Collaboration on a Massive Scale – Conceptual Implications of *the Crowd*

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Abstract: The question of how to engage large user groups in web-based learning arrangements is consistently raised in CSCL discourse. Recently the interest in crowd phenomena of joint knowledge creation and inquiry as well as their adaptability within institutionalized learning is brought together under the term of mass collaboration. This paper proposes a conceptualization of the crowd since learner involvement, sociality, collaboration and knowledge construction, coordination and regulation efforts, as well as assessment must be fundamentally thought anew, when we take a step away from a small group setting. Thus, we put forward a design framework that provides perspectives on CSCL environments on a massive scale and thereby challenges our understanding of collaborative learning.

Introduction

In the last years, the masses have played a decisive role in raising social, economic, political and environmental issues and mass movements like Occupy, the Arab Spring or #blacklivesmatter have drastically established unprecedented ways of public discourse and engagement. In science and education, large accumulations of learners, researchers or civic participants are addressed in open education initiatives like Massive Open Online Courses (MOOCs) or Open Educational Resources (OERs) and get involved in open science or citizen science projects. Further, it is also relevant to mention phenomena of joint development and creation (for example open source software development or the global online encyclopedia Wikipedia) as well as various possibilities for distributed financing, fundraising or forms of investigative journalism (for example the investigation platform Bellingcat). With these new forms of participation we notice new forms of collaboration and knowledge practices that are inseparably linked with technological developments especially in the fields of social software and web2.0/3.0 applications like social network sites and microblogging services. Herein lie promising challenges and opportunities for CSCL research and development to further evolve in the light of technological advancement and novel forms of interaction. The relevance of web 2.0 dynamics and tools has already been extensively discussed within the CSCL community, particularly in the discourses on collaborative knowledge building (Lu et al. 2010; Scardamalia et al. 2012). Also, the quality of massiveness has been introduced under the term of mass collaboration as one of the future-oriented topics for the design of and the research on collaborative learning environments (Cress et al. 2016; Fischer 2016; Jeong et al. 2017).

This paper contributes to the ongoing discourse. Firstly, we try to conceptualize the socio-technical construct behind the above-mentioned phenomena, that we further refer to as the crowd. We distinguish the crowd from a community and outline it as a distinct entity with specific qualities. In this way, the crowd serves as a productive anchor point to envision innovative learning scenarios and learning environments that are designed to transcend conventional classroom or distant learning settings towards participatory, engaging and fast paced forms of interaction. Secondly, we put forward a design framework for CSCL scenarios that allows to discuss implications of the crowd for the development of a learning environment that supports large groups of learners to establish collaborative knowledge practices. Building on four forms of mediation (Paavola et al. 2012), we introduce five design areas - learner involvement, coordination and regulation, sociality, collaboration and knowledge construction, assessment and feedback - under which we deepen our understanding of the crowd for learning contexts. Finally, we discuss in what way and to what extent the crowd as an organic entity and as an institutionalized and formalized educational setting - as most CSCL scenarios suggest - can be integrated with one another productively. Additionally, forms of crowd inquiry and crowd insight must be specified, especially in comparison to conventional scientific knowledge practices. Thus, this paper provides clarification regarding the current and highly relevant social phenomenon of crowds and systematically opens it up for further theorization and the development of computer supported collaborative learning environments.

Conceptualizing *the Crowd* for a CSCL context

In the following section, we discuss the crowd from two complementary angles. We ask how the crowd can be understood in its procedural nature - mainly in its formation, its internal coherence and its actions - and how we

can describe it in its fundamental structural and socio-technical properties. To ensure integrability within the current CSCL discourse, we structure our argumentation by building on the state of the art of the mass collaboration approach and by deriving it closely from widespread and acknowledged concepts, namely the Community of Practice (CoP) (Lave & Wenger 1991) and the Community of Interest (CoI) (Fischer 2001; Fischer 2007). As stated above, mass phenomena are quite different in nature. Not only explicit cases of education or, in a broader sense, knowledge creation come to mind but also instances of civic engagement, socio-political participation and activism. While in the field of institutionalized education massiveness remains an ongoing challenge, at the same time we can observe the emergence of informal large-scale accumulations of respective reach, vigor, creative power, productivity and voice. Following, the latter serve as a starting point to conceptualize the crowd and discuss it from a CSCL point of view. Therefore, with the crowd, we are facing a complex social entity, characterized by a highly dynamic nature and intricate internal structure, making use of diverse sets of socio-technical tools and infrastructures and bridging between online landscapes and physical arenas.

