



# The Global Diffusion of Social Innovations – An Analysis of Twitter Communication Networks Related to Inclusive Education

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In recent decades, different social innovations – such as lifelong learning, inclusion or Education for Sustainable Development – have had a huge impact on domestic education systems. In an increasingly globalized world, innovations diffuse across national borders. At the same time, diffusion processes seem to be highly influenced by public and private actors, e.g., international organizations (IOs) or non-governmental organizations (NGOs). Both state and non-state actors use social networks and digital communication platforms, such as Twitter, as channels for the diffusion of social innovations and practices. Inclusive education, which has become the main alternative to special schools for the schooling of children with disabilities, is a widely discussed innovation in education and, hence, represents a suitable case for the study of global diffusion processes and the involved actors. Thus, drawing on social network theory (SNT), the aim of this paper is to examine the structure of the Twitter communication network forming around the social innovation of inclusive education. Empirically, we use social network analysis (SNA) to map the communication network; identify central actors; and infer assumptions about the role of different actor groups. Our results show, for instance, that especially NGOs and IOs hold central positions in the network, which enables them to exert influence on the diffusion of innovative ideas. Overall, the findings of our study indicate how the online communication tool Twitter can play a crucial role for actors who seek to influence the global diffusion of social innovations in education and effect education policies, norms and systems at the global, national and regional levels as such.

**Keywords:** social innovation, social network analysis, inclusive education, Twitter, global diffusion

## INTRODUCTION

In recent decades, education systems around the world have been confronted with reform initiatives, resulting in a growing number of social innovations related to education. Results of international student assessments such as the program for international student assessment (PISA) or the trends in international mathematics and science study (TIMSS) – which have demonstrated educational needs and weaknesses concerning educational justice – have urged political actors to develop and implement innovative ideas with the aim to meet the needs of disadvantaged groups

(e.g., persons with disabilities). In an increasingly globalized world, the diffusion of educational reforms and innovations (such as inclusive education) is not limited to national borders. Instead, international organizations (IOs) as well as multinational and transnational actors are influencing educational systems and settings at the global level with significant consequences at the national and regional levels in many countries.

As a result, different concepts and programs – such as the Bologna reforms in European Higher Education or digitalization in schools – have had a huge impact on domestic education policy. These social innovations are often developed in response to general societal change or to meet the needs of disadvantaged groups (e.g., persons with disabilities). We define social innovations as new social concepts with a direct connection to the search for solutions to social problems or challenges (Zapf, 1994; Rogers, 2003; Kolleck, 2014). Hence, social innovations are not only related to the development of new ideas, services or models to better address social issues, but also require a stage of implementation (Kolleck, 2016). In contrast to technological innovations, social innovations entail normative, functional or pragmatic concepts such as lifelong learning, Education for Sustainable Development or inclusive education. As a result, social innovations are neither abstract goals nor intentions but have already demonstrated an effect on social practices. To give an example, they have resulted in social movements, educational reforms, novel pedagogical and organizational practices and changes in educational discourses.

A variety of scholars have tried to identify different mechanisms that influence the diffusion (or ‘traveling’) of social innovations around the globe (for an overview, see Steiner-Khamsi and Waldow, 2012). Some authors argue that, driven by international, large-scale assessments such as PISA, policymakers take particularly successful countries as examples of best practice and try to transfer specific concepts to their own domestic structures. Scholars refer to such mechanisms as cross-national ‘policy borrowing’ (e.g., Steiner-Khamsi, 2012). Others emphasize the role of IOs as global players that exert their influence through the setting of standards, the development and dissemination of policies, or the provision of technical and financial assistance (Jakobi, 2009). Aside from these public actors, the involvement of private actors, such as non-governmental organizations (NGOs), philanthropic actors or businesses, is highlighted by a growing number of scholars (for an overview, see Verger et al., 2016b). Overall, it can be noted that the diffusion of social innovations at the global level seems to include a variety of different stakeholders that needs to be considered in the study of such processes.

With its impact on education systems worldwide, the concept of inclusive education has developed into one of the most influential social innovations in education in recent decades. It has experienced a tremendous institutionalization, as manifested in a variety of organizations and social movements. In particular, the social innovation has been adopted as a human right through the creation of the United Nations (UN) Convention on the Rights of Persons with Disabilities (CRPD) with its Article 24 on education. This has resulted in the restructuring of educational systems in diverse UN countries, successively

replacing special schools with inclusive settings (Kanter et al., 2014; De Beco, 2016). Despite its legitimization in the CRPD, the level of implementation of this concept still differs widely when compared internationally. Scholars argue that although inclusive education needs to be implemented at the domestic level, different stakeholders must build networks and spread different ideas and issues surrounding the topic at the international level (Torres Hernandez, 2008; Biermann, 2016). Hence, we argue that the discourse on the implementation of inclusive education is shaped by a variety of different state and non-state actors, each with its own intentions, interests, and means to influence how social innovations such as inclusiveness are defined, operationalized, and put into practice.

In these discursive battles and processes of international policymaking, information and communication technologies (ICTs) play an increasing role as ‘new’ channels for information and knowledge diffusion. Social media platforms, such as Twitter, have become increasingly relevant for the dissemination of information and innovation, also in education policy (Conover et al., 2012; Dubois and Gaffney, 2014). Different actors use Twitter communication to build links to other actors and to form debates around specific topics.

