

Adapting Interaction Analysis to CSCL: A systematic review

Rolf Steier, Oslo Metropolitan University, rolf.steier@oslomet.no
Jacob Davidsen, Aalborg University, jdavidsen@hum.aau.dk

Abstract: Interaction Analysis (IA) (Jordan & Henderson, 1995) is a fundamental reference in the learning sciences, and a core method within the International Journal of Computer Supported Collaborative Learning. Surprisingly, despite the vast number of citations and labs around the world practicing forms of interaction analysis, there have been few if any substantial efforts to articulate its central premises in the context of CSCL. Following a systematic review method, the purpose of this preliminary study is to provide an overview and foundation for investigating the ways that IA has been interpreted and applied in the field of CSCL. Our findings suggest that IA has been applied in a variety of computer-mediated learning contexts and arrangements which have required extending and adapting the method in novel ways. Our broader goal is to consider ongoing methodological and technological developments for the future directions of interaction analysis within CSCL.

Introduction: The relations between Interaction analysis and CSCL

CSCL is generally concerned with the triadic relationship between human-technology-human (Ludvigsen & Steier, 2019) in a diverse number of learning settings and at different scales. In CSCL a wide range of methodological approaches have been used to study collaborative learning mediated by computers (Jeong, Hmelo-Silver and Yo, 2014) with different analytic foci. Within these diverse methodological approaches, however, it is also clear that one of the popular methods used for studying collaborative learning processes is Interaction Analysis (IA) (Jordan & Henderson, 1995). In 1995 the first CSCL conference was held and Jordan and Henderson's paper "Interaction Analysis: Foundations and Practice" was published in the journal of the Learning Sciences. Since then, researchers in CSCL have applied and adapted IA to studies of different collaborative arrangements mediated by technology. Hall and Stevens (2015) presented IA as a method for studying 'knowledge in use' which perhaps partly explains the popularity of IA in CSCL studies. The emergence of CSCL as a field over the past 25 years similarly reflects a growing interest in interactional meaning making as opposed to the mental representations of individuals (Stahl, Koschmann, & Suthers, 2006). In this short paper, we provide a brief description of the central premises of IA, followed by our methodological procedures for developing a corpus of relevant articles in ijCSCL. By examining and identifying the range the learning contexts in which IA methods have been adapted, we create a foundation for the re-specification of such methods in the field of CSCL.

Framing assumptions and practices of Interaction analysis

On a general level, IA is a set of foundations and practices that describe how video can be used for studying social processes of learning. IA concerns all the steps involved in using video - including camera work, the process of curating the video into data, how to transcribe and present the video. In addition, Jordan and Henderson also summarized seven core analytical foci (structure of events, temporal organization of activity, turn taking, participation structures, trouble and repair, spatial organization of activity, and artifacts and documents) - or ways of looking, that have proven to be fruitful in their own analytical work. The foci for analysis described by Jordan and Henderson are furthermore grounded in theories highlighting social aspects of learning processes, Conversation Analysis and Ethnomethodology. It is worth noticing that these foci each carry some historical legacy from the before mentioned theoretical positions, but the key point for Jordan and Henderson is to provide a more comprehensive way of working with and looking at the video data, which reflects their 'practice' of working with video from being affiliated with different labs in the early 1990's. The foci for analysis are not codes or categories that should be added to the video data - each of the foci offer a way of looking at the interaction at the different scales (the structure of events, the temporal organization of activity and turn-taking) and at specific resources used in the environment by the participants to organize their activity (participation structures, trouble and repair, the spatial organization of the activity, and artifacts and documents).

IA does not exclusively deal with learning in institutional settings like schools, but broadly speaking uses video to understand learning in a diverse number of co-located settings including human-machine interaction, hearing children and their deaf parents and design-group work, etc. In all of these settings IA has proven to be a useful method for studying how people go about learning together in different situations. The core interest in IA is "human activities, such as talk, nonverbal interaction, and the use of artifacts and technologies, identifying routine practices and problems and the resources for their solution." (Jordan and Henderson, 1995, p. 39) Hence,

a key element for researchers performing IA is the focus on what people actually do, and not a retrospective account of what happened.

