Psychological characteristics in cognitive presence of communities of inquiry: A linguistic analysis of online discussions

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A R T I C L E   I N F O

A B S T R A C T

Benefits of social interaction for learning have widely been recognized in educational research and practice. The existing body of research knowledge in computer supported collaborative learning (CSCL) offers numerous practical approaches that can enhance educational experience in online group activities. The Community of Inquiry (CoI) model is one of the best-researched frameworks that comprehensively explains different dimensions of online learning in communities of inquiry. However, individual differences, well-established in educational psychology to affect learning (e.g., emotions, motivation and working memory capacity), have received much less attention in the CSCL and CoI research published to date. This paper reports on the findings of a study that investigated linguistic features of online discussion transcripts coded by the four levels of cognitive presence — a CoI dimension that explains the extent to which a community can construct meaning from the initial practical inquiry to the eventual problem resolution. The automated linguistic analysis, conducted by using the Linguistic Inquiry and Word Count (LIWC) framework, revealed that certain word categories – reported previously in the literature as accurate indicators of specific psychological characteristics – had distinct distributions for each level of cognitive presence of the CoI framework. The most significant finding of the study is that linguistic proxies of increased cognitive load have unique representation patterns across the four levels of cognitive presence. Consequently, this study legitimizes more research on individual differences in general and on cognitive load theory in particular in communities of inquiry. The paper also discusses implications for educational research, practice, and technology.

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1. Introduction

Recent progress in computer-supported collaborative learning (CSCL) research and tool development (Clark, Sampson, Weinberger, & Erkens, 2007) offered a number of important opportunities for learning and education such as development of argumentation and critical thinking skills (Garrison, Anderson, & Archer, 2001; Weinberger & Fischer, 2006), creating and enhancing the sense of community (Dawson, 2008), and fostering and measuring creative potential (Dawson, Tan, & McWilliam, 2011). This progress enabled a critical shift from knowledge transmission pedagogies with instructors playing the central role in the process, to learner-centered approaches offering rich social learning experiences (Garrison & Anderson, 2000).

In parallel with and guiding the technological progress, comprehensive frameworks have emerged in order to assist i) instructors in designing courses that promote a deep and meaningful learning experience in communities of inquiry; and ii) researchers in understanding individual and group facets of learning in social interactions. The Community of Inquiry (CoI) model is one of the best-researched frameworks that comprehensively explains different dimensions of online learning in communities of inquiry[1] (Garrison & Anderson, 2000). The framework consists of three interdependent dimensions (Garrison, 2007; Garrison, Anderson, & Archer, 2010; Kanuka, 2011) — social, cognitive and teaching presence. Social presence describes relationships and social climate in a learning community (Rourke, Anderson, Garrison, & Archer, 1999). Cognitive presence covers the learning phases from the initial practical inquiry to the eventual problem resolution (Garrison et al., 2001). Teaching presence explains the instructional role during social learning (Anderson, Rourke, Garrison, & Archer, 2001).

Research centered around the CoI model has been based on both: i) *qualitative methods* — by using quantitative content analysis (Krippendorff, 2013; Rourke & Anderson, 2004) of transcripts of online discussions based on the coding schemes specifically tailored for each of its three dimensions; and ii) *quantitative methods* — by developing a survey instrument for measuring the perceived value of each of its

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[1] According to Garrison and Anderson (2003, p. 2), a community of inquiry is *a group of individuals who collaboratively engage in purposeful critical discourse and reflection to construct personal meaning and confirm mutual understanding.*

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three dimensions (Garrison, Cleveland-Innes, & Fung, 2010). Validity of both the survey instrument (i.e., consistency and factor loadings) and the coding schemes (i.e., high inter-rater reliability) has been confirmed in numerous empirical studies (Arbaugh et al., 2008; Gorsky, Caspi, Blau, Vine, & Billet, 2012; Rourke & Anderson, 2004). Probably, the most important finding is the central role of teaching presence in "*establishing and maintaining social and cognitive presence*" (Garrison, Cleveland-Innes, & Fung, 2010). This perspective holds that just establishing interaction between students is not enough, but that interaction should be guided through a careful instructional design (i.e., teaching presence). Therefore, several pedagogical approaches and feedback loops have been proposed to inform instructional design and enhance educational experience through advanced cognitive and social presence (Kanuka, 2011; Swan, Matthews, Bogle, Boles, & Day, 2012).

Educational psychology offers numerous accounts about the importance of individual differences (e.g., prior knowledge; Kalyuga, 2007), working memory capacity (Paas, Renkl, & Sweller, 2004), motivation (Pintrich, 2004), and metacognitive awareness (McCabe, 2011) for learning success. However, individual differences in CSCL research have received much less research attention. Existing CSCL research with respect to individual differences can be characterized by two important foci. First, the studies focus on individual differences related to social interaction such as classroom community facets (e.g., spirit, trust, and interaction) (Dawson, 2008) and communication styles (Cho, Gay, Davidson, & Ingraffea, 2007). Second, the use of social network analysis to investigate relationship between individual network positions with the above-mentioned individual differences. Probably, the reason for the extensive use of social network analysis lies in the public availability of the tools for extraction and analysis of social networks that are easily pluggable in to the commonly-used learning environments (e.g., SNAPP; Dawson, Bakharia, & Heathcote, 2010).