However, to date there is only little knowledge about the actors involved in the respective networks of innovation diffusion, the way these actors engage in the diffusion and what role they play in social media discourses. In this article, we address this research gap. Using inclusive education as an example of one of the most successful social innovations in education over recent decades, we investigate

*how the Twitter communication network around the social innovation of inclusive education is formed, which actors and actor groups are involved and how they interconnect with each other in order to shape and diffuse the social innovation.*

In order to answer these questions, we draw on concepts of social networks and relate these to questions of social innovations. Empirically, we use techniques of social network analysis (SNA) to identify the most central actors in the network and to make assumptions about the involvement of different actor groups. Following this introduction, we describe inclusive education as a social innovation in education and conceptualize it using social network theory (SNT). Thereafter, we give a short introduction to the social media platform Twitter. After describing our methodological approach, we then present and discuss our results. We conclude the article with a short summary of main findings and prospects for further research.

## THEORETICAL BACKGROUND

### Inclusive Education and Innovation Diffusion

Inclusive education as a concept for the schooling of children with disabilities, in contrast to separate schools or classes, has gained increasing acknowledgment and acceptance over recent decades. With the adoption of the CRPD, the disability rights movement has further made a seminal step in establishing inclusive education as a human right. Article 24 of the convention

highlights that “States Parties recognize the right of persons with disabilities to education” and “shall ensure an inclusive education system at all levels” [Convention on the Rights of Persons with Disabilities (CRPD), 2006]. This demands that member states take necessary actions to implement inclusive settings in their education policy. However, studies show that even among the signatories of the convention there are still great differences concerning the implementation of Article 24. Most studies that examine different approaches to implementing inclusive education focus on single countries or conduct cross-national, comparative studies (e.g., Ainscow et al., 2006; Powell et al., 2016; Li, 2018). These studies suggest, among others, differences in the role of government or in the various national traditions around the schooling of persons with disabilities, which in turn result in differences in the national discourse about the issue. However, attempts to change these current states are not limited to national borders. As the historical development of the CRPD shows, non-governmental actors such as IOs or NGOs have always advocated for inclusive education (Degener and Begg, 2017). As is the case for other educational concepts, such as lifelong learning (Jakobi, 2009), inclusive education must be conceived of as a social innovation that is diffused globally.

The term social innovation refers to processes of implementing and diffusing new social concepts across different sectors of society. While ‘innovation’ implies a kind of renewal, ‘social’ connotes interaction of actors. Social innovations are directly related to the search for solutions to social problems and challenges. Educational innovations are social innovations in educational contexts, such as new forms of educational cooperation or novel learning concepts. It is assumed that the structural properties of social networks have an impact on how social and educational innovations are implemented and diffused. Empirical studies show that the behavior of contact persons correlates highly with an individual’s adoption behavior (Rogers, 2003). Implementation and diffusion of innovations are social processes; innovations are accepted and established in social networks and diffused via social relations that are based on these networks. Likewise, education is seen to be a key to implementing innovations.

One main aspect of innovation is the diffusion process. As defined by Rogers (2003, p. 5), “diffusion is the process in which an innovation is communicated through certain channels over time among the members of a social system.” The concept of diffusion is thereby mostly related to the process itself as opposed to the results (Elkins and Simmons, 2005). Tews (2005, p. 65) adds to these considerations that diffusion comprises “the spreading of innovations due to communication instead of hierarchy or collective decision making within international institutions.” Thus, we argue that the sort of communication channel is of less relevance when it comes to innovation diffusion. In theory, stakeholders pass through different stages in their adoption and realization of an innovation, from knowledge of the concept, to persuasion, to adoption, implementation and, eventually, confirmation. In the case of inclusive education, most countries – at least the member states of the CRPD – can be located at the fourth stage, the implementation. According to Rogers’ considerations, reflections

about adopting or implementing innovations depend highly on the communication with others. Consequently, communication networks emerge from the constant interpersonal exchange about experiences and ideas, with certain stakeholders acting as ‘policy entrepreneurs’ embedded within them (Mintrom and Vergari, 1998). Hence, “we must understand the nature of networks in order to understand the diffusion process” (Rogers, 2003, p. 331), focusing on the question of which actors use which channels to communicate and which networks are formed by these channels.

It may be argued that inclusive education is not necessarily a ‘new idea’ because it has been discussed and even implemented in the educational systems of some countries for years. However, as Rogers (2003, p. 12) states, “‘newness’ of an innovation may be expressed in terms of knowledge, persuasion, or a decision to adopt.” Hence, as Heiskala (2007, p. 54) summarizes, it only matters if the idea is “perceived as new in the context of application.” Rogers defines an innovation as “an idea, practice, or object that is perceived as new by an individual or other unit of adoption. It matters little, so far as human behavior is concerned, whether or not an idea is objectively new as measured by the lapse of time since its first use or discovery. The perceived newness of the idea for the individual determines his or her reaction to it. If the idea seems new to the individual, it is an innovation” (Rogers, 2003, p. 12). Consequently, in this article we conceptualize inclusive education as a social innovation because it has experienced a process of policy implementation and global diffusion, thereby resulting in numerous political, judicial, social, and educational reforms in recent years.

## Conceptualizing Social Networks

In recent years, the term ‘social network’ has attracted a lot of interest. Network approaches are becoming increasingly important in several scientific disciplines. To give an example, the social background and the social relations of individual pupils are regarded as among the most important factors having an impact on school achievement (Sun, 1999). Further, social networks influence processes of learning (Morgan and Sorensen, 1999), socialization (Hennig and Stegbauer, 2012), and innovation (Valente, 2009).