In IA, video is the primary means for capturing learning where learning is taking place - and Jordan and Henderson highlight several affordances of video, e.g. repeated viewing, permeance of the recording and the possibility to engage in collaborative analysis of the recording. In addition, IA researchers are also collecting other types of resources as a part of the research design, including notes, task description from the setting and general ethnographic information. The process and outcome of data collection has of course changed dramatically in the past 25 years because of innovations in video technology and one of our broader aims of reviewing the application of IA in ijCSCL is to document some of the ongoing developments.

Surprisingly, despite the vast number of citations and labs around the world practicing forms of interaction analysis, there have been few if any substantial efforts to articulate its central premises in the context of CSCL. Thus, the purpose of this study is to provide an overview and foundation for investigating the ways that IA has been interpreted and adapted in the field of CSCL specifically. Our broader goal is to consider ongoing methodological and technological developments for the future directions of interaction analysis within CSCL. We pose the following question: In what research contexts, including, environmental, technological, and collaborative arrangements, have IA methods been applied in the International Journal of Computer Supported Collaborative Learning? Extending this line of inquiry into the future will allow us to reflect on and respecify our methodological premises for investigating new collaborative learning interactions.

Methods: Systematic review and building a corpus

The current short paper presents preliminary analyses of a larger project investigating the role of IA methods in CSCL. The project is conducted as a systematic review (Gough, Oliver, & Thomas, 2017), and the data for this paper include a selected corpus of 48 articles published in ijCSCL between 2006 and 2019 (14 years). This corpus was produced based on the following search queries and criteria:

We first identified papers that cite Jordan & Henderson 1995 directly. This produced 32 articles. We then searched for “interaction analysis” which produced 65 results. Removing duplicates (29); editorials (12); superficial references to “interaction analysis” (e.g., reviewing another study, or otherwise peripheral to the methods of the study); and uses of “interaction analysis” from a different research tradition (e.g., Gundawara, Lowe, & Anderson, 1997) produced 3 additional papers for the corpus.

Finally, because our purpose is to identify methodological trends in ijCSCL and not statistically analyze the self-labeled methods of researchers, we wish to ensure a comprehensive and broad corpus. Thus, we searched for related terms including “Video”, “Conversation Analysis”, and “Ethnomethodology” to identify additional papers rooted in the same methodological tradition as Jordan & Henderson (1995). Such studies needed to be qualitative, based on a sequential, turn-based analysis of interaction, and should generally rely on some form of transcription of video data or digital recordings. Studies with methods primarily based on coding, thematic analysis, or content analysis were not included. This added (17) more papers to the corpus resulting in a total of 52 articles. For the current paper, which is investigating empirical conditions for performing IA, we removed 4 articles without a clear empirical setting to arrive at 48 articles used in this analysis.

We intentionally took an expansive approach to identify these studies which means the role of interaction analysis and the 1995 text is more central in some studies than others. While a limitation of this approach is that making precise categorical claims about the collection of studies becomes problematic, the advantage is that we are able to take a more holistic view of methodological developments in the journal. Another reason for including an expanded search beyond the initial 32 references is grounded in the many voices Jordan and Henderson integrated in the original paper; IA builds upon a diverse set of theoretical and methodological positions and some researchers in CSCL are informed by some of these voices, and do not cite Jordan and Henderson explicitly.

The broader project from which this study is based follows a systematic review of the above corpus. For this initial study, the authors reviewed the selected 48 articles in the corpus with attention to the empirical settings of the research, noting 1) where the learning activities were occurring (e.g. school, museum, etc.); 2) the primary mediating technology (e.g. computer, mobile phone, etc.); and 3) the group size of the participants (e.g. small group, whole class, etc.). These categories were collaboratively refined by the authors. We note that this is a subjective process, and in many cases, such categories are not clear. For example, many articles in the corpus incorporate a variety of collaborative technologies or occur across multiple settings. In such instances, we have tried to emphasize the primary empirical focus of the studies - see Table 1 for definitions of these categories.

Data and analysis

Since the inauguration of ijCSCL roughly 300 papers have been published and 48 of the papers are referring to or performing an analysis of interactions confirming the popularity of IA in ijCSCL. Based on our review it is

evident that IA has been used to study collaborative learning in many different settings (Figure. 1), but it is also clear that more than half of the studies are located in primary/secondary education. Three studies are conducted in experimental laboratory settings, whereas the rest take place in what can loosely be determined as interaction occurring in natural settings (in most cases as part of a research project). The fact that researchers have used IA in many different settings shows that there is a broad interest in understanding learning as social interaction and that IA is not exclusively used to study collaborative learning in one particular setting. In our review of the papers, we furthermore see that different studies do not necessarily apply the same elements from IA. While some studies adopt particular foci for analysis, others adopt relevant procedures for working with data, thus adapting the method to fit the particular study and the research question being addressed in the paper.