Individual differences of learners in communities of inquiry have received much less attention in the research literature published to date. Only recently, initial research attempts have been made by Akyol and Garrison (2011a). They defined metacognition in CoI as "*complementary self- and co-regulation that integrates individual and shared regulation*" (Garrison & Akyol, 2013) that can be measured through self-reports and analysis of online discussion transcripts (Akyol & Garrison, 2011a; Garrison & Akyol, 2013). While very valuable, these are only preliminary steps toward bridging the gap in understanding the effects of a broad range of factors, well-established in educational psychology (e.g., cognitive load and affects (Janssen, Kirschner, Erkens, Kirschner, & Paas, 2010); Baker, Järvelä, & Andriessen, 2013), on learning in communities of inquiry.

In this paper, we propose that the analysis of automatically-extracted linguistic features of online discussion transcripts can be beneficial in identification of psychological factors of learning in communities of inquiry. This is justified by the fact that a major method for research of communities of inquiry is based on content analysis and coding of online discussion transcripts based on the three dimensions of the CoI model (Rourke & Anderson, 2004). Therefore, it seems promising to study the connection between the three dimensions of the CoI model and the psychological meaning of words (Tausczik & Pennebaker, 2010). Moreover, trace data recorded by online learning software are shown to be reliable indicators of psychological constructs important for learning (Winne & Jamieson-Noel, 2002; Zhou & Winne, 2012).

In particular, the study presented in this paper centers around the analysis of linguistic features of cognitive presence in online discussions. The study is conducted by analyzing transcripts of online discussion collected through multi-year offerings of a master's course. The linguistic features of online discussion transcripts are extracted by using the well-known Linguistic Inquiry and Word Count (LIWC) framework (Tausczik & Pennebaker, 2010). Consequently, the contributions of the study are:

- identification of linguistic features – reported in the literature to be accurate indicators of specific psychological characteristics (e.g.,

emotions and cognitive load) – and their distinct distribution patterns for each level of cognitive presence of the CoI model
- implications of the identified linguistic features of cognitive presence in relation to educational research, technology, and practice.

2. Theoretical background and research questions

2.1. Community of Inquiry: Cognitive presence

Garrison et al. (2001) presented a practical approach to evaluating the nature and quality of reflective (critical) discourse in online discussions. Cognitive presence is recognized as a core concept in the CoI definition, and is focused on the processes of higher-order thinking. Cognitive presence is operationalized through practical inquiry (i.e. critical thinking) in order to support the development of the model for critical discourse assessment in continuous communication within educational environments. The model has been defined through four phases of comprehensive process of critical thinking, which include the problem definition (i.e., triggering phase), exploration of different ideas (i.e., exploration phase), construction of the meaning of the proposed solutions (i.e., integration phase), and specification of possibilities to apply developed knowledge (i.e., resolution phase).

Each phase in the process of a practical inquiry is characterized by different sets of socio-cognitive processes. Manifestation of these processes, within asynchronous text-based collaboration, is described by using a comprehensive set of descriptors and indicators. Thus, the triggering phase was defined as "evocative" and "inductive", the exploration phase as "inquisitive" and "divergent", the integration phase as "tentative", while the resolution phase was described as "committed" (Garrison et al., 2001). By combining descriptors, indicators and socio-cognitive processes, coders of online discussions should be able to provide reliable categorization of the messages under study. Characteristics of each phase are presented in following paragraphs and more details are provided by Garrison et al. (2001) and Park (2009), as well as within the concept map developed by van Schie (2008).

The triggering phase is related to discussions of general concepts of an area of interest, but not strictly directed to defined learning topics (Garrison et al., 2001). Messages belonging to this phase assume posting a new question, thus focusing the discussion on a new topic. Another manifestation of this phase is reflected in presenting background information about a certain issue that culminates in posting a question (Garrison et al., 2001).

The exploration phase is based on the personal reflection and social exploration processes (Garrison et al., 2001). Among other characteristics, divergence within an online community and within a single message is an important indicator of this phase. Divergence within the online community means posting messages that contradict the general opinion of the community, introduce new ideas and view points, or make distinction among different ideas. Divergence within a single message assumes presenting several different ideas in one post (Garrison et al., 2001; Park, 2009). Other important properties are information exchange, making suggestions, brainstorming and posting unsupported conclusions. Information exchange is qualified by personal narratives, description of certain topic(s), and stating the facts that do not support a general conclusion. Messages where the author makes suggestions are often concluded with a question whether other community members agree with the stated opinion or not (Garrison et al., 2001). Brainstorming messages are based on the previously stated facts, but do not contribute to a conclusion. The exploration phase is considered critical for the advancement of the cognitive inquiry toward the integration and resolution phases (Garrison & Arbaugh, 2007).

The integration phase presents a constructed meaning from the developed ideas, and assumes a continuous process of integration and reflection (Garrison et al., 2001). In contrast to the exploration phase, the convergence among group members and within a single message along with connecting ideas and creating solutions are the main factors