goal orientation also makes a 108difference: someone who wants to learn from the discourse participates differently than 109someone who wants to make minimal effort, or is mainly focused on receiving appreciation 110from others (Wise et al. 2012). Student participation also benefits from teacher presence 111 characterized by their providing feedback without taking over the conversation (Dennen 1122005). Too little or too much teacher participation was found to have a negative impact on 113student participation (Schrire 2006; Zingaro and Oztok 2012), indicating that teachers should 114dose their contributions carefully. Nevertheless, the degree of participation in online knowl-115edge building communities has repeatedly been reported as disappointing. 116

One cause of limited participation may be that follow-up participation lags behind, causing 117 conversations to cease prematurely. Online contributions often do not receive follow-up, for 118

example due to participant characteristics such as the role of the contributor. Several studies 119indicated that students who are perceived as active or are considered intelligent, tend to receive 120more follow-up (Ke et al. 2011; Zingaro and Oztok 2012). Ioannou et al. (2014) have 121suggested that the absence of indications referring to one's own beliefs, opinions and 122reference to sources jeopardize knowledge construction, as readers do not find textual clues 123to build on. A study by Jeong (2006) found that aspects of conversational language in 124computer-supported collaboration (e.g. posing questions, agreement, apology, gratitude, hu-125mor, using a signature, greeting) lead overall to more follow-up. Jeong suggested that 126conversational language may be found more personable and express more openness to 127differing viewpoints, which might encourage readers to respond more easily than in contribu-128tions without signs of conversational language. The present study aims at taking these 129suggestions a step further and is based on the assumption that the characteristics of the online 130contributions to discourse itself might be understood as different manifestations of socio-131cognitive openness that encourage the continuation of a conversation. This study therefore 132explores how social and cognitive openness are manifested in online contributions in two 133 separate student cohorts operating as knowledge building communities in differently organized 134consecutive course that were facilitated by different teachers and investigates how manifested 135openness relates to the continuation of their conversations. 136

Socio-cognitive openness as a characteristic of community knowledge building discourse

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The work of a knowledge building community is intentional and primarily benefits the community 139itself (Scardamalia and Bereiter 2010). In knowledge building communities working with the 140assumptions of intentionality and community benefit, openness is key (Chinn et al. 2011; Song 141 2017), reflecting the willingness to think together. In this study, the term openness pertains to the 142cognitive, epistemic, and relational activities of community members as manifested in their 143discourse. To build knowledge as a community, members must cognitively engage with each other 144 in an intellectual process of developing knowledge claims. This implies intellectual efforts such as 145developing, comparing, and judging claims. It also implies taking a critical and flexible epistemic 146stance in order to evaluate knowledge claims and develop alternative viewpoints. In addition, 147openness has a social dimension. Practicing the relational skills inherent in opening up to others 148fosters a climate of freedom to contribute immature knowledge claims (Ness and Riese 2015). 149Relational skills are a prerequisite to becoming truly engaged with other community members, 150which in turn supports the ability to think along with each other. (Song 2017). This study therefore 151takes as its departure point the assumption that openness is a necessary condition for understanding 152one another during online knowledge building and aids the development of new insights as a joint 153effort. We also assume that it involves both social and cognitive aspects, and that it can be expressed 154in different ways. The next section presents a conceptual framework to analyze socio-cognitive 155openness in online discourse. 156

The conceptual framework for socio-cognitive openness

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Departing from the observations above, a conceptual framework was developed to enable a 158 systematic analysis of online contributions to collective knowledge building. The framework is 159 composed of eight different components which serve to detect openness. The selection of compo- 160 nents to be included in the framework is grounded in a dialogical approach to learning and 161

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knowledge building (Ludvigsen and Mørch 2010). The dialogical approach views the construction162of knowledge as an intermental process, where new insights emerge from a multivocal dialogue163encompassing multiple perspectives (Koschmann 1999; Wegerif et al. 2010).164

In compliance with the dialogical approach, the current study presumes two key principles 165to knowledge building: a) knowledge building starts with producing knowledge claims and b) 166taking an intersubjective stance is of vital importance to develop new insights in response to 167these claims. Producing knowledge claims takes place when an individual brings in a 168proposition on a relevant subject or asks a question with the aim of being able to bring in a 169new proposition. Concomitantly, community members engage in *intersubjective stance taking* 170(see du Bois 2007; Hyland 2005; Kärkkäinen 2006; Martin and White 2003), Following du 171Bois, an intersubjective stance is viewed as a public dialogical act consisting of three 172simultaneous activities: Evaluating knowledge claims, positioning the self, and aligning with 173174the other(s). The intersubjective stance relies on the principle of *multivocality*, which implies acceptance of the multifaceted character of conversations, where different voices can co-exist 175without necessarily reaching consensus ((Skidmore and Murakami 2012; Suthers et al. 2013). 17603

