

# Research Questions and Research Methods in CSCL Research

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**Abstract:** While research questions play a critical role in research, their role has seldom been examined systematically. In this study, we examined what kinds of research questions are addressed in CSCL empirical research and what is the relationship between research questions and methods, in part using outcomes of an earlier analysis. The analysis showed that CSCL research has mainly focused on design and implementation of technological and/or curricular interventions. Research questions influenced research methods to a degree, although the relationships were not strict. The results confirmed, as well as contradicted, some of the intuitive conceptions about the relationship between research questions and methods. Implications for future CSCL research are discussed.

**Keywords:** research questions, research methods, CSCL, relationship

*The scientist is not a person who gives the right answers, she's one who asks the right questions (Claude Lévi-Strauss)*  
*I suppose it is tempting, if the only tool you have is a hammer, to treat everything as if it were a nail (Abraham Maslow)*

## Introduction

The progress of a field is often judged based on the validity of empirical findings generated in the field, but the kinds of outcomes we find in our research are inherently tied to the kinds of question we ask. Research questions direct our attention to particular aspects of phenomena and/or influence the kinds of methods we choose to answer the questions. At the same time, research questions are also often determined and/or constrained by the methods available to us because it is not possible to answer questions without proper methodology. Despite their importance, relatively little attention has been paid to the kinds of research questions we ask and how they influence research methods. In this study, we examined research questions in recent empirical investigations of CSCL and how they are related to research methods used to answer the questions.

## Research questions

Research questions bridge and connect what is known and what is unknown. Research questions organize our research activities. We use research questions to determine the appropriateness of data collection and analysis methods and evaluate the relevance and meaningfulness of results (Onwuegbuzie & Leech, 2006). By understanding what kinds of research questions are being asked, we can understand where the field is headed (Moore, 1993). Research questions are often distinguished from research problems or research goals (Creswell, 2007; Johnson & Christensen, 2008; Onwuegbuzie & Leech, 2006). According to Johnson and Christensen (2008), a *research problem* is an issue or dilemma within the broad topic area that needs to be addressed or investigated (e.g., lack of learner motivation in online learning). A *research purpose or objective* follows from the research problem and specifies the intent of the study such as whether it intends to describe variable relationships, explain the causality of the relationships, or explore a phenomenon (e.g., whether to search for causes or seek a remedy). A *Research question* is a statement of specific inquiry that the researcher seeks to address (e.g., whether lack of motivation can be reduced in certain conditions). A *Hypothesis*, unique to quantitative research, is a formal expression of the research question.

CSCL emerged as a result of the efforts geared toward understanding how learners learn together with the help of digital technologies. There is a great diversity in research questions being asked in CSCL. Over the years, CSCL research has helped us to understand, for example, that collaborative learning is not a recipe, media effectiveness is a myth, a greater resemblance to face-to-face interactions is not necessarily better, and structuring communication is a subtle compromise (Dillenbourg, Järvelä, & Fischer, 2009). A number of researchers, however, recently raised concerns about gaps in CSCL research, arguing that the field as a whole has emphasized the cognitive dimension of learning too much and neglected the role of affect; lack of research on institutional contexts of CSCL has also been raised (Arnseth & Ludvigsen, 2006; Dillenbourg et al., 2009; Kirschner & Erkens, 2013). There are a number of different ways to examine the kinds of questions that the

field as a whole has been asking. We may ask what drives our research questions, that is, whether they are motivated by theoretical or practical concerns. Some research questions seek proof of concept (e.g., can this work?), whereas others aim to test the effect of a design or variable. One may also evaluate research questions in terms of whether they require quantitative and/or qualitative outcomes to address them and/or whether they are socially relevant and responsible (Roschelle, Bakia, Patton, & Toyama, 2011). Although these are all meaningful and useful typologies, in this paper, we examined which aspects of domain knowledge have been addressed in CSCL research, that is, whether CSCL research questions are directed toward understanding learning processes, outcomes and/or interventions.

## Research questions and research methods

Research questions influence or even determine the kinds of answer we get (Maslow, 2002; Suthers, Lund, Rosé, Teplov, & Law, 2013). This is in part because the way we ask questions determines the method we use to answer those questions. Questions often dictate the methodology needed to answer the questions so that questions about causal relationships of variables lead to experiments, whereas questions about correlational relationships of variable relationships and/or about contextual factors often lead to descriptive studies. Similarly, questions about learning outcomes requires the collection of data that can reveal student performance on exams or other kinds of measures that can show the interim or end product of learning.