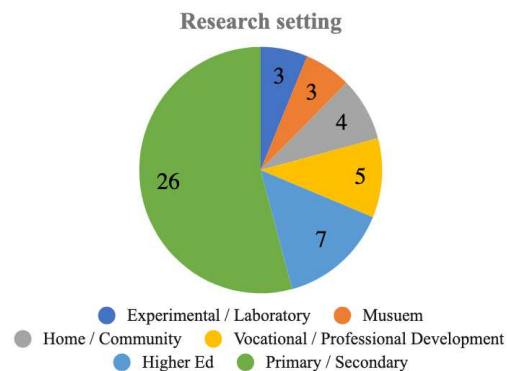


Figure 1. Research setting of interaction analysis and related methods in ijCSCL corpus.

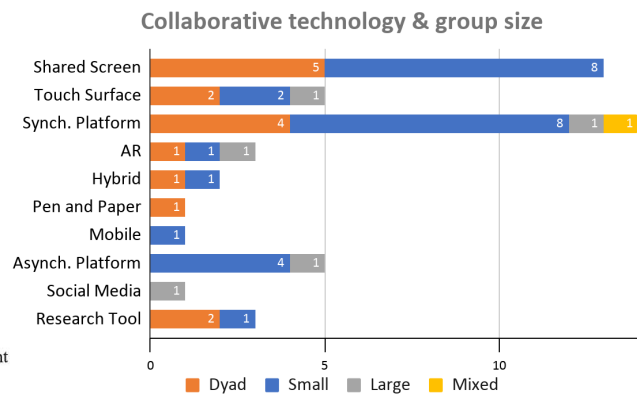


Figure 2. Comparing collaborative technology & group size by paper in ijCSCL corpus. Dyad, Small, and Large refers to group sizes of 2, 2-8, and 8+ respectively. Mixed refers to a combination of group sizes.

Looking into the relations between the collaborative technologies and group size (Figure 2.), we see that the majority of studies work with either dyads and small groups using a shared screen, touch surface or a synchronous platform. However, it is also evident that IA studies in ijCSCL are not exclusively dealing with one group size using a particular technology. New collaborative arrangements have emerged in CSCL as a result of new technologies, e.g. touch surface, augmented reality and social media platforms. Thus, the adaptation and innovations of IA should be viewed as genuine interest in understanding collaborative learning in different constellations of togetherness with different technologies. We only see two studies conducted in hybrid environments and only one study is working pedagogically with a mix of group sizes (small and large group).

Table 1: Category definitions

<i>Shared Screen</i>	Multiple users sitting/standing around the same computer screen or device.
<i>Touch Surface</i>	Touch tables, multi-user touch screens, and interactive white boards. Does not include tablets or mobile phones.
<i>Synch. Platform</i>	Computer /web-based platform in which participants collaborate on their own individual device, and interaction mostly takes place in the platform (not in front of the screen).
<i>AR</i>	Augmented Reality, Mixed Reality, or Simulators with physical and digital components.
<i>Hybrid</i>	Analytic focus is on a range of mediating technologies.
<i>Pen and Paper</i>	Analogue tools like pen and paper.
<i>Mobile</i>	Mobile technology like mobile phones. Does not include laptop computers or handhelds unless mobility is a part of the design/ task.
<i>Asynch. Platform</i>	Platforms and learning management systems mainly using asynchronous communication.
<i>Social Media</i>	Publicly available social media platforms.
<i>Research Tool</i>	Tool for visualizing/ working with CSCL data. The tool is not used by the participants, but the primary goal of the study is to develop a tool to describe participant interactions.

Another interesting finding is that IA has not only been applied to co-located collaborative activities but is also used to study collaborative learning in synchronous platforms (14), asynchronous platforms (5) and social media platforms (1). In these papers the authors have adapted and innovated IA to study social interaction in different media. In some of these papers social interaction is mediated by text in chats or online forums, which is

in contrast to the co-located studies presented by Jordan and Henderson (1995). Such studies depict significant methodological development in terms of data collection methods that do not rely on video, instead turning to screen capture, data logging, and related procedures. These studies similarly demonstrate analytic innovation in terms of how interaction is conceptualized across novel temporal and spatial arrangements. Further analysis may better articulate such developments in CSCL.