The components that have been brought together in the framework reflect these basic principles 177and were first grouped on the basis of their cognitive or social character. The components have a 178descriptive character; they refer to the ways in which openness can be expressed in online 179contributions. The cognitive dimension contains components that primarily relate to the mental 180 activities of producing and evaluating knowledge claims. These activities entail connecting knowl-181 edge to earlier contributions (Gweon et al. 2013; Weinberger and Fischer 2006), justifying knowl-182edge claims, (Baehr 2015; Chinn et al. 2011), taking epistemic stance (Chinn et al. 2011; Howley 183et al. 2013) and inviting response (Goodman et al. 2005; Martin and White 2003). The social 184dimension contains components mainly relating to how the contributor aligns with others and 185presents him- or herself. These components relate to the transactivity of knowledge between self and 186another (Gweon et al. 2013; Mitchell and Nicholas 2006), the ownership of problems (Ligorio et al. 187 2013; Loperfido et al. 2014), personal positioning towards the claim (Martin and White 2003; 188 Rourke et al. 2001) and the authority position that is taken by the contributor (Howley et al. 2011; 189Howley et al. 2013). The background, development and content of the framework are described in 190more detail in van Heijst et al. (2019). 191

In a second step of building the socio-cognitive openness framework, discourse acts were 192articulated as an intermediate category between the components and the social and cognitive 193dimensions of the framework. The components were grouped in pairs on the basis of their 194resemblance relative to the above stated key principles of knowledge building producing 195knowledge claims and taking intersubjective stance. When engaged in the discourse acts of 196 building knowledge, expression of uncertainty, community orientation and the expression of self 197the interactants are actually doing things with regard to the discourse as they express social and 198cognitive openness in the collective knowledge building process. Building knowledge reflects 199the principle of producing knowledge claims, while the expression of uncertainty, community 200orientation and the expression of self are reflecting the activities necessary to accomplish the 201principle of intersubjective stance taking. The final framework for the analysis of openness thus 202represents three levels of openness: dimensions, discourse acts and components (see Fig. 1). 203

Thus far, there is no clear insight into the expression of openness in online knowledge 204 building, nor into its association with context characteristics such as community, participant 205 roles, or trimester characteristics (temporality, course characteristics), nor how openness under 206 the different context characteristics impacts on the continuation of conversations. The objective of the present exploratory study is therefore to investigate the presence and impact of 208



Dimensions Discourse acts Components

Fig. 1 The conceptual framework for socio-cognitive openness

socio-cognitive openness in the online knowledge building discourse of two knowledge209building communities in a Master's program. The research questions guiding the study are:210(1) How do social and cognitive openness manifest themselves in online contributions? (2)211How do social and cognitive openness relate to follow-up? (3) How do context characteristics212213213

Method

Context

The study took place in the context of a nationally top-rated Master's Program in Education 216Learning and Innovating (M. Ed.) at a Dutch university of applied sciences and teacher 217education. The two-year part-time program is based on knowledge building pedagogy which 218focuses on collective knowledge creation (de Jong 2015) and includes study activities 219supporting students' work on an innovation in their workplaces. The practice-based research 220221they conduct during the program is supportive of the decisions they make in their innovative work practices. Students are experienced professionals who aspire to become innovators of 222learning and development in their work place. The Master's program, emphasizes the joint 223development of knowledge in a knowledge building community of students and teachers 224 which lasts throughout the program. To support the work-related processes during the 225

program, five trimester courses are designed around four monthly one-day meetings at the 226227 institute. The two cohorts of students selected for the present research (n = 37; n = 32)participated in three trimester courses scheduled one after the other in the first academic year. 228The three courses, labeled "Innovating in Teams", "Learning" and "Design for Learning" 229focused on investigating how innovations can be developed effectively at the team level, 230deciding which vision for learning is appropriate for the innovation, and designing an 231intervention to support the innovation. The consecutive courses differed with regard to the 232assignments. There were also differences with regard to the organization and facilitation of the 233online discourse, based on personal style of the teacher and the characteristics of the course. 234The overall aim of the three courses, was to collectively work on the improvement of students' 235conceptual ideas about the course subjects, using scientific and practical knowledge and using 236each other's perceptions and experiences to create a community knowledge base for the benefit 237of all. Each course ended with the writing of a term paper, either individual, as a sub-group, or 238as a combination of individual and collective tasks. Regardless of the degree of collective work 239included in the assignment, students were encouraged to build knowledge collectively 240throughout the program. Although there were slight differences between the courses of the 241two cohorts, the pedagogy and the facilitating teachers were the same. 242

Participants

The study included 61 students (44 females, 17 males), all of whom were experienced professionals 244participating in the part-time Master's program to become more proficient in initiating and steering 245innovations in their working practices. A minimum of two years of work experience is required to 246enroll. The majority (n = 52; 85.3%) were in the teaching profession, nine (14.7%) were knowledge 247professionals (e.g., human resource development professionals, educational consultants, director of a 248consulting company). The average age was 44.5 years (SD = 9.4; range 23-59 years). Contributions 249from seven teachers, (five females, two males; mean age 42.4 years (SD = 8.1; range 31–56 year) 250who participated in the selected conversations, were included in the data. All teachers had at least 251three years of experience in the Master's program and in the use of Knowledge Forum. Five teachers 252253(including the first author) were course teachers, while two additional teachers were study coaches who joined the conversations. 254

