

HOW TEACHER SOCIAL NETWORKS MIGHT BE LEVERAGED TO ENHANCE DIFFUSION AND IMPLEMENTATION OF NEW PEDAGOGIES

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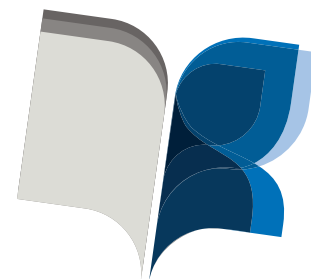


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Introduction

Background and Purpose of the Study

In the past, most international education interventions have involved top-down approaches to diffuse new pedagogies. These generally consist of massive, cascaded teacher trainings, even though evidence shows sustained school change is “socially constructed.”¹ As teachers interact with each other, they learn and adapt their beliefs and actions toward new ideas and practices, which has a variety of outcomes. Depending on the network of collegial relationships and interactions in a school or wider community, teachers may align their actions with new pedagogies or may stick with their previous ways of doing things. A 2022 study funded and conducted by RTI International suggested that in a selection of 10 primary schools in Tanzania implementing an early grade reading intervention, teachers’ decisions to adopt the new pedagogies were influenced by the expectations of their peers; that is, change was “socially normed.” Teachers would adopt some aspects of the approach to show compliance while retaining their previous, less effective pedagogies.²

The conventional ways that new pedagogies are taught and supported in low- and middle-income countries rarely leverage the social networks and relationships that are paramount for individuals to shift their beliefs and make positive decisions about adopting new methodologies, and for them to sustain these behavior changes in the long run.³

The purpose of this study was to apply social network analysis (SNA) and qualitative inquiry to understand the composition and structure of primary school teacher social networks to inform policy basic education programming about how to improve the diffusion and support for implementation of new pedagogies through these social networks.

Summary of Methodology

This study used a mixed model design to study the compositional and structural properties of teacher social networks in sub-district administrative areas or “wards” in Tanzania. Using data from completed sociometric inventories, separate teacher social networks were generated for Mbawala, Madimba, Milangominne, and Nitekela wards in the Mtwara Region of Tanzania. Researchers used SNA to calculate quantitative measurements and generate teacher sociograms (i.e., network graphs) for each of the ward-level teacher social networks. We combined these data with data from teacher informant interviews that described the content, context, and benefit of educators’ interactions in the different wards and to help explain the SNA findings.

¹ L. Hubbard, H. Mehan, & M. Stein, (2006), *Reform as learning*, Routledge; S. Borgatti & P. Foster, (2003), The network paradigm in organizational research: A review and typology, *Journal of Management*, 29(6), 991–1013.

² S. King, (2023), *The behavioral science and systems perspective: How teachers respond to educational change*, Presentation at CIES Conference, Washington, DC, <https://shared.rti.org/content/behavioral-science-and-systems-perspective-how-teachers-respond-educational-change-cies-2023>

³ E. Rogers, U. Medina, M. Rivera, & C. Wiley, (2005), Complex adaptive systems and the diffusion of innovations, *The Innovation Journal*, 10(3), 29; E. Rogers, (2003), *Diffusion of innovations* (5th ed.), Free Press.

Sampling and Data collection

Data collection for the study took place July 17–25, 2023, in 20 schools throughout four wards in Mtwara, Tanzania: Mbawala, Madimba, Milangominne, and Nitekela. The wards were selected based on their number of schools and location. Mbawala, Milangominne, and Nitekela wards all have 5 schools which were selected. Madimba ward has a total of 7 schools of which 5 were selected for a total sample of 20 schools. Milangominne and Nitekela are adjacent wards located in Nanyamba District; Mbawala and Madimba are neighbouring wards located in Mtwara District.

Prior to data collection the research team identified a total of 140 educators in the 20 selected schools, including Ward Education Officers (WEO). All 140 of these educators who were available at the time of data collection were invited to complete a sociometric inventory, with a final 110 who volunteered.