The relationships between research questions and methods have been generally conceived in relation to the research objectives, that is, whether the research aims to achieve quantified or qualitative understanding. According to Onwuegbuzie and Leech (2006), for example, quantitative research questions tend to be very specific in nature and deal with descriptive (e.g., what are high-school graduation rates?), comparative (e.g., what is the difference between elementary and middle school students' math abilities?) or relationship questions (e.g., what is relationship between variable A and B?). Within the quantitative tradition, survey or descriptive designs are typically used when describing correlational relationships, but experiments are the method of choice when determining causal relationships among variables (Shadish & Campbell, 2002). Qualitative questions, on the other hand, may be open-ended, evolving, and non-directional. They seek to discover, explore or describe processes and experiences. They typically describe, rather than relate variables or groups, and tend to address "what" and "how" questions (Yin, 2009).

Although there is a view that certain methods are inherently superior than others (Becker & Geer, 1957; What Works Clearinghouse, 2010), appropriate research methods are likely to vary depending on the research problems and questions (Onwuegbuzie & Leech, 2006; Trow, 1957). The exact nature of these relationships, however, has never been systematically examined in CSCL research. In this paper, we are interested in understanding whether research questions about certain aspects of CSCL learning (e.g., questions of CSCL outcomes) are studies with certain methods more so than with other methods. For example, do research questions about CSCL outcomes tend to be studied more with certain methods over others? Or do research questions about collaboration processes require the collection of certain data types and analysis method? By examining these relationships, we hope to understand more clearly how research questions interact with research methods and what the resulting relationships mean.

## Current investigation

This paper aims to address two questions. First, what kinds of research questions have been asked in recent CSCL empirical investigations? Second, what are the relationships between research questions and research methods? In order to answer the first question, we used content analysis and categorized research questions in terms of whether they address learning outcomes, process, or CSCL interventions. In answering the second question, we relate the analysis of research questions to the results of a prior study. Jeong, Hmelo-Silver, and Yu (2014) analyzed the research methods of published empirical investigations of CSCL between 2005 and 2009. They coded CSCL research methods along four dimensions—research design, settings, data types, and analysis—and found that CSCL researchers employ a diverse set of methodology in their research. In order to explore how research questions guide and influence research methods, we systematically examined the relationship between the question types and dimensions of research methods. In the current study, we focus on studies between 2005 and 2008 due to the availability of question coding results. Note that this is part of an ongoing project that examines CSCL research practice comprehensively. Analysis of additional years and aspects of CSCL research are ongoing.

## Methods

### Journal and paper selection

Papers were selected first by choosing relevant journals and then selecting appropriate papers from them (Hrastinski & Keller, 2007). In this study, we chose representative CSCL journals by surveying 16 CSCL community leaders (e.g., CSCL committee of ICLS and the editorial board members of *ijCSCL*). Based on their responses, we selected the following seven journals: (1) *International Journal of Computer Supported Collaborative Learning* (*ijCSCL*) (2) *Journal of the Learning Sciences*, (3) *Learning and Instruction*, (4) *Computers and Education*, (5) *Journal of Computer Assisted Learning*, (6) *International Journal of Artificial Intelligence in Education*, and (7) *Computers in Human Behavior*. 1,422 research articles were published in the seven journals during the 2005-2008 periods. We selected 310 empirical CSCL investigations using the following criteria: Learning needed to be collaborative and supported by technological tools, but as long as parts of the learning process involved interaction (e.g., collaborative discussion after individual study), it was considered collaborative (see Jeong et al., 2014 for additional details about the selection criteria and process; Due to space limitations, the full list of these 310 papers are not provided here, but are available upon request).

### Analysis

We combined content analysis and qualitative descriptions to analyze research questions and methods of CSCL empirical investigations. Coding categories for the content analysis were developed using a combination of inductive and deductive approaches: They were initially developed based on a combination of several top-down schemes (e.g., categories drawn from the submission descriptors of the 2005 CSCL conference) and later refined inductively in the process of coding. The coding categories used in this study are reported below. 20% of the papers were checked for reliability. Cohen's Kappa for all coding categories was all above .75.