Procedure

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The data were taken from a database containing the online discourse of students and their 256teachers. To facilitate collective knowledge building between the course meetings, Knowledge 257Forum® (KF) was used. KF is designed to facilitate collective construction of knowledge and 258a well-developed understanding of issues which arise in the community (Scardamalia 2002). In 259KF, collaboration spaces (KF views) were created by the course teachers as an integral part of 260the course design. In addition, students were allowed to create their own collaboration spaces. 261In the collaboration spaces, students build knowledge related to the course subjects, starting 262from questions and ideas which arise from the activities they undertook as innovators in the 263work place. Building knowledge in KF was done by placing contributions (KF notes). A note 264could either be a *conversation starter*; which initiates a new conversation thread, or a *build-on* 265*note*, which connects to a previous one. KF also provides the feature of a *rise-above note*, in 266which previous notes can be collapsed and a new conversation can be started based on insights 267of the previous conversation. Figure 2 shows a screen shot of a KF view included in this study. 268 Students and teachers were informed about the study before the start of the program and
agreed to participate in the study. Selection of data and data analysis took place after
completion of the courses and the associated formal assessment of the assignments. The
procedures were approved by the Open University research ethics committee.269
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Instrument

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Based on the conceptual framework (van Heijst et al. 2019), a coding scheme (see Table 1) and 274coding instruction were developed through an iterative process involving three coders who 275were familiar with the program and KF. The first and second author developed the coding 276procedure and applied it to data which was not involved in the study. Then, in three stages of 277coding, discussing differences and refining of the coding manual and instructions, 20% (n = 278119) of the KF notes were subjected to the coding procedure to establish sufficient reliability. 279The first author and a third coder independently coded 10% (n = 59) and reached almost full 280agreement in discussing the results while refining the manual. Next, the first author coded 281another 10% (n = 60) of the data and recoded them after approximately three months. Finally, 282six KF notes that remained under discussion were, together with their adjacent notes, once 283again coded by an external coder who was unfamiliar with the educational and research 284context and not involved in the development of the instrument. Comparison of the coding of 285the first author and the external coder yielded satisfactory intercoder reliability (K_{cognitive} 286 $_{openness} = .94; K_{Ck} = 1.00; K_{Jkc} = 1.00; K_{Es} = .78; K_{Ir} = 1.00; K_{social openness} = .89, K_{T} = 1.00;$ 287 $K_0 = .89$; $K_{Ptc} = .77$; $K_A = .68$, n = 19). The first author coded the remainder of the data. 288

Data collection

For the study, 638 notes written by 68 community members were selected from 10 KF views. These 290 notes covered a representative image of the students' activities over the two cohorts and the three 291 courses. Five KF views were full community views (i.e., collaboration spaces per cohort for all 292 participating students and their teachers) and five others were created for further exploration of issues 293



Fig. 2 Screen shot of a KF5 sub community view

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sponding i	, indicators of openiness					
Openness dimension	Knowledge building Discourse Acts	Component (derived from literature)	Indicator of openness (the open manifestation of component visible in the data)			
Cognitive	Building knowledge	Connecting	Elaboration			
opennes	38	knowledge	elaborates on knowledge claim(s) in the preceding note			
		Justifying knowledge	Multiple justification			
		claim(s)	justifies a knowledge claim by exploring its meaning from multiple perspectives (e.g., empirical observation, common community knowledge and scientific knowledge)			
	Expression of	Epistemic stance	Relativist stance			
	uncertainty		presents knowledge claim(s) in relative terms			
		Inviting response	Questioning of knowledge claim(s) welcomes contradiction, nuance, or alternative viewpoints			
Social	Community	Transactivity	Other transactivity			
opennes	s orientation		builds on notes of others (instead of building on own notes)			
		Ownership	Joint ownership			
		.Ġ	uses knowledge claim(s) primarily for exploration of someone else's or a community issue			
	Expression of self	Positioning towards	Personal positioning			
	Q	the claim	uses words reflecting appreciation, affection or moral views towards knowledge claim(s)			
		Authority	Expert authority			
			brings in knowledge claim(s) or judges knowledge claim(s) of others			

Table 1 Socio-cognitive discourse openness scheme including dimensions, categories, components and corresponding indicators of openness

of sub-communities within the cohorts. The full community views were initiated by the course 294teachers. These views were initiated at the start of the courses and dealt with collaboration tasks 295aiming at knowledge construction based on prescribed knowledge sources, exploring each other's 296work contexts and understanding the courses' knowledge base. The sub community views were 297mostly initiated by students and dealt with a further exploration of a chosen theory or perspective. 298Here the aims were to develop a knowledge base to be applied to students' own practices. Some 299views included sub community collaboration tasks to be assessed as part of their individual term 300 papers. The sample contained notes of extensive conversation threads containing at least three notes 301 (n = 64), as well as isolated notes, which were not connected (n = 56) or were merely connected to 302one note (n = 33). All notes within the selected conversation threads were included in the analysis, 303 including both students' and teachers' notes. 304