The scientific literature includes several different understandings of social networks. Frequently, SNA is used metaphorically to describe social phenomena (Hwang and Moon, 2009), such as how cultures influence behavior in bounded groups (Wellman, 1988). However, relying on metaphors as the foundation for development strategies and policy advice can be harmful and lead to unintended results (Ostrom, 2011). This article draws on Wassermann and Faust’s (1994) definition of social networks, which is broad enough to be combined with different theoretical approaches. Hence, a social network “consists of a finite set or sets of actors and the relation or relations defined on them. The presence of relational information is a critical and defining feature of a social network” (Wassermann and Faust, 1994, p. 20). At the same time, in this article we specify social networks as collective actors that emerge from common interests, topics and problems. Thus, social networks, and their members and boundaries, are defined according to their specific contents and topics.

Network boundaries are fluid, the result of ongoing negotiations and content-related, substantial interactions. Exchange and deliberation facilitated by social networks give them the potential to generate new knowledge and promote ideological and structural change in local systems (Kolleck, 2016).

## Conceptualizing the Diffusion of Social Innovations Using Social Network Theory

In recent years, the transfer and diffusion of social innovations has been further theorized using SNT. SNT builds on previous thoughts on the role of social networks and social relations in processes of reform and innovations. It does so by distancing itself from the assumptions of both methodological individualism and methodological structuralism and by highlighting the interactions between structure and agency. Actors are not regarded as islands, but rather as being embedded in social structures (Kolleck et al., 2017b).

To give an example, building on different theoretical approaches, Borgatti and Lopez-Kidwell (2011) develop a theoretical framework that helps to better understand processes of social innovation diffusion and communication networks such as Twitter (Kolleck et al., 2017a). This theoretical framework is built upon the assumptions formulated by Granovetter (1973); Burt (1982), and Coleman (1988) to conceptualize relational phenomena: the backcloth and the traffic of social networks. While the backcloth offers the infrastructure that enables or constrains the traffic, the traffic refers to what flows through the network (e.g., information on inclusive education). Hence, the backcloth serves as the conduit through which the traffic or social innovations flow (Borgatti and Lopez-Kidwell, 2011).

One main interest in applying SNT is to gain information on the position of and the structure surrounding an actor in a network; that is, its embeddedness. The advantage resulting from an actor's embeddedness in his/her relational neighborhood has been conceptualized in different ways. While Granovetter (1973) argues that the network structure or 'context' in which an actor is embedded matters, others stress the importance of the actor's position. Burt (1982) developed such a conceptualization of positional advantage as a source of social capital. In his study on structural holes, he finds that an actor increases his/her social capital by being in a unique position that allows only this actor to connect several clusters in the network. By exploiting structural holes and acting as a broker between clusters, this actor has an informational advantage and increased leeway for maneuver (Sabatier and Jenkins-Smith, 1993; Christopoulos and Ingold, 2015).

For the theoretical framework used in this article, this network theoretical perspective is relevant because it allows us to neatly distinguish between the structural conditions (e.g., centrality) and the actual flows (e.g., exchange of information on inclusive education). Hence, we extend the existing literature by using this network theoretical perspective to examine the Twitter communication network related to inclusive education. In this way, we specify the network in order to make assumptions about the involvement of different

stakeholders and their interconnections in diffusing information on inclusive education.

## SOCIAL NETWORKING ON TWITTER

The microblogging service Twitter is one of the most popular social media platforms worldwide, with over 300 million accounts and 500 million messages per day (Steinert-Threlkeld, 2018). With its global scope and its flat hierarchy, it allows users from all over the world to publish short messages of up to 280 characters (so-called 'tweets') and to connect with other users through mentions, replies or retweets. To mention someone, users simply put the @-symbol in front of another username. In this way, the mentioned user receives a notification. Replies are mentions at the beginning of a tweet and they are often used for actual (public) conversations. Retweets are tweets originally written by others, which are republished by a user. Retweets are often used to spread information to new audiences, but also to comment on a specific tweet (Boyd et al., 2010). Moreover, users can engage in specific discussions by using hashtags (adding the #-symbol in front of a keyword). Hashtags are usually established either by users writing about a specific topic or are predefined in advance of a specific event. Once a hashtag is established, users can easily contribute to the same discussion and follow the discussion by subscribing to the hashtag.

Having started as a private blogging service, Twitter has now become a news and information medium that is widely used by public stakeholders, such as politicians, government agencies, or NGOs (Kwak et al., 2010). These political actors use the platform to communicate with the wider public, to promote ideas, and also to mobilize and connect to others (Conover et al., 2012; Dubois and Gaffney, 2014; Guo and Saxton, 2014). Especially connecting to others offers the opportunity to exchange information and, by doing so, spread ideas and innovations across a broader network. While there has been limited research to date on the use of Twitter in education policy, it can be assumed that political actors in this field participate in global networking activities on Twitter.