From an educational perspective, these current mass phenomena lack a theoretical framework which approaches the crowd as a distinct type of socio-technical entity. Large-scale interactions, in an admittedly expansive understanding, are mainly discussed in connection to the CSCL concept of mass collaboration (Cress et al. 2016; Fischer 2016; Jeong et al. 2017). Despite the marginal conversation about the crowd as a theoretical construct and the use of the term itself, the discussion on how participants come together and engage in large-scale collaborative efforts offers a valuable starting point to establish an understanding of the crowd. Under the term of mass collaboration we are able to distinguish the collaboration in massive scale environments from interactions in small groups or teams. Mass collaboration, in the broadest sense, is described as a large gathering of people in order to work or learn together (Fischer 2016). These social entities are understood as knowledge communities which Jeong et al. (2017) use as an umbrella term to describe a union of people in which knowledge is shared, picked up by others and in some cases newly constructed (Cress et al. 2015). For such knowledge communities, Jeong et al. (2017) list three distinct characteristics in terms of their interaction. Firstly, when such knowledge communities come together at arguably large scale, this form of interaction results in the collaboration among participants from various backgrounds and different geographical locations (Jeong et al. 2017; Fischer 2016). Secondly, despite the differences in knowledge background and geographical location, the participants of knowledge communities manage to organize their work in order to collaborate on artifacts (Jeong et al. 2017). Lastly, the product of mass collaboration usually entails knowledge creation based on collective work efforts (Jeong et al. 2017). Although this definition includes an underlying notion of a crowd, by taking a closer look, it becomes clear that the crowd and the community are not considered separately. Yet, we have reason to believe that the crowd bears its own distinct features which we discuss in more detail in the following.

Knowledge communities understood in the context of massiveness are defined by bearing a shared "mission" (Jeong et al. 2017) in order to achieve a productive way of working together. We argue that when considering the crowd, this shared "mission" has to be viewed from two complementary perspectives. A shared concern on the one hand is what incites masses of participants to form and maintain a crowd while joint efforts on the other hand are their unified actions. To illustrate this distinction: For the social justice crowd phenomenon #blacklivesmatter the unified rage about police brutality against citizens of african-american decent can be regarded as a shared concern and the various activities within the movement (for example using the hashtag across the whole social media landscape or participating in rallies and demonstrations) represent the joint efforts of the crowd. Shared concerns in our understanding of crowds are able to initially and virally vitalize exceptionally large amounts of people and keep their unified momentum going. Whether or not crowds eventually dissolve without a shared concern or with a concern losing its force of attraction over time - just like CoIs dissolve, after a project has ended (Fischer 2007). Another possible scenario could be the gradual stabilization or institutionalization of certain domains of a crowd in more sustainable communities. Also, communities may not only be seen as a remnant of crowd activity but as a relevant factor when it comes to virally spreading a concern or collectively joining efforts. In this reasoning we assume that crowd and community aspects interplay in a certain way for productive large-scale collaboration, the complex synergy of those socio-technical entities has yet to be empirically explored in more detail.

To further distinguish the crowd from communities, we consult the conceptions CoP and CoI. For one thing, a CoP is characterized by a shared social practice as a constituting element. It implies specific properties such as long-lasting, ongoing participation and holding together the members through the attribution of certain roles (e.g., newcomer/oldtimer). The internal structure of a CoP has an underlying notion of being potentially open to anyone while practically offering restricted access for people that can constitute themselves as a member by enacting and upholding the communities' shared practices or by becoming part of it by progressively adapting (Lave & Wenger 1991). This notion of community is typically used to describe social unions of people from similar (knowledge) backgrounds which are defined by a form of biased communication as the members only