Data analysis

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The qualitative and quantitative analysis of the KF contributions consisted of five consecutive 306 steps, outlined as follows: 307 308

1) Determination of appropriate level of analysis

- Individual contributions were used as primary data. As many contributions build on 309previous ones, texts of the surrounding contributions in the same conversations were taken 310into account in the coding decisions, allowing for analysis of all contributions, whether 311 they stood alone or were part of a conversation between community members. 312 2) Determination of unit of analysis 313 • The unsegmented KF note was considered appropriate, as the aim of the study was to 314determine the degree of openness and the interrelatedness of different kinds of openness 315 within contributions. 316 KF notes were regarded as single segments with natural borders, signaling the contribution 317 to knowledge of an individual at a particular point in time (Clarà and Mauri 2010; Strijbos 318 et al. 2006). 319• For the sake of consistency, four KF notes in the sample had to be segmented. The coders 320 agreed that these notes elaborated on two distinct topics, which should have been 321 discussed in separate notes. 322 3) Preparation and qualitative analysis of data 323 KF notes were extracted from the KF databases, anonymized, marked for participant ٠ 324 number, time of creation and thread structure information, and entered into ATLAS.ti® 325Qualitative Data Analysis software for coding. 326 Together with the coding function of the software, comments and analytic and theoretical memo 327 • functions were used, guaranteeing constant comparison during coding (Friese 2014). 328 The socio-cognitive openness of each KF note was analyzed for the eight components of 329the coding scheme in the ATLAS.ti® project database. For each component codes were 330 created which indicated signs of openness. These were attached to selected text fragments 331in which linguistic markers of openness were found. If no signs of openness for a 332 component were found in the note, it was coded as not-open for this component. In 333 sum, 642 units were analyzed. 48 notes were excluded from the analysis, due to lack of 334 content or off-task character (i.e., not related to the knowledge subject). 335 4) Entry of coding results into IBM SPSS version 24.0 for quantitative analysis 336 SPSS-variables were created for the components and defined as 1 when the KF note 337 • showed manifest openness or as 0 in case no signs of openness were observed. 338 Descriptive statistics were applied to investigate the frequencies of the occurrence of 339 openness and mean scores for the social and cognitive dimension. 340 Principal Components Analysis for Categorical Data (CATPCA) was then carried out to • 341examine whether the relatedness of components in the conceptual framework was reflected 342 in the data. 343 5) Measurement of relationship between follow-up and level of social and cognitive 344 openness 345
- Using McNemar's test, the level of social and cognitive openness was compared to 346 community type (i.e., was the KF note located in a full community or in a sub community 347

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view) and teacher-student role. Using Chi-square tests, the level of social and cognitive348openness was compared to trimester (entailing potential differences such as character of
the course subjects, assignment, teacher style, student enculturation or community
development).350

• McNemar's test compared openness per component to the presence of follow-up notes.

The authors are aware that, due to the nature of the data, the CATPCA and chi-square tests 353 violate the statistical independence assumption. To account for the interdependence of the data, 354 McNemar's test was used for comparisons where possible. Nevertheless, the results should be 355 interpreted cautiously. 356

Results

This section presents the results in two parts. First, findings concerning the question as to how social 358 and cognitive openness manifest themselves are presented. In this part, two full text examples of the 359analysis of KF notes are presented to explain how socio-cognitive openness occurs in the contribu-360 tions. In addition, the interrelatedness of the components, the average sum scores for the social and 361 cognitive dimensions and frequency counts for the components of social and cognitive openness are 362 presented. Second, findings are presented concerning the question of how the level of social and 363 cognitive openness relates to follow-up contributions. The answers to both questions are described in 364terms of the levels of social and cognitive dimensions as well as the eight components and the four 365 discourse acts, and are differentiated for community type, trimester, and teacher-student role. 366

The manifestation of socio-cognitive openness

As an illustration of how socio-cognitive openness emerged in the conversations, the qualita-368 tive analysis results of two typical and contrasting KF notes are presented. The notes were 369 posted in a 15-note conversation amongst five students. The conversation was situated in the 370 context of a Learning course and started with a note about the character of modern educational 371 processes, where communities of students permanently have to consciously choose what they 372 want to learn. The conversation discussed the assumption that this might cause motivational 373 problems. The first note shows openness for all the components and received follow-up. The 374second note shows a much less open character with only two indices of openness and received 375no follow-up. Figure 3 illustrates the analysis of openness in ATLAS.ti® using the codes for 376 the eight indicators of openness, attached to text fragments in which openness was observed. 377

In the first KF note, the maximum of social and cognitive openness was found. In this note, 378 student P96 responds to student P86, who states that teachers have to set rules to overcome 379 motivational problems and invites those students in the community who are teachers themselves, 380 to express their opinion on this. The note reveals cognitive openness in adding new information 381 based on course material (i.e., the textbook written by Illeris¹) (elaboration), and shows how different 382 insights from theory combined with an own opinion (expressing uncertainty) underpin the claim that 383 students need structure, rules and clarification (multiple justification). The note ends with an 384invitation to bring in different viewpoints (thereby questioning own claims). Social openness is 385

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¹ Illeris, K. (Ed.). (2009). Contemporary theories of learning. Learning theorists ... in their own words. New York: Routledge.