## METHODOLOGICAL APPROACH AND MEASURES

Empirically, we operationalize our theoretical thoughts on social networks and social innovations by drawing on techniques of SNA in order to examine the Twitter network that has formed around the discussions about inclusive education. "Networks are a way of thinking about social systems that focus our attention on the relationships among the entities that make up the system" (Borgatti et al., 2018, p. 2). The main idea of analyzing social networks is to shift the focus from attributional information to the relational aspects of the researched subjects, that is, the way they are embedded in a network (Wassermann and Faust, 1994; Jörgens et al., 2016). This approach contrasts with more traditional methods of social sciences, such as interviews or surveys, and can therefore provide a different type of information. As noted by Nooy et al. (2011, p. 5), the main

objective of SNA is “detecting and interpreting patterns of social ties among actors,” thereby allowing for a better understanding of the dissemination of ideas, arguments and innovations (Kolleck, 2016). Social networks consist of a set of actors (nodes) and the connections between them (edges; Borgatti and Halgin, 2011). The nodes in a social network are not necessarily individuals but can also represent groups or organizations. Edges can comprise information exchange, interactions or all sorts of relationships (Wassermann and Faust, 1994). Translated to a Twitter context, the nodes represent Twitter accounts and the edges represent retweets or mentions. To determine the direction of the retweets we refer to Kumar et al. (2014) who suggested that a link goes from user A to user B if A retweets B. This understanding of a retweet is closer to a traditional network theoretical perspective as the actual action of retweeting is employed by A whereas B remains passive.

Recently, techniques of SNA have been increasingly applied in educational research (for an overview, see Zander et al., 2014; Menashy and Verger, 2019), as well as in the study of policy implementation processes (for an overview, see Lecy et al., 2014). Usually, the main focus of these studies is the identification of particularly central actors or organizations – where centrality is understood as the potential power to slow down or accelerate flows of ideas or innovations in a network, as well as gaining better access to information due to an actor’s position (Borgatti et al., 2009; Nooy et al., 2011). For the present study, our main interest is the network that has formed around the Twitter debates on the topic of inclusive education. We assume that specific public and private actors try to actively take central positions in the Twitter network in order to exert influence on the information flow. Hence, in order to identify particularly central actors, we conduct SNA to calculate different centrality measures. Using different centrality measures allows for a more comprehensive description of the network.

The most common centrality measure is degree centrality, which can be further divided into in-degree and out-degree for directed networks.<sup>1</sup> The in-degree counts the number of incoming ties, whereas the out-degree represents the number of outgoing ties. On Twitter, the in-degree means the total number of retweets, mentions or replies a Twitter account has received and can therefore be conceived as a measure of prestige or popularity. In contrast, the out-degree measures the number of mentions or retweets a user published and is defined as the extent of activity of Twitter users, as well as a measure of their expansiveness (Borgatti et al., 2018). For the present study, we calculate the centrality measures to identify particularly active and popular accounts. Against the backdrop of processes of policy diffusion these are rather simplistic measures and prone to error if used to assess the individual role of the accounts in the communication network and their centrality or influence on the actual diffusion of social innovations.

Two more complex and more valid measures to calculate centrality and influence in processes of innovation diffusion are

betweenness centrality and eigenvector centrality. “Betweenness centrality is a measure of how often a given node falls along the shortest path between two other nodes” (Borgatti et al., 2018, p. 201). Hence, these measures provide a more profound basis to measure an actor’s centrality, influence or ability to control the flow of information in a communication network. Assuming that information is likely to take the shortest path to flow from one actor to another, being on many of these shortest paths allows an actor to further pass on information or to stop the flow. Eigenvector centrality, in contrast, is calculated in relation to the centrality of the nodes it is adjacent to and is often interpreted as a measure of popularity in the sense that an actor is popular if it is connected to other popular actors. In this way, even actors with only few connections can hold central positions in a network (ibid.). These additional centrality measures can provide further insight, not only into the Twitter activity of the different actors but also into their embeddedness in the network. Hence, in contrast to degree centrality, these measures consider the embeddedness of different actors in the diffusion network, allowing for assumptions about their placement within more complex network structures. This, in turn, enables further assumptions about the influence different actors might have on the diffusion of innovations.

## Data Set

In order to collect Twitter messages relevant to the CRPD and inclusive education, we gathered data that was published during the conferences of states parties (COSPs) 2013–2017. The COSPs were chosen for the data collection because – as an integral part of the CRPD (Article 40) – they represent a crucial platform for different actors to discuss the implementation of the convention. We collected the data over the whole duration of the conferences and added one day before and after to cover all relevant data. In addition to tweets containing hashtags directly linked to the convention and the conferences (e.g., #CRPD or #COSP10), we also searched for disability-related hashtags for specific years, such as #post2015 in 2015 or #thisability in 2013 and 2014.<sup>2</sup> Overall, the data set contained 44,545 tweets. As we had a particular interest in the network around the debates on inclusive education, we further searched for related messages using the following search syntax:

educa\*<sup>3</sup> OR article 24 OR sdg<sup>4</sup> OR school OR (child AND inclu\*)

This filter led to a reduced data set of 1,638 tweets, of which we generated an education-specific network consisting of 986 nodes and 1,793 edges. The edges represented 1,557 retweets (86.84%) and only 236 mentions (13.16%). Although we were not able to conduct more detailed analyses of the data due to the still high number of messages, we added further information about the actors in the network by assigning them to the

<sup>2</sup>The complete search syntax can be found in the **Appendix**.

<sup>3</sup>To cover education (engl./fr.) and educación (esp.) for the languages mainly used in the data set.

<sup>4</sup>The fourth sustainable development goal (SDG) proclaims quality education and is therefore widely used in the context of inclusive education.