communicate amongst each other, building up on a common background (Fischer et al. 2007, p. 14). Since the crowd as pointed out is mainly held together by its shared concern and joint efforts, the diversity among its participating individuals may reach far beyond that of a CoP. Although CoIs (primarily described as focusing on a specific mutual interest) include the notion of diverse members as well (Fischer 2001), it is important to point out that CoIs fail to pick up the argument of viral temporality and the inherent momentum that we would ascribe crowds. CoIs per definition present a "community of representatives of communities" (Fischer et al. 2007, p. 13) for example in interdisciplinary project teams. In contrast to these conceptions of community, a crowd does not exhibit the procedural characteristics of moving from peripheral to full and core membership (as conceptualized by Lave & Wenger 1991), for example engaging in an ongoing process of enculturation by upholding a shared practice. Rather, in a crowd, various perspectives on shared issues are brought together and expressed side by side, not in a way of successively becoming a part of something by adapting to a set of enacted practices but in a way of being momentarily involved. Certainly shared practices play an important part in connecting the various members of a crowd and securing their mutual understandings to some extent. Nevertheless we would argue that there is a declining significance of inherent processes of establishing convergence for the social entities at hand. Within the concept of CoPs there is a strong focus on reenacting a given internal structure. This is also discussed for CoIs with the difference that a diversity in participants calls for processes of negotiating and establishing common ground to a greater extent (Fischer 2007). For massive-scale interactions however it can be put into question if common ground and a widely accepted consensus provide an underlying mechanism of agreement at all or if antagonisms and notions of dissent can coexist in a unified crowd without endangering the overall efforts.

To this point we have established the crowd by building on a community perspective. To add to this we have to further take into account the crowd not only as a social entity but as a socio-technical one. Crowds are inextricably connected with modern informational and communicational technology. Especially Web 2.0 and 3.0 applications play a significant role when it comes to the aspect of virality, various forms of contributions and the modes of communication within a crowd. In this, crowds are not bound to one service alone but act across a diverse range of social media platforms in particular. Additionally, crowd efforts are not limited to virtual environments but also cover joint activities within offline spaces.

Given the fact that we establish a conceptualization of the crowd against a pedagogical background, naturally the aspect of learning must not be neglected. Therefore, we concern ourselves with the question what an approach to learning in crowd settings could look like. One specific model, that we assume to be adaptable in a crowd context, is the rhizomatic learning approach (Cormier & Stewart 2010). We see a great chance in further refining the concept of rhizomatic learning - which in its core means the distribution of knowledge in digital environments without hierarchical forms of dispersion - in close correlation with our notion of the crowd as a specific case of application.

Concluding, this attempt to provide a first heuristic discussion of the crowd, we can summarize the following procedural and structural qualities: The crowd in our understanding is a mass phenomenon that virally emerges around a concern that touches all participants in their own way and initiates them to contribute to joint actions. The crowd's members are diverse. They face the shared concern from potentially very different perspectives while simultaneously being connected and activated by their smallest intersection, their mutual affectedness. Therefore, the crowd's temporality is solely bound to its own momentum. The crowd is potentially open for everyone to join. Participation involves solely an act of contribution and no process of growing into a shared practice. In this sense, the content of a contribution may differ broadly in regard to the individuals behind them but they are not endless in their variation. Rather, forms of meaningful participation are connected to overstretching practices that are reproduced or emerge within the crowd's socio-material manifestation (e.g., posting on a social network platform), social events (e.g., taking part in a demonstration) and the crowd's operational area (e.g., writing an article for an online encyclopedia). In this, the crowd proposes a promising new take on education in a digital society.

Collaboration on a massive scale - a design framework

Thus far we have proposed a first conceptualization of the crowd that ties in the current CSCL discourse. Now, the next question is how to approach this insight from a developmental perspective to envision innovative CSCL scenarios on a massive scale. More precisely, the question is to which extent learning activities in the crowd raise design issues that resemble or go beyond those, pertinent to other CSCL scenarios and environments.

To identify crucial themes of interest for computer supported collaboration and learning in general, we conducted an exploratory literature review into notable research discourses that bring together notions of collaboration and knowledge creation, namely CSCL research and research on open education. To pinpoint the consequences of massiveness, we then enriched our findings with insights from additional domains that address scenarios of large-scale participation and creation, like citizen science and open source software development.

Within these domains we focused on (1) collaborative scenarios in general while keeping in mind the transferability to, as well as consequences for the crowd context and (2) particular scenarios that involve arguably massive participation.

Table 1: Design Framework for CSCL Scenarios

Formational Mediation: Learner Involvement	**Pragmatic Mediation**: Coordination & Regulation	**Social Mediation:** Sociality	**Epistemic Mediation:** Collaboration & Knowledge Construction	**Reflective Mediation:** Assessment & Feedback
Recruiting Participation Engagement Motivation Sustainability	Dynamic Static Intrinsic Extrinsic Process awareness Decision making Didactics Technology Negotiation Established practice Hierarchy	Communality Social awareness Communication Authorship Accountability Responsibility	Common ground Resources Knowledge objects Knowledge artifacts Shared insights Currents of inquiry Epistemic frames Subjects Social permeability	Many-to-many Peer-to-peer Instructor-based Creation of value Institutionalization Formalization