E1321 Coping with frustration 2015-01-04 14:33 by P96	-	
[P86, you present nicely] what Ziehe outlines about this new culture, in which		🗱 🛙 other transactivity
many options for choices are available but motivational problems also exist. [Even		I expert authority I joint ownership
though I myself am not working as a teacher I agree that students need		
structure, rules and clarification, in addition to respect for individuality and		
safety.] [[Illeris writes that students pay more attention to: What does it bring		🗱 🛚 multiple justification 💥 🛛 elaboration
me? Do I find it attractive? Does it fit me? And that this determines the degree		
of involvement with certain subjects in the curriculum.][Establishing a		🗱 I relativist stance
connection with the future seems to me to be of help to fuel motivation.] At the		
same time I also read in Ziehe that he encourages teachers to just say		-
sometimes "I'm not going to explain why you should do this. Just do it!" Have		
faith in me!]		
[Learning to deal with frustration at work and in learning are just all in the game,		🗱 I personal positioning
in my opinion.] Here, teachers and parents can play an important role. Because		
when you choose something, you have to go for it. Without resistance no growth.		
[I wonder how others look at this?]		t questioning of knowledge claim
	-	
E132111 Exactly 2015-01-21 21:58 by P100		
[Ні Р71,		t other transactivity
You have perfectly expressed this in my eyes.] The added value you give to Ziehe's		
theory is not only in the fact that you have finally found a scientific foundation for		
something that has been bothering you for a long time. No, you have been able to		
embark on [the implications of what Ziehe suggests, namely your (and mine and		🔆 I elaboration
other teachers') role in dealing with students.] After reading Ziehe I was like Yes! I		
fully agree, but what does this mean to me as a teacher? I'm not going to say I know	v	
this now completely, but your piece brings me a lot further. Thanks for that, I'm		
definitely going to do something with it and hope to explore this further with you.		

Fig. 3 Full text of two KF notes with codes for socio-cognitive openness attached to selected text fragments in ATLAS ti®. Font style of text between brackets is changed for reasons of clarity. Italics indicate social openness, bold font indicates cognitive openness. "Ziehe" and "Illeris" refer to first authors in the course reading material. Texts were translated from Dutch

manifested by building on P86's note (other transactivity) and by giving an opinion (expert 386 authority) about someone else's problem (joint ownership) in "even though I myself am not working 387 as a teacher I agree that students need structure ...". The claim that learning to deal with frustration is 388 part of the game expresses a moral view of the contributor (personal positioning). Figure 3 389 demonstrates that text fragments which reveal openness for the different indicators show overlap, 390 in that three out of four indicators of cognitive openness in this example are clustered around a 391 particular part of the text. 392

In contrast to the first KF note, the second note contains only two indicators of openness. With 393 this note, student P100 responds to a note of student P71, who gave a representation of Ziehe's 394 thoughts on the problematic effects of the culture of optionality that students live in and the demands 395

this imposes on teachers. P71 asked other community members who are teachers how they think 396 about the suggested solution. The response of P100 shows other transactivity ("Hi P71, You have 397 perfectly expressed this..."). The note also indicates elaboration by stating that Ziehe's theory has 398 implications for the role of teachers in dealing with students, although it remains unclear what the 399 knowledge claim would consist of exactly. Despite the fact that uncertainty and enthusiasm about 400 knowledge claims in the preceding KF note are expressed, these characteristics cannot be related to a 401 specific knowledge claim, and therefore no manifestations of other indicators of openness in 402building knowledge were found in this KF note. 403

To examine the relationship between the components of the framework in the data, coding results 404 were subjected to Principal Components Analysis for Categorical Data (CATPCA) in SPSS, version 40524. Principle components analysis with Promax Kaiser rotation yielded two dimensions in the model 406 with Eigen values exceeding 1, accounting for 36.2% of the total variance. Dimension 1 explained 407 20.9% of the variance (loadings ranging from .36–.75), while dimension 2 explained 15.2% of the 408variance (loadings ranging from .49-.70). The two extracted dimensions show strong similarities 409 with the theoretical framework, with the four cognitive components (connecting knowledge, 410 justifying knowledge claim(s), epistemic stance and inviting response) included in dimension 1, 411 and three social components (ownership, positioning towards the claim and authority) included in 412 dimension 2. One social dimension component (transactivity) was not included in the model. For 413this study, the authors maintain the theoretical importance of this component as an indicator of 414 intersubjective stance. Therefore, as this study is the first empirical data analysis using the socio-415cognitive framework, it was decided to maintain authority as part of the framework until more 416 extended analysis has been carried out. 417