### Research questions

Research questions were categorized into one of the seven categories, some with sub-codes: (1) Conceptual, (2) Methodological, (3) Process, (4) Outcome, (5) Learner characteristics, (6) Interventions, (7) Other (see Table 1). Coding into multiple categories was allowed when the paper addressed more than one research questions.

Table 1: Coding categories for CSCL research questions

Question codes	Code descriptions
Conceptual	Developing/testing conceptual framework and/or refining/testing theoretical constructs/models.
Methodological	Assessment instrument, analysis methods, or design tools or processes.
Process	CSCL processes that can be about (a) collaborative processes (e.g., argumentation), (b) general, often individualistic learning processes (e.g., conceptual change), or (c) other processes related to CSCL (e.g., participation frequency, help use).
Outcome	CSCL outcomes that can be about (a) knowledge outcomes either at the individual or shared/collective level (e.g., knowledge building), (b) skills, (c) non-cognitive outcomes (e.g., perceptions, motivations, attitudes, etc.), or (d) miscellaneous.
Learner characteristics	Individual differences and learner characteristics (e.g., gender differences, individual differences in help-seeking).
Intervention	CSCL interventions that can be (a) instructional (e.g., curriculum development, scripting) and/or technological (e.g., mobile technology, representational tools).
Other	Questions that did not fit one of the above categories (e.g., parental involvement, community network structures).

### Research methods

Research methods were coded along four dimensions: (1) Research design, (2) Setting, (3) Data, and (4) Analysis. Research designs were coded as (a) Experimental, (b) Descriptive, or (c) Design-based method. Research settings were coded as (a) Laboratory, (b) Classroom or (c) Other settings. Data were coded as (a) Process (e.g., text-messages, video, log data), (b) Outcome (e.g., multiple-choice, open-ended artifacts), and (c) Miscellaneous (e.g., self-report questionnaires, interviews). Analysis methods consisted of three general categories: (a) Quantitative (e.g., code-count, inferential statistics), (b) Qualitative (e.g., Conversation Analysis), and (c) Mixed-analysis (see Jeong et al., 2014, for coding details).

## Findings

### CSCL research questions

As can be seen in Figure 1, a small portion of CSCL research addressed theoretical or methodological questions (3% and 7% each). Although these studies included data, often in the form of examples, they mainly addressed theoretical (e.g., how to conceptualize the institutional impact of CSCL) or methodological questions (e.g., development of rating scheme for interaction quality). Close to half of the methodological papers were about content analysis addressing issues such as coding scheme development (Meier et al., 2007), unit of analysis (Strijbos & Stahl, 2007), or validity and reliability of content analysis (Beers et al., 2007). The rest of the methodological questions addressed issues such as statistical solutions to multi-level analysis (Cress, 2008), Social Network Analysis (Martine et al., 2006), asynchronous discussion data mining (Dringus & Ellis, 2005), or mixed-method (Schrire, 2006).

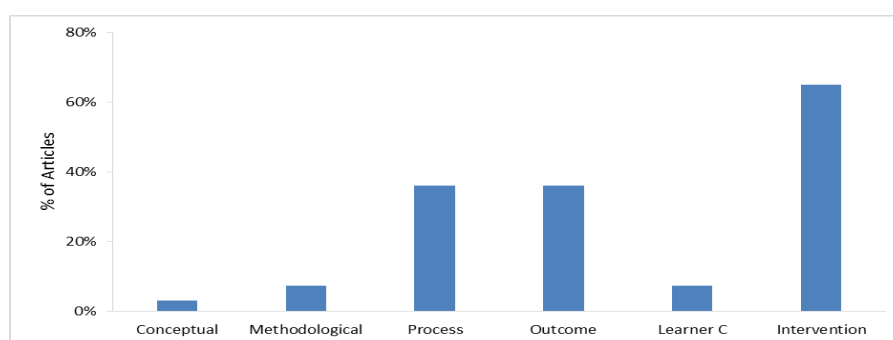


Figure 1. Research questions in empirical CSCL research.