<sup>1</sup>In contrast to undirected networks, where the ties represent symmetric relationships such as shared membership in a group, ties in directed networks have a sender and a receiver (e.g., a friendship network).

different organization types. The categories that were generated inductively throughout the process included:

- Businesses (e.g., Ai Media, Karlen Communications),
- governmental actors (e.g., the United Kingdom Department for International Development, the United States Agency for International Development),
- IOs [e.g., the United Nations Children’s Fund (UNICEF), World Bank],
- general NGOs<sup>5</sup> (e.g., Human Rights Watch, Lumos),
- disabled people’s organizations (DPOs; e.g., Inclusion International, Disabled Peoples’ International),
- research [e.g., Foro de Educación, Institute of Social and Policy Sciences (I-SAPS)],
- media (New York Times, Driven by Health), and
- private persons (including users that could not be assigned to other categories).

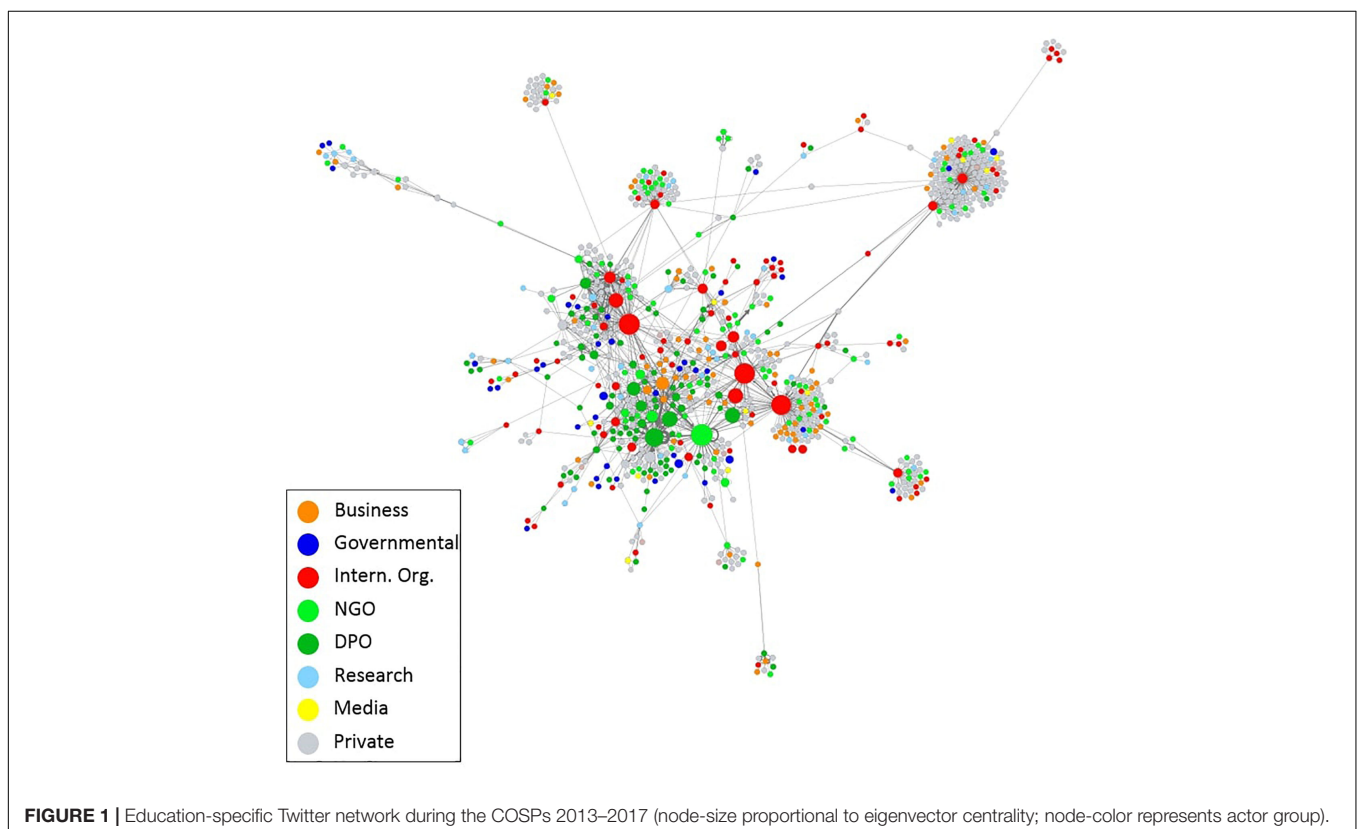
## RESULTS

Aside from private actors ( $N = 446$ ), NGOs represent the largest group in the data set with 127 accounts, followed by DPOs ( $N = 109$ ) and IOs ( $N = 104$ ). A slightly smaller number of

<sup>5</sup>General NGOs’ are distinguished from DPOs on the basis that they do not have a singular thematic emphasis on disability rights but rather a broader or different agenda; however, throughout the paper we sometimes refer to general NGOs and DPOs collectively as ‘NGOs’ as they represent the same type of organization.

accounts can be assigned to businesses ( $N = 91$ ). Only a small proportion of users in the network can be observed for research-related accounts ( $N = 50$ ), governmental actors ( $N = 43$ ) and the media ( $N = 16$ ). Overall, it can be noted that the Twitter network forming around inclusive education consists of a diverse set of actors.