Table 2 shows the overall degree of socio-cognitive openness resulting from the analysis of418the full sample. The degree of social openness in KF notes (M = 2.37; SD = .88), is higher than419the degree of cognitive openness (M = 1.60; SD = .88), t(594 = 16,60, p < .001).420

Further examination of the frequency distribution of the overall socio-cognitive openness 421 scores showed that all the socio-cognitive scores from the minimum score of zero (2 notes) to 422 the maximum score of eight (1 note) were present in the data. At the extremes, there were two 423 KF notes showing no openness at all, and one showing openness for every component in the 424 framework. The average number of openness indicators in the notes was 4 (152 notes). 425

Figure 4 shows the proportions of notes in which openness indicators were observed for 426 each component. Frequently observed openness was found in elaboration (92.4%), other 427 transactivity (91.8%) and expert authority (77.3%). More evenly divided scores were observed 428 in joint ownership (51.5%) and relativist stance (44.1%). Openness was not frequently 429observed in questioning of the knowledge claim (16.8%), personal positioning (16.2%) and 430multiple justification (6.9%). The frequency of openness within the knowledge building 431discourse acts differs substantially for the underlying indicators (e.g., building knowledge 43292.4% - 6.9%, expression of uncertainty 44.1% - 16.8%, community orientation 91.8% -433 51.5% and expression of self 77.3% - 16.2%). 434

t2.1 **Table 2** Descriptive statistics for the overall degree of cognitive, social and socio-cognitive openness

t2.2		Mean score	Standard deviation	Mode	Minimum score	Maximum score
t2.3	Cognitive dimension	1.60	.88	1	0	4
t2.4	Social dimension	2.37	.89	3	0	4
t2.5	Socio-cognitive total	3.97	1.37	4	0	8

n = 594

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The relatedness of socio-cognitive openness to follow-up

To examine differences in social and cognitive openness, the average dimension scores 436 $(M_{social} = 2.37; M_{cognitive} = 1.60)$ were used as a separation point to divide the data into either 437 high or low level openness notes. Subsequently, the level of socio-cognitive openness was 438related to community type, trimester and teacher-student role. McNemar's tests indicated that 439for the social and cognitive dimension, the level of openness was different depending on 440 community type. Full community views had more high social as well as high cognitive 441 openness dimension scores compared to sub communities (p < .01). Chi-square tests revealed 442 a small difference in the cognitive dimension score related to trimester ($\chi^2(2) = 6.75$, $p < 10^{-10}$ 443.05). Trimester 2 had more high scores for cognitive openness than the other trimesters. 444 although the effect size was small ($\phi = .13$). For the social dimension, trimester was not 445 significantly related to the level of openness. With regard to teacher-student role, descriptive 446 analysis revealed that 65 of the analyzed KF notes (10.9%) were contributed by the course 447 teachers. McNemar's test showed that teachers' contributions were more often characterized 448 by a high level of social openness than students' contributions (p < .01). For cognitive 449 openness no difference in the level of openness was found. Teachers' KF notes received less 450follow-up than expected compared to students' notes (p < .01). 451

Out of 594 analyzed units, 282 (47,5%) had follow-up notes; 312 KF notes (52,5%) lacked 452follow-up. To examine whether socio-cognitive openness of KF notes for the dimensions of 453openness were related to follow-up, McNemar's tests were conducted. For both the social and 454cognitive openness dimension, the results did not indicate a significant association between 455dimension scores of KF notes and having follow-up notes. For the components of the social 456and cognitive dimension of openness, McNemar's tests revealed a mixed picture of the 457 relationships with follow-up. With regard to the social dimension, two components 458(transactivity and authority) were found to be significantly associated to follow up (p < .01)459in the sense that KF notes that are open with respect to these components were less likely to 460receive follow up, whereas the components ownership and positioning towards the knowledge 461 claim were not significantly associated with having follow-up notes. On the other hand, 462 regarding the cognitive dimension, three components were significantly related to follow-up, 463in that KF notes showing openness for the components connecting knowledge, justifying 464



Fig. 4 Proportion of open scores for indicators of socio-cognitive openness related to total number of notes (n = 594)

knowledge claims and inviting response had more follow-up than expected (p < .01). The 465 cognitive component epistemic stance was not significantly related to follow-up. 466

The findings for the relatedness of the separate components of the framework to follow-up 467 were supported by additional chi-square tests relating the four discourse acts to follow-up. For 468the social dimension, notes having openness for both components of community orientation 469had less follow-up than expected ($\chi^2(2) = 13.91, p < .01$), while expression of self showed no 470significant association with follow-up. On the other hand, for the cognitive dimension, notes 471 lacking openness for building knowledge had less follow-up than expected ($\chi^2(2) = 10.93$, 472p < .01). Notes having openness for both components of expression of uncertainty had more 473follow up than expected ($\chi^2(2) = 11.93$, p < .01). 474