Process questions were addressed in 35% of the studies. Most of them (80%) posed questions about collaborative processes, including collaborative learning and problem solving (e.g., Schwarz & Groot, 2007), linguistic and communication processes such as grounding or chat confusion (e.g., Fuks et al, 2006), or social processes such as group dynamics or development (e.g., Guldberg & Pilkington, 2006). The rest of the process questions (20%) dealt with miscellaneous processes such as system use or coordination processes in CSCL (e.g., Erkens et al., 2005), along with generic learning processes such as conceptual change (Parnafes, 2007). Questions about CSCL outcomes were addressed in 36% of the studies. About half of them (52%) examined knowledge outcomes, but these were mostly outcomes at the individual level. Only a small portion of studies (11%) posed questions about group-level outcomes such as collective knowledge building (e.g., van Aalst & Chan, 2007). Relatively little attention (13%) has been paid to skills such as collaboration skills or critical thinking skills (Rummel & Spada, 2005), but close to half (46%) examined a variety of non-cognitive outcomes such as students' and teachers' perception of the environment, motivation, or attitudes (e.g., Bergin et al., 2007). The remaining papers (6%) examined miscellaneous outcomes such as ethical behavior and accuracy of peer assessment (e.g., Sitthiworachart & Joy, 2008).

The dominant question in CSCL research (65%) was about interventions. Most (76%) focused on technological aspects of CSCL interventions such as the effect of a software agent as a learning partner or the use of ITS to support collaborative learning (e.g., Holmes, 2007). About one-third of intervention studies (31%) examined instructional interventions such as effects of new curricular activities (e.g., Smith & Reiser, 2005) or assessment schemes (e.g., Lee, Chan, & van Aalst, 2006) within the contexts of CSCL. These questions were studied with a focus on the intervention itself (e.g., situating a specific CSCL application across different academic disciplines) as well as in relation to their effects on student learning processes and outcomes (e.g., effects of CSCL application(s) on post-tests or students' attitude toward mathematics) or learning process (e.g., whether a chat tool decreases 'chat confusion', comparison of different CSCL applications on the discussion process). A small proportion (7%) of studies were interested in understanding *learner characteristics*. These include individual differences in help-seeking, communication styles, or gender differences in CSCL (e.g., Cho et al., 2007).

### CSCL research questions and methods

In this section, we consider how research questions are related to various dimensions of research methods. To simply the analysis, we focused on the papers that asked one of the three most frequent CSCL research questions, that is, intervention, process, and outcome questions (N=127). The analysis showed that although

descriptive designs were dominant in studying all three types of research question, different questions tended to be studied with different research designs (Table 2). Questions of CSCL process and outcomes were both likely to be studied in a descriptive manner, whereas intervention questions relied more on experimental designs. Design-based research was largely used to study CSCL processes and interventions.

Table 2: Research questions and design

Questions	Descriptive	Experimental	Design-Based	Total
Process	28 (80%)	3 (9%)	4 (11%)	<b>35</b>
Outcome	12 (80%)	3 (20%)	0 (0%)	<b>15</b>
Intervention	43 (56%)	22 (29%)	12 (16%)	<b>77</b>
<b>Total</b>	<b>80.84</b>	<b>28</b>	<b>16</b>	

Research questions are also associated with analysis methods (Table 3). Reliance on quantitative analysis was strong for all research questions as reported in Jeong et al. (2014), but the degree varied across the questions. Although outcome questions exclusively relied on quantitative or mixed methods, process and intervention questions relied more on mixed and qualitative methods. Research questions were also related to data collection, that is, the kinds of the data collected in the study. Process questions were more likely to be associated with the collection of process data such as text messages or video. Outcome questions relied on data such as pre- and post-test questions, but also on self-report and/or questionnaire data. Intervention questions relied on a roughly equally frequent distribution of process and outcome data. Unlike other dimensions coded, research settings do not seem to be related to research questions, at least at the level of questions coded in this study. Across all questions, classrooms were the dominant setting, followed by laboratory and other settings, indicating that questions of causal relationships are no longer restricted to studies in laboratory settings.