In 3 studies, IA has been used as part of a broader methodological stance to inform the development of a research tool. The purpose of developing the research tools is primarily a search for finding new ways of visualizing collaborative learning activities. Such tools might be viewed as extensions of Jordan and Henderson's emphasis on transcription and representation methods.

Finally, it is important to note that IA has been used to study collaborative activities mediated by a range of different technologies. For Jordan and Henderson artifacts/technologies was one among many possible analytic foci, whereas the mediating technologies tend to be foregrounded in ijCSCL. This is perhaps not surprising as the core interest in many of the papers is to investigate what role the mediating technology is having on collaborative learning. But it is important to emphasize that such technologies strongly inform the ways that collaboration is conceptualized. In other words, these findings suggest that much more nuance is needed when examining the role of mediating technology in ijCSCL than is provided by the single analytic foci described by Jordan & Henderson. Synchronous and asynchronous collaboration are fundamentally different activities, for example, and there is also a clear distinction between collaboration that occurs *within* a computational artifact (e.g., Synch. Platform) and that which occurs outside the artifact (e.g., Shared Screen). Overall, it seems fair to state that IA has proven useful for uncovering social mechanisms of collaboration in the triadic relationship between human-technology-human.

Discussion and Conclusion

The findings reported in this short paper are part of a larger ongoing systematic review on the use of IA in ijCSCL. They suggest that Interaction Analysis is a popular method in ijCSCL used in different settings to better understand how learners go about learning together using different technology. The majority of papers in our corpus research how dyads or small groups learn together, a few papers work with collaborative activities in larger groups, and only 1 paper is looking across different constellations of collaboration. It is less surprising to see the number of studies with dyads and small groups as CSCL researchers have promoted the idea of small groups as being a primordial site for studying meaning making processes (Stahl, 2006). In addition, this study also shows that researchers in ijCSCL have developed innovations for studying different collaborative arrangements moving beyond the face-to-face arrangements originally described by Jordan and Henderson (1995). As we move into the future, new kinds of technologies will emerge, and it is important that we develop and adapt IA to capture these different forms of reality/interaction (virtual, augmented, mixed, etc.) without forgetting the foundations and practices of IA. We have identified some general trends with this preliminary study; however, we have only scratched the surface and the next steps would be to identify the qualitative nature of the methodological developments in the field - to better understand the history and future practices of IA in CSCL. Moreover, a significant interest is also to articulate the status of collaboration across the different interaction analytical studies.

References

- Gough, D., Oliver, S., & Thomas, J. (2017). *An introduction to systematic reviews*. Sage.
- Gunawardena, C. N., Lowe, C. A., & Anderson, T. (1997). Analysis of a global online debate and the development of an interaction analysis model for examining social construction of knowledge in computer conferencing. *Journal of educational computing research*, 17(4), 397-431.
- Hall, R., & Stevens, R. (n.d.). Interaction Analysis Approaches to Knowledge in Use. In A. A. diSessa, M. Levin, & N. J. S. Brown (Eds.), *Knowledge and Interaction A Synthetic Agenda for the Learning Sciences* (Vol. 1, p. 37).
- Jeong, H., Hmelo-Silver, C. E., & Yu, Y. (2014). An examination of CSCL methodological practices and the influence of theoretical frameworks 2005–2009. *International Journal of Computer-Supported Collaborative Learning*, 9(3), 305–334. <https://doi.org/10.1007/s11412-014-9198-3>
- Jordan, B., & Henderson, A. (1995). Interaction Analysis: Foundations and Practice. *The Journal of the Learning Sciences*, 4(1), 39–103.
- Koschmann, T., & Suthers, D. (2006). Computer-supported collaborative learning: An historical perspective. *Cambridge Handbook of the Learning Sciences*, 2006.
- Ludvigsen, S., & Steier, R. (2019). Reflections and looking ahead for CSCL: Digital infrastructures, digital tools, and collaborative learning. *International Journal of Computer-Supported Collaborative Learning*, 14(4), 415–423. <https://doi.org/10.1007/s11412-019-09312-3>
- Stahl, G. (2006). *Group cognition computer support for building collaborative knowledge*. MIT Press.