To be able to map and compare critical elements of crowd-based learning scenarios in relation to other CSCL settings, we build on the multidimensional model of mediation, suggested by Béguin & Rabardel (2000) and adapted to the field of CSCL by Paavola et al. (2012). According to Paavola et al. (2012), CSCL scenarios can be described and analyzed along four dimension or types of mediation. These types of mediation include (a) epistemic mediation, the procedural means through which knowledge is created collaboratively, (b) pragmatic mediation, the procedural means through which the collective efforts are coordinated and regulated, (c) social (or collaborative) mediation, the procedural means through which social relations and networks are (re-produced), as well as (d) reflective mediation, the procedural means through which the collective efforts are assessed, evaluated and advanced. The literature review however pointed to a set of design issues, which goes beyond the types of mediation suggested by Paavola et al. (2012). These issues relate to what Jeong et al. (2017) have discussed as different "forms of joint interaction that occur in large-scale community settings" (p. 134). We take up the relevance of categorizing such phenomena to describe how people work together and interact with each other by abstracting it to a more nuanced idea of learner involvement which is concerned with those processes and means by which actors are recruited and participation is motivated and ensured. We subsume these issues under the notion of (e) formational mediation, the procedural means through which involvement and participation are ensured. Table 1 provides an overview of the design issues we have identified with regard to these five types of mediation. The table can be understood as generic framework for the description, analysis, design and evaluation of computer supported collaborative learning scenarios and environments. In the following, we will use this framework as a vantage point to further discuss the particularities of crowd-based learning scenarios.

Formational mediation – Learner involvement

The first question for the setup of collaborative learning is that of how to address and involve participants and who those participants are. The recruiting of learners, so to say. Thinking along the lines of a crowd setting that transcends a given and formalized union of a classroom, recruiting implies that a critical mass of individuals has to be attracted, for crowd dynamics to develop at all. The actual process of rallying a crowd can only be understood in regard to the party responsible for the recruitment - for example a research team in a citizen science context (Chu et al. 2012), a MOOC provider (Haywood 2016, p. 75) or the crowd itself in its own momentum. Following this argument, the internal structure of a crowd comes into view, since different activities call for different levels of diverse or shared perspectives or practices among the involved individuals (Bonney et al. 2016) - regardless of the externally given or internally established origin of mutual objectives. Therefore, the participants and their individual qualities can be of high importance as well, because for being successfully involved in the joint effort they might need to have certain knowledge and competences at their disposal (Kobori et al. 2016) or their contributions need to achieve a specific standard to be considered of value or compatible at all (Ghosh & McAfee 2011). Adding to the consideration of recruitment, a distinction between participation and engagement seems reasonable. Within the frame of participation we can ask in what ways participants are able to take part in a meaningful way, which forms of contribution are compatible and if members face some kind of participational

threshold. Engagement on the other hand addresses the ongoing and active involvement of participants and is therefore a vital topic within the open education and open science discourse (Walji et al. 2016; Sprinks et al. 2017). Considering the social entity of a crowd we must challenge the idea that ongoing and active involvement constitutes a desirable participant. On the contrary, we should be mindful of punctual - and maybe minimal - acts of contribution and dissemination in consideration of the crowd's shared efforts and concern.

Following this contemplation, the view on motivation changes as well. Participant motivation is a leading topic for all kinds of educational and participatory scenarios (Rogat et al. 2013; Eveleigh et al. 2014) while the explicit implications for crowd-based learning have yet to be discussed. In the light of heterogeneous participants, diverse forms of participation and various modes of engagement as well as shared concerns and efforts as a constituting element of a crowd, motivation has to be conceptualized between these contrasting poles of enormous variability of being part of a crowd and presumably more common reasons to be involved at all.

Finally, we have to question the live-cycle of a crowd, for example its sustainability. With the constitutive factor of a shared concern and a joint effort, a crowd may dissolve when those inherent impulses are no longer given or may partially evolve in more stable forms of communality like a community or an organization. Besides this, processes of institutionalization of crowd phenomena, the compatibility of temporal arbitrariness of crowds and often temporally ridged educational structures have to be considered when imagining learning in a crowd-based environment.