Discussion

The purpose of this study was to investigate how socio-cognitive openness manifests itself in 476 the online discourse of two knowledge building communities of Master's students and how 477 openness relates to the continuation of their conversations. Findings indicate that: (a) those 478Knowledge Forum contributions studied show on average a moderate degree of openness, 479with a higher social than cognitive openness; (b) community type, trimester and teacher-480 student role within the Master's program have little impact on the presence of openness; (c) 481 cognitive openness has a positive impact on follow up, but social openness does not; and (d) 482the openness indicators that are most likely to receive follow-up are not identical to the 483indicators that are most often used. In sum, this study indicates that socio-cognitive openness 484 matters: it impacts upon the chance of receiving follow-up and affects the continuation of 485 online conversations, depending on the character of openness that is reflected in the online 486contributions. The results suggest that socio-cognitive openness is one of the determinants of 487 the socio-cognitive dynamics of knowledge building discourse as a process of evaluation of 488 ideas and generation of new insights, as described by Scardamalia (2002). In particular the 489cognitive dimension seems to be conducive to continuation of the discourse, whereas the social 490dimension does not contribute or even could bring continuation to a halt. 491

Moderate openness, with a more social than cognitive nature

This study found large differences in the presence of openness for the various components in493the framework. Of the eight components of openness, three constituted a frequently observed494pattern by indicating expert authority in building on another participant's notes through adding495knowledge claims. Openness was observed less frequently for the other five components. In496general, the degree of social openness was higher than that of cognitive openness.497

It was also observed that within the four knowledge building discourse acts there is a 498tendency to use one of the indicators more often than the other. Possibly, this indicates that 499community members deliberately show a moderate degree of openness with regard to the 500discourse acts. This might be due to previous educational settings that the students experi-501enced, in which individual learning was advocated instead of the knowledge building peda-502gogy that was adopted in the Master's program. As a consequence, contributing online on an 503individual basis might be an issue for the students. Posting contributions to knowledge 504building discourse may be viewed as publicly displaying knowledge. Not using certain types 505of openness (i.e. questioning their knowledge claims, taking a multi-perspective, showing a 506

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personal stance) might be students' strategy to avoid being held accountable for the construct-507ed knowledge, as was suggested by Lester and Paulus (2011). From this perspective, not being 508open functions as a rhetorical move to stay safe in the discourse and avoid the challenge of 509exploring knowledge outside the safe borders of the educational context. A tentative sugges-510tion is that there is a hierarchy in openness indicators, from the more basic ones that were used 511frequently, to more subtle ones relating to discourse acts such as expression of uncertainty and 512the expression of self. These subtler expressions of openness might be of a more demanding 513nature and therefore possibly emerge only in a later stage in the program, when practices for 514knowledge building discourse have been re-negotiated and incorporated into the community 515culture. As Wise and Schwarz (2017) have stated, the development of a group into a 516community takes place simultaneously at the individual, small-group and collective level 517and takes time. The present explorative study did therefore possibly capture the full develop-518ment of the community culture. Similarly, community members' development of self-519awareness may not have fully developed yet. Individuals may lack the awareness or the 520repertoire to position themselves to engage in the process of intersubjective stance taking. 521They may feel reluctant "to stamp their personal authority onto their arguments" and instead 522"step back and disguise their involvement" (Hyland 2005, pp. 176). Such factors might 523provide an explanation for the limited degree of taking stances in the community discourse. 524

Community type, trimester and student-teacher role have little impact on the presence of openness

From the small differences in the degree of social and cognitive openness related to community 527type and for the trimesters it is apparent that the manifestation of openness is a relatively stable 528fact in the context of the first year of the Master's program. Socio-cognitive openness appears 529not to be related to trimester differences such as the course subject and assignments, the 530organization and facilitation of the courses and the course teachers' communication style. Also, 531the fact that the degree of openness hardly changes during the trimesters, suggests that gaining 532experience as a knowledge building community during the first year of study does not impact 533on openness as a feature of a gradually developing community culture, as might be expected in 534the course of time (Barab 2003; Barab and Duffy 2000). There was however a slight difference 535between the degree of openness of messages between students and teachers: teachers' contri-536butions were on average slightly more socially open, whereas for cognitive openness no 537difference was found. A possible explanation is that social openness relates to the role of 538facilitator, whereby teachers act differently according to their role, as was indicated by Schrire 539(2006) and Zingaro et al. (2012). It is plausible that due to their role perception, teachers focused 54004 more on the concerns of others or the community than students on average do. 541