Table 3: Research questions and design

Questions	Quantitative	Qualitative	Mixed	Total
Process	15 (29%)	11 (31%)	9 (26%)	<b>35</b>
Outcome	10 (67%)	0 (0%)	5 (33%)	<b>15</b>
Intervention	27 (35%)	19 (25%)	31 (40%)	<b>77</b>
<b>Total</b>	<b>52</b>	<b>30</b>	<b>45</b>	

The relationships reported above suggest that there are some connections between research questions and methods, we should also bear in mind that the relationships are not entirely deterministic. For example, Mirza, Tartas, Perron-Clermont, and de Pietro (2007) studied graphical tool use for argumentation. Their approach was descriptive and the analysis described an example of learning activity mediated by the software with a focus on knowledge construction and argumentation processes. Although the analysis relied on some coding and counting (e.g., of meaning-making oriented units), the main part of the analysis were qualitative characterizations of two argumentation maps (e.g., whether and when a moral dimension became a focus of discussion) and how each map evolved over turns. On the other hand, Lund, Molinari, Sejourne, and Baker (2007), adopted an experimental approach as they also studied students' use of argumentation diagrams. They compared two conditions, one in which student pairs used the tool as a means for debate and another in which they used the tool for representing debate. Graphs generated during the debates were analyzed using an elaborate coding scheme called ADAM (Argumentation diagram Analysis Method), which produced debate and difference scores. Statistical tests were also carried out to identify main factors for studying argumentative graphs and to compare the two experimental conditions. These two studies both shared similar, overlapping questions about the same kinds of graphical argumentation tools. They even collected and analyzed the same type of data (i.e., argumentation maps). Yet, they adopted different study designs and analysis methods so that Mirza et al. relied on a descriptive case study and described how the tool are used in the process of meaning-making more or less qualitatively, whereas Lund et al. focused on comparing different instructions accompanying the tool and attempted to quantify the impacts. So, while certain question tended to be studies with certain methods, research questions does not appear to constrain research methods in any inherent way and a diverse methods have been applied to study different aspects of CSCL.

## Conclusions and implications

Not surprisingly, our results suggest that questions in CSCL empirical research have mostly been focused on examining technological and/or instructional interventions of CSCL, often in connection to learning processes and outcomes. These represent important areas of CSCL and it appears that the field is trying to lead the way in innovating technological and curricular interventions and examining them in connection to learning processes and outcomes. At the same time, the results also raise questions as to whether CSCL research is overly driven by technological interventions and/or whether adequate attention has been paid to other important aspects of CSCL, such as the role of teachers or other mechanisms for facilitating productive knowledge building. In this sense, our analysis confirmed some of previously identified concerns such as that there were few studies that addressed institutional contexts of CSCL (Arnseth & Ludvigsen, 2006). Although our coding categories did not have a separate code for it, we did not find these captured in the *other* questions category. In addition, although learning in CSCL environments involves changes not just in individual learners, but also in groups or communities (Cress, 2008; Stahl, 2013), few studies addressed learning at the collective level. This is likely to change with newer analytic techniques found in more recent studies, but we need to be mindful of examining CSCL at multiple levels and/or from multiple perspectives. Although it appears that affective or non-cognitive dimensions of CSCL have received a fair amount of research attention judging from the kinds of questions and data collected, there have been few attempts to examine them deeply. Moreover, studies that attempt to integrate cognitive and social mechanisms of CSCL were rare but this is an area that we anticipate will change as we continue our ongoing analysis of more recent research.

Our analysis found that research methods did vary depending on the research questions, although the coupling between the two was loose. Research methods do not automatically follow research question in one path, and there are different methods for pursuing similar questions. This is good news, especially considering recent attempts at crosstalk between different methodological traditions (Suthers et al., 2013) and can serve as a basis for research synthesis. However, the relationship between research questions and method is not arbitrary. Research questions do constrain research methods to some extent. The constraints may be inherent in the questions and/or method at least in certain cases, but they may also originate from our own biases in the kinds of questions we ask and methods we are familiar with. As the productive multivocality project demonstrated, we also have much to learn from each other (Suthers et al., 2013). Through a collaborative effort on common data sets, researchers from different disciplines engaged in effectively expanding their repertoire of both questions and methods. Further research is needed to understand more clearly the nature of these relationships. This will likely involve understanding the inherent methodological mandates of certain research questions and/or methods and overcoming our deep-rooted biases and experimenting with new research topics and methods. It will also involve a further examination of a selection of papers in terms of how they define the problems and justify the selection of the methods. It is unclear yet how the results of the study can be used to guide the choice of research methods, but we hope that our goal opens these issues up for further discussions and help us better understand what we ask and how we seek answers to our question.

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