The Twitter network was visualized using Gephi, an “open-source software for the visual exploration of networks” (Heymann, 2014, p. 612). For a better interpretability of the visualized network, we applied the ForceAtlas 2 layout, an algorithm that makes adjacent nodes approach and unconnected nodes repel (Jacomy et al., 2014). **Figure 1** shows the graph of the network, including the actor group affiliation and the eigenvector centrality of each node. To keep the graph readable, it only represents the main component, that is, the largest set of nodes in which every node is somehow connected to each other. Consequently, the presented network contains 826 nodes (83.77% of the overall education network) and 1,646 edges (91.8%). The high percentage of nodes included in this main component suggests that the Twitter network on inclusive education in the context of the CRPD does represent – to some extent – a cohesive group of interconnected nodes with only a few loose islands. Some aspects of the graph are noteworthy. First, the network consists of one main body containing the most central nodes (according to eigenvector centrality) and some smaller groups that are loosely connected with this main body. The most central actors are mainly IOs, NGOs, and DPOs. As for the distribution of different actor groups, from this graph



no observable patterns can be identified. Only a ‘green nest’ in the lower part of the main body suggests a close connectivity of different NGO-related actors. Others, such as governmental or research-related accounts, are rather randomly located in the graph. This unsystematic arrangement could be regarded as an indication that the involvement of many different actors may shape the implementation of inclusive education in many ways.

In order to specify the most central nodes with respect to different dimensions of centrality, we calculated the in-degree, out-degree, eigenvector and betweenness centrality measures for the network. **Table 1** presents the top ten actors according to in-degree. The account that received the most mentions and retweets is the UN Entity for Gender Equality and the Empowerment of Women (in short, UN Women). This is particularly noteworthy because this agency is neither necessarily concerned with education-related issues, nor is the topic of inclusive education explicitly directed at girls and women. UN Women is followed by the education-related account of UNICEF and – at some distance – UNICEF’s main account. Four further UN-related accounts and the World Bank show that users tend to address IOs with their activities in the network. Only two of the leading NGOs in the field (Inclusion International and Lumos) break this dominance, suggesting that civil society actors are not popular addressees for this sort of online communication. This distribution suggests that other users address the formally influential Twitter accounts (i.e., the IO-related accounts) in order to diffuse the innovation by using their wide reach.

In respect to activity in the network, **Table 2** displays the ten users with the highest out-degree. By far the most active user is Karen McCall, a disability rights activist and founder of the company Karlen Communications which provides accessible documents. Other active accounts belong to NGOs, predominantly DPOs, such as Sightsavers, Inclusion International or the International Federation for Spina Bifida and Hydrocephalus (IFSBH). Also, more accounts of individual persons seem to take the initiative in mentioning or retweeting others, such as, for instance, the chair of the Accessibility for Ontarians with Disabilities Act (AODA) Alliance, David Lepofsky, Sightsavers’ Head of Multilateral Engagement and Campaigns, Natasha Kennedy, or the global disability advocate Edmund Asiedu. Hence, in contrast to the results of in-degree centrality, aside from UNICEF, the active roles in the network

**TABLE 2** | Ten most central users according to out-degree.

Username	Real name	Out-degree
KarlenInfo	Karen McCall	35
Sightsavers_Pol	Sightsavers’ Policy and Research Team	21
InclusionIntl	Inclusion International	17
DavidLepofsky	David Lepofsky	16
lumos	Lumos	15
Kennedytasha	Natasha Kennedy	13
UNICEFEducation	UNICEF Education	12
ifsbh	International Federation for Spina Bifida and Hydrocephalus	12
AsieduEdmund	Edmund Asiedu	11
aodaalliance	AODA Alliance	11

AODA, Accessibility for Ontarians with Disabilities Act.

seem to be taken by private actors, indicating a different approach to diffusing the concept of inclusive education: these actors seem to actively address others (potential partners) to exchange ideas and information concerning the concept itself and its implementation.

More detailed insights into the actors’ roles in the overall diffusion network can be drawn from the distribution of eigenvector centrality. As can be seen from **Table 3**, there are several actors with high values in the network. The most central account in this regard belongs to the NGO Lumos, which was founded by the author Joanne K. Rowling and which aims to bring orphaned children back to their families.<sup>6</sup> Other accounts with similarly high values belong to leading UN agencies and initiatives, underlining their important role in the network. The only individual person in this list is Connie Laurin-Bowie, the Executive Director of Inclusion International, which further reinforces that organization’s central position. Thus, the most central positions in terms of popularity are held by key actors in the field, especially UNICEF and leading NGOs.

Finally, **Table 4** presents the top ten accounts according to betweenness centrality. In this regard, the most central account is the UN’s Global Education First Initiative. This five-year initiative was launched in September 2012 to strengthen the Education for All goals and the education-related Millennium

<sup>6</sup><https://www.wearelumos.org/who-we-are/>

**TABLE 1** | Ten most central users according to in-degree.

Username	Real name	In-degree
UN_Women	UN Women	136
UNICEFEducation	UNICEF Education	105
UNICEF	UNICEF	69
InclusionIntl	Inclusion International	64
Lumos	Lumos	59
UNGEI	UN Girls’ Education Initiative	53
GlobalEduFirst	Global Education First Initiative	49
WorldBank	World Bank	49
Education2030UN	Education 2030	48
AustraliaUN	Australian Ambassador to the UN	41

**TABLE 3** | Top ten users according to eigenvector centrality.

Username	Real name	Eigenvector centrality
lumos	Lumos	1.0
UNICEF	UNICEF	0.95
GlobalEduFirst	Global Education First Initiative	0.92
UNICEFEducation	UNICEF Education	0.89
InclusionIntl	Inclusion International	0.80
claurinbowie	Connie Laurin-Bowie	0.61
GLOBI_inclusion	Global Observatory for Inclusion	0.58
GEFI_Youth	Youth Advocacy Group	0.57
WorldBank	World Bank	0.55
ZeroProjectorg	ZeroProject	0.48

Development Goals. Aside from already mentioned accounts – such as Karen McCall, Inclusion International, or Lumos – among the most central accounts are also the Global Observatory for Inclusion, a global advocacy network, or the disability rights advocates Kimber Bialik and Andrea Pregel. Given the underlying meaning of this measure (i.e., the identification of brokers between different parts of the network), the diffusion of the social innovation seems to be supported by some actors that are particularly important in forwarding ideas and information. Consequently, these actors might be able to shape the concept in favor of their own interests.