For the qualitative study, researchers purposefully sampled 14 teachers and head teachers from different schools in the ward, all of whom had participated in the Tusome Pamoja and/or Jifunze Uelewe trainings and program activities. Informants were active classroom teachers of grades 1–7, often teaching multiple grades. One respondent was a pre-primary teacher. As it is common in the Tanzanian context, many of selected teachers had additional roles within their schools, including exemplary teacher (three respondents), head or assistant head teacher (three respondents), health teacher (three respondents), sports and games teacher (three respondents), and disciplinary teacher (two respondents). Respondents' years of experience ranged from 3 to 18 years.

The data collection team consisted of two Tanzanian research consultants and one lead researcher from the RTI International. A week long workshop was held to orient the research consultants on the study and to field test and finalize the sociometric survey and the structured informant interview guide. Data collection proceeded over a period of 7 days. The sociometric inventory was administered through a tablet-based self-administrated instrument, which respondents completed in a group, each using a separate tablet. The qualitative data were collected through face-to-face informant interviews. Both tools were administered in ki-Swahili.

The Mtwara Region is divided into nine districts, with a regional population of just over 1.6 million, based on the 2022 census.⁴ The region's economy is based on agriculture, with foreign investment in offshore oil and gas exploration in the coastal capital, Mtwara. Mtwara is home to the Makonde, one of the five largest ethnic groups in the country, and, like much of coastal Tanzania, is predominantly Muslim. In 2018, Mtwara was ranked 12th out of 23 regions in gross domestic product per capita and ranked 8th out of 25 regions with comparable data on the primary school leaving examination pass rates.⁵



4. United Republic of Tanzania, Ministry of Finance and Planning, Tanzania National Bureau of Statistics and President's Office Finance and Planning, & Office of the Chief Government Statistician, Zanzibar, (2022, December), *The 2022 population and housing census: Administrative units population distribution report*.

5. National Examinations Council of Tanzania, (2018), *Statistics in primary schools*, <https://prem.necta.go.tz/prem/>

Instruments

The sociometric inventory involved the development of a roster-based name generator consisting of a list of potential contacts, assembled from school rosters of teachers supplied by USAID/Tanzania's Jifunze Uelewe project team. Respondents were asked to identify persons from the roster or name persons off the roster with whom they had communicated with during the past month. Then, for each of their contacts, respondents answered questions about the content, context, frequency, and helpfulness of their interactions.⁶ [Appendix A](#) provides a flow-chart, logic model, and general content of its administration.

The qualitative interview guide focused on gathering insights about (1) informants' perceived expectations of their roles as teachers, (2) formal and informal opportunities in their schools and wards for peer exchanges and peer learning such as communities of learning (CoLs) and the benefits therein, (3) their attitudes and successes in adopting new pedagogies, and (4) their perceptions of their head teacher's leadership style. Responses were recorded on paper during the interview and transcribed daily in an Excel spreadsheet, which researchers analyzed and interpreted alongside the SNA. A copy of the interview guide is [Appendix B](#).

Introduction to the analyses

As mentioned above, respondents were asked not only to identify persons with whom they had communicated with in the past month, but were also asked to indicate, for each person named, the topics they discussed. Respondents selected which of the following topics they talked about with each named contact: teaching practices, formative assessment, other school topics, other professional topics, personal or social topics. For this study, we selected the set of communication dyads (between respondents and named contacts) in which formative assessment was a topic of conversation.⁷ The decision to focus on formative assessment for this initial study is that the Jifunze Uelewe project is introducing this methodology and has, in the past year engaged in operations research specifically related to formative assessment. These findings are intended to supplement the operations research findings.

Based on data generated from the sociometric surveys, separate SNAs were conducted to evaluate the *structural* and *compositional* characteristics of the teacher social networks in each of the four participating wards in Mtwara Region.

The *structural analysis* involved the calculation and evaluation of three measures of network cohesion for each network (see discussion in Findings Section, Research Question 1). We then combined these findings with data from informant interviews to help explain differences in the connectedness and cohesion of the ward-level teacher social networks. We used the information to identify the opportunities and resources in schools and wards that might serve to strengthen teacher relationships and