Cognitive openness impacts follow-up positively, social openness does not

Findings indicated that for several components and discourse acts, cognitive openness appears 543 to be beneficial to follow-up and social openness has no bearing on follow-up. Contributions 544 that elaborate on knowledge claims from others, make use of multiple justification and invite 545 others to contribute alternative standpoints received more follow-up. Indeed, the results are congruent with studies of Gweon et al. (2013) and Weinberger and Fischer (2006) indicating 547 that cognitive activities such as reasoning on knowledge claims expressed earlier in the conversation are key to sustaining knowledge building. In addition, the results support the 549

claim of Chinn et al. (2011) that expressing different perspectives and communicating 550openness to different viewpoints foster the development of initial ideas and beliefs into better 551supported views. For social openness the results of the study are reversed in that the social 552openness components do not relate to follow up or are actually associated with less follow-up, 553as is the case for the components transactivity and authority. Similar results were obtained at 554the framework level of discourse acts. Here, the results seem to contradict previous research 555findings that absence of indications to own beliefs might hinder follow-up (Ioannou et al. 5562014) or that openness as a result of language containing features of orientation towards the 557other would more easily lead to follow up (Jeong 2006). At present it is unclear how these 558results can be explained. Further study is needed to investigate whether or not social openness 559could be beneficial in community knowledge building. 560

Manifested openness does not correspond with openness that leads to follow-up 561

It is striking that of the three frequently used indicators of openness, only elaboration 562supported the continuation of the conversation by generating more follow-up. The other 563two often used indicators of openness (e.g. other transactivity and expert authority) 564were instead associated with less follow-up. These findings indicate that the repertoire 565of openness that was often used and remained stable over the three trimesters is not 566particularly efficient for continuation, and that a more favorable repertoire for sustain-567ing the knowledge building discourse - containing indicators of the expression of 568uncertainty - was not optimally used. This study suggests that the expression of 569uncertainty in the making of knowledge claims is a key variable in the framework of 570socio-cognitive openness that may lead to discourse in which the social-cognitive 571dynamics more effectively support the process of community knowledge building. 572Findings regarding the expression of uncertainty are in line with existing literature 573emphasizing the value of expressing uncertainty with regard to knowledge claims 574(Chinn et al. 2011; Goodman et al. 2005; Howley et al. 2013). Expressing uncertainty 575contributes to the open space needed to explore ideas in the knowledge building 576process (Jordan et al. 2012). Further work might explore why uncertainty is not 577 expressed more frequently in the discourse and how knowledge building discourse 578may benefit from this discourse act. 579

Implications for practice

Previous studies into knowledge building in communities have indicated that meta-discourse is 581not easily realized (Scardamalia and Bereiter 2006; van Aalst 2009). Educational practices that 582build their pedagogy around knowledge building communities may benefit from the socio-583cognitive openness framework in that it offers community members an educational vocabulary 584to evaluate the discourse and thereby gives an impulse to the meta-discourse of a community. 585The knowledge building discourse acts in the framework (i.e., building knowledge, expression 586of uncertainty, community orientation and expression of self) provide teachers and students 587 with an accessible and efficient language for reflection on their knowledge building commu-588nication and knowledge results and possibly also impacts the awareness of self of individuals 589and community as a whole. Reflection on the openness of teachers may help them to 590consolidate their critical role as facilitator by contributing with more cognitive openness 591compared to social openness, and in so doing, evoking more follow-up from students. 592

Limitations and directions for future research

The present study has used a novel analysis perspective to provide an impression of the role of socio-594cognitive openness in sustaining online knowledge building discourse. Some methodological 595limitations should be mentioned here. Many CSCL studies, including the present one, use data 596from collaborative settings within fixed groups and as a consequence violate the assumption of the 597independence of observations (Janssen et al. 2011; Nussbaum 2008). This problem has been 598accounted for by using McNemar tests where possible. However, the results should be interpreted 599with caution. Furthermore, we acknowledge that the binary coding scheme did not capture nuances 600 of openness within each component. Further development of the coding scheme is warranted to 601 vield a sharper picture of openness and its effects in collaboration processes. Nevertheless, the 602 framework offers the CSCL research community an interesting perspective to further investigate the 603 socio-cognitive dynamics of discourse needed to expand the dialogic space needed for students' 604 thinking and learning together (Wise and Schwarz 2017) and for instance enhance our understand-605 ing of phenomena such as rotating leadership in the discourse (Ma et al. 2016). 606

This study did not examine how the degree of openness relates to the realized levels of the 607 knowledge in the discourse as a result of idea improvement, nor whether the expression of 608 openness correlates with individual epistemic beliefs or perceptions of collaboration. These are 609 directions for research which the authors of this study will address in a future study. As socio-610 cognitive openness is relevant in all kinds of situations in which knowledge is constructed 611 collaboratively, it is also an interesting idea for future research to use the lens of socio-612 cognitive openness to investigate the dynamics of knowledge building in other types of 613 conversations aiming at collaboration, such as synchronous or face-to-face knowledge build-614 ing communication. In fact, online collaboration in educational contexts is frequently embed-615ded in blended learning arrangements, as was the case in the present study. Using the socio-616 cognitive openness framework, the research into the online social-cognitive dynamics can be 617 extended to include the more comprehensive communication of knowledge building discourse. 618

Acknowledgements This study was supported by a PhD-grant for teacher-researchers by the Netherlands 619 620 621

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