Overall, concerning the diffusion of the concept of inclusive education the results of the current study show that the most central accounts in the Twitter communication network belong to IOs and NGOs. Hence, these actors can be assumed to have a certain potential to influence the diffusion and shape of the concept of inclusive education. However, a closer look at different centrality measures suggests the distribution of specific roles according to actor groups. While IO-related accounts are rather passive, yet still influential actors, because they are used as potential levers for information, in particular private actors such as NGOs and businesses try to benefit from the opportunities on Twitter to further diffuse ideas concerning the implementation of inclusive education.

## DISCUSSION

The aim of the present paper was to examine the Twitter network forming around the topic of inclusive education. In order to better describe global diffusion processes of social innovation in education, we drew on Twitter data as a data source that covers a variety of different stakeholders involved in debates on inclusive education at the global level. Based on SNT, we applied SNA to map the network and to identify the most central actors. Calculating different centrality measures allowed us to specify the diverse actors and actor groups to a more detailed extent.

The visualization of the main component of the education-specific network in the context of the CRPD suggests that the actors participating in this debate use Twitter to connect to each other and to exchange information. Whereas the opportunity to engage in such diffusion processes is often limited to a few

influential actors, Twitter – due to its accessibility and flat hierarchy – enables less powerful and known stakeholders to have their information further distributed and to span geographic and structural boundaries. Following Tews' (2005, p. 65) idea of innovation being diffused “due to communication instead of hierarchy,” the communication platform Twitter seems to provide ideal channels for low-threshold exchange of information on social innovation. However, although the users seem to be well connected, a main group in the center of the network, containing mostly central IO- and NGO-related accounts, seems to dominate the network.

Looking at the centrality measures in more detail, it can be noted that the network contains a diverse set of central actors who occupy central positions in different ways. A striking difference can be seen between in-degree and out-degree in terms of actor group affiliation. Whereas the most active users, i.e., the users with the highest out-degree in the network, mostly belong to the private sector, those with the highest in-degree are mostly IOs. These differences lead to first assumptions about different roles of the actors and actor groups in the Twitter network. The particularly high activity of Karen McCall is in line with the increasing tendency of private businesses to engage in (global) education policy (e.g., Verger et al., 2016b). However, Menashy (2016) distinguishes two forms of business participation in education: whereas (often successful and leading) businesses participate in a form of corporate foundations as nearly independent organizations, others attempt to implement products or projects in the respective domain. Business actors participating in the Twitter network on inclusive education might be motivated to spread their ideas and products in the network and to possibly build new connections. A high level of business activity in the field of inclusive education is generally not too surprising given the increasing focus of ICT businesses in particular on the broad field of assistive and accessible technologies (e.g., Goggin and Newell, 2007; Stienstra et al., 2007).

In contrast, the high activity of civil society actors in retweeting and mentioning might lead back to different interests. The results suggest that these actors try to benefit from the accessibility of Twitter in order to diffuse their information to a broad and global audience. As could be shown for the promotion of women's rights in the context of the UN Convention on the Elimination of All Forms of Discrimination Against Women, NGOs make a lot of effort to build transnational networks in order to spread ideas about the implementation of human rights conventions (Zwingel, 2005). Hence, DPOs such as Sightsavers, Inclusion International or the IFSBH can be assumed to use Twitter not only to share information but also to build coalitions with others to increase the visibility of the topic of inclusive education. Similar observations were also made by Svensson et al. (2015), who investigated how NGOs used Twitter to shape the concept of sport-for-development, a social innovation introduced to promote social change using sport. They found that NGOs particularly use Twitter to directly engage with other stakeholders in order to form communities and build collective action.

The top ten for in-degree presents a completely different image. IO-related accounts seem to attract particular attention

**TABLE 4** | Ten most central users according to betweenness centrality.

Username	Real name	Betweenness centrality
GlobalEduFirst	Global Education First Initiative	15,830.9
KarlenInfo	Karen McCall	12,782.0
GLOBL_inclusion	Global Observatory for Inclusion	12,402.7
Inclusion_Intl	Inclusion International	11,686.2
lumos	Lumos	11,454.8
kimberbialik	Kimber Bialik	11,436.4
UNGEI	UN Girls' Education Initiative	11,343.0
UNICEFeducation	UNICEF Education	11,192.4
A_Pregel	Andrea Pregel	10,995.7
Kennedytasha	Natasha Kennedy	10,221.4



and the reasons for retweets and mentions of IOs may vary. On the one hand, less influential users might mention accounts with a wide reach (that is, a high number of followers) in order to increase their own visibility or that of a specific topic. This indicates that IOs, such as the UN, serve as levers in the inclusive education Twitter network. A similar pattern has already been noted by Rogers (2003, p. 317) who distinguished *change agents* that “try to utilize *opinion leaders* to leverage diffusion activities.” In the case of the Twitter network on inclusive education, DPOs and other disability rights advocates can be seen as change agents that take advantage of the visibility of opinion leaders, such as the UN, in order to diffuse their ideas. On the other hand, retweets can be used to amplify tweets to new audiences, thereby spreading ideas to a wider public (Boyd et al., 2010). Hence, IOs seem to benefit from the retweeting activities of others. Overall, Ausserhofer and Maireder (2013, p. 293) state that “the more people mention or retweet a specific account, the more authority is attributed to it.” For the observed Twitter network this indicates a form of validation given that the most retweeted and mentioned accounts represent the presumably most influential organizations in the global policy field of inclusive education. It can also be seen as indication of the very central role of IOs in the global diffusion of educational innovation and further confirms findings from studies on the use of Twitter in other cases of social innovation. For instance, Kolleck et al. (2017b) examined the Twitter network forming around Climate Change Education, an innovative approach to integrating the issue of climate change into education, and found the secretariat of the UN Framework Convention on Climate Change (UNFCCC) to hold a particularly central role in the Twitter communication network.

The results for eigenvector and betweenness centrality reveal additional information about the network and its central actors. In regard to eigenvector centrality as a measure of popularity in the sense of being connected to other popular nodes, the results are not too surprising. The list of the most central nodes mostly contains accounts that belong to leading public and private organizations. Hence, these leading accounts appear to display a high level of interaction among themselves. This, in turn, can cautiously be interpreted as their attempt to build coalitions of influential actors for the advocacy of inclusive education.

In contrast, the list of the most central users in terms of betweenness centrality is more diverse as it contains leading NGOs, such as Lumos or Inclusion International, UN-related accounts, businesses, as well as less known individuals (with affiliations to organizations). Although the relevance of betweenness centrality on Twitter is certainly disputable – given that users do not usually depend on the mentions of others to receive new information – for completely unconnected nodes, the brokering user can still have some influence. Hence, especially the rather unknown users can benefit from their brokerage position. Furthermore, being the ‘missing link’ between users that are not connected on Twitter can open up the discussion on a certain topic to new ideas and, thereby, support the diffusion of innovations. This brokerage position, as described by both Granovetter (1973) and Burt (1982), attributes a certain role to specific actors that has already been discussed broadly in the literature. Verger et al. (2016a) define those

in brokerage positions as policy entrepreneurs and boundary spanners who are indispensable in the (global) diffusion of social innovations in education.

## Limitations and Conclusion

When looking at both the visualization of the network and the most central actors, the lack of governmental actors is remarkable. This suggests that Twitter as a means for the diffusion of innovation is mostly used by non-state and intergovernmental stakeholders, while governmental actors seem to prefer traditional channels for their information exchange. Hence, the results from analyses of Twitter data can only serve as evidence for diffusion processes taking place on Twitter, as some main political actors do not participate in activities on this platform. To gain a more comprehensive picture of the global policy network forming around the debate about inclusive education, additional network data needs to be collected. Future research could examine to what extent Twitter networks might mirror offline processes in general.

Another limitation of the present study is the focus on the type of activity, neglecting the content of the tweets. Although the main information regarding the diffusion of innovation is the activity of mentioning or retweeting another actor (and the resulting network), considering the content could increase knowledge about the diffusion processes on Twitter. Due to the large number of tweets, this would have gone beyond the scope of this study. However, a qualitative content analysis of tweets could be applied in future studies, thereby providing additional information on the diffusion of social innovations in education.

Finally, the global scope of the network and its lack of (geographical) boundaries make it hard to infer connections to national policymaking processes. It is therefore difficult to observe relations between the discursive processes at the global level on Twitter and the actual implementation of inclusive education at the national level. In order to investigate the nexus of global and national policymaking and the impact of diffusion processes, future research in this field needs to collect information on the national affiliation of certain actors. In this way, connections could be drawn between global and national policy networks.

Overall, it can be noted that a Twitter network is forming around the topic of inclusive education and that it contains a variety of different actors who engage in the diffusion of the social innovation. Some actors stand out by occupying central positions according to several perspectives. On the side of the UN, a leading position is held by UNICEF, which is not necessarily the primary UN agency for disability rights but which nonetheless has a clear agenda and an explicit focus on the rights of children with disabilities as “one of the most marginalized and excluded groups in society.”<sup>7</sup> Hence, its strong engagement on inclusive education as one main vehicle for the inclusion of children with disabilities seems logical. However, it is notable that the official CRPD secretariat is not visible in the network. Whereas in other studies on the Twitter networks around the UNFCCC the secretariat

<sup>7</sup><https://www.unicef.org/disabilities/>

was observed to play a central role even within an education-specific subset (Kolleck et al., 2017b), in the inclusive education network the lead is taken by others. Although the actual impact of such processes cannot be investigated with the approach used for the present study, it can set the ground for further research on the implementation of inclusive education, in particular, and the diffusion of social innovations in education, in general.

## DATA AVAILABILITY STATEMENT

The datasets presented in this article are not readily available due to data protection reasons.

## AUTHOR CONTRIBUTIONS

NK and JS conceptualized and conducted the study and drafted the research manuscript. JS completed the analyses. Both authors contributed to the article and approved the submitted version.

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## SUPPLEMENTARY MATERIAL

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