Pragmatic mediation – Coordination and regulation

The various ways in which collaborative processes are coordinated and regulated are an ongoing issue within CSCL discourse (Ludvigsen et al. 2018). Assuming an inseparable relation between didactic prompts and interventions and technical affordances, we have to ask how participants are able to interact with the environment and with each other in a meaningful way. Especially when designing for a crowd the question arises how didactics and technical guidelines can support the joint efforts without restricting or preventing the crowd's constitutive momentum. In short, how can an emergent property like virality be facilitated at all? It is also relevant to consider the coordinating and regulating aspects of a learning scenario between the poles of static and dynamic structures and intrinsic and extrinsic determinations. Is a structure for example pre-established or does the environment enable the participants themselves or an external instructor to question, adapt and change their ground rules of collaboration? With the quantity and the diversity of crowd participants in mind, we further have to ask if equal negotiation and unanimous decision making is possible or even necessary for the crowd to be able to act and for people to join. Rather it seems essential to establish some kind of process awareness to help participants to find ways for at least minimal or perhaps more elaborate forms of contribution. Process awareness here serves as an ideal concept, because within the crowd's complexity and its emergent evolution it is an impossible task to concurrently describe it entirely. Finding the fine line to foster a crowd's dynamic without crippling it with a tight pedagogical frame and ensuring access for learners despite its complexity seems to be one of the main challenges when designing crowd scenarios for educational context.

Social mediation – Sociality

We have outlined the crowd as a socio-technical entity that is on the one hand diverse, complex and to an extent unbound and on the other hand temporally constituted under a joint concern and with a mutual cause. By accommodating such qualities, it can be clearly distinguished from other forms of communality that are addressed in CSCL scenarios as we argued in the previous paragraph.

Another concept that relates to sociality within the fields of computer supported collaboration is that of social awareness (Dourish & Bellotti 1992). It addresses possible ways for users in a virtual environment to perceive themselves as part of a social unit and consequently take note of each other. In this regard we raise questions at three levels. How is an individual able to become aware of all the other participants in the crowd entity, given the fact that so many people are involved in different ways at different levels (Jeong et al. 2017)? How does a notion of being part of a mass-movement emerge and what shapes this experience? And lastly, how can social awareness as a concept address the crowd as an entity that may not be attached to one specific environment but stretches over multiple virtual spaces and spreads into the offline world as well?

When members of a crowd communicate with each other, it can reasonably be concluded that communication exceeds dialogical forms. Such exceeding communication modes - which we assume to be highly relevant for crowd settings - can be observed in social networking or microblogging applications (e.g., in follower-followee relations, under shared hashtags or through @mention functionalities). With those mass-environments in mind, communication modes like one-to-many broadcasting (Page 2012) or pushing of pre-existent content without adding to it (Kaplan & Haenlein 2011) have to be considered in their consequence for the development of means of communication within learning scenarios for the crowd.

Another important factor that has to be thought anew in crowd settings is that of authorship which also implies the question of accountability and responsibility. We assume that in part, participants maintain visibility as authors as such. Additional scenarios though are anonymous forms of participation as well as rather content-less acts of meaningful participation (e.g., liking or reblogging/retweeting) that are immanent in crowds. In this case the question arises who can be held responsible for contents, statements and actions. If we consider a joint effort of a crowd as manifestation of its work, is it even possible to ascribe authorship, responsibility or accountability to a single person? Or must a crowd as entity be held accountable or responsible somehow?

Reflective mediation – Assessment and feedback

Assessment and feedback structures are among the most recurring and discussed issues in the CSCL community, not just as final evaluation method, but especially as an advancing act within the process of collaborative learning. In this regard the concept of peer-to-peer interaction is of particular importance and investigated in its own qualities (Reinholz 2016) as well as in its differentiation from instructor-based feedback and assessment mechanics (Harney et al. 2017). Additionally, many-to-many assessment scenarios have been explored within the field of open education and MOOC development, with the expectation of bringing together different levels of expertise, experience and prospects to evaluate contributions (Clougherty & Popova 2013). For crowd-based collaboration we have to ask how hierarchy-driven, peer-driven and in particular crowd-driven feedback and assessment dynamics take shape and in which way they can be fostered or are emerging organically during massive-scale interactions. In the open, complex and diverse socio-technical structure of the crowd, the ways in which the ascription of value unfolds in regard to the joint concern and efforts can therefore only be anticipated as an issue of future investigation. We assume that in addition to evaluating and reflecting functions of assessment and feedback, we will observe aspects of admission, such as generally including contributions as meaningful or disregarding them as irrelevant. In comparison to institutionalized educational settings, we assume that there are no explicit and formalized forms of valuation (e.g., examinations, grades or standards of education) existent in the crowd. Nevertheless, we ask ourselves if processes of formalization - beyond the shared practices of participation - play a role in crowd environments and how they can be explored further.

Epistemic mediation – Collaboration and knowledge construction

Lastly, we have to consider the crowd from an epistemic standpoint and discuss the circumstances of collaborative knowledge practices. To understand such processes, we have to determine the crowd's resources which ultimately create the foundation for knowledge construction. These resources include a certain diversity in perspectives, different approaches to problem solving and by sheer mass of participants, a major workforce.

Within a heterogenous crowd we can assume participants from various epistemic backgrounds to bring in their disciplinary practices and standpoints or, as Shaffer (2006) suggests, their epistemic frames. For a crowd setting it has to be revised, if an epistemic diversity only presents itself as a resource for multifaceted knowledge creation or if it may interfere as a participatory obstacle or even a gatekeeper. Diversity may call for the negotiation of common ground. But, as we have already discussed that common ground in a crowd context is sufficiently ensured by the shared concern and that beyond that, integrability of contributions only arises by the participatory act of contributing itself. Thus, different perspectives and approaches can coexist under a shared concern and are realized through joint efforts without necessarily coming into conflict with one another.

Framing crowd activities as an epistemic endeavor the question arises what can be considered as the outcome of a collaborative knowledge work. What shapes do crowd insights might take and are they for example of a more collective or a more individual nature. Clarification is needed on how such insights can become visible at all. How can a multitude of contributions together form a coherent current of inquiry? To further elaborate on the shared concern from an epistemic perspective, we see great potential in adapting Knorr Cetina's (2001) concept of Knowledge Objects and partial artefacts. Especially the notion of partiality we see as a starting point to examine the role of scattered contributions in relation to the collective epistemic process of a crowd.

Finally, recalling the observation that crowd phenomena are socially motivated, the matter of permeability comes into focus. We have to ask in what way integrability beyond the educational context of crowd insights can be established not only for scientific societies but for civic discourses. This can be understood in two different ways: For one, the crowd can be enriched and motivated by sources beyond the specific educational context, but also, its insights can be regarded in their societal accessibility.

Implications and discussion

With this paper we have put forward two contributions to the consideration of massiveness within CSCL contexts. Building on the discourse around mass collaboration and the concepts of CoPs and CoIs, we have conceptualized the crowd as a first attempt to establish a productive connection between current mass phenomena and educational

design. Within a framework of five areas of mediation we then took this conception of the crowd as a vantage point to raise issues of collaborative mass scenarios in a more detailed way. Drawing conclusions from this approach, we see the crowd as an opportunity to evolve computer supported collaborative learning alongside current technical and societal processes of transformation. Nevertheless, or possibly for exactly this reason, the crowd presents itself as a challenging design target.

We have outlined the crowd as a highly complex entity with an emergent nature and an inner momentum that is primarily fueled by the mutual affectedness of its participating individuals. The open question remains how an educational design can address all those issues in a way that fosters a crowd's formation and productive interactions within the scope of pedagogical expectations and constraints without inadvertently suppressing the dynamics. How can we achieve to cultivate an organic entity inside institutionalized education? Or do we rather have to envision a new form, a guided crowd, as a formalized variety alongside informal crowd phenomena?

In the light of the crowd, the aspects of learning, of collaboration and of inquiry require a reconsideration as well. We can ask where learning processes arise while taking part in crowd activities and which understanding of learning seems suitable to describe and facilitate those instances (e.g., rhizomatic learning). Further, we may have to widen our understanding about subjects of learning all together and consider not only the individual learner but the crowd as a collective learning entity. It is also worthy of discussion whether or not present conceptions of collaboration are suitable to describe joint efforts where interpersonal activity is not a constituting circumstance, or if crowd phenomena can lead to an extended theorization of collaboration all together. Another fundamental challenge lies within the CSCL objective to foster forms of inquiry derived from scientific practice. An idea of crowd-based inquiry may help to broaden the perspective of meaningful collective knowledge creation, especially in close relation to societal and cultural issues.

Finally, to entirely grasp the crowd, we have to acknowledge it not only as a socio-technical entity but in its performativity. The crowd as such only exists as long as individuals engage and contribute in a certain way. Only from this joint action the crowd emerges and is produced and reproduced in its particular features and only by contribution, participants can perceive themselves as being a part of it. Thus, understanding the crowd as a performative act is marked by an inherent contingency that proposes highly relevant implications not only for the design of educational crowd scenarios but for their scientific exploration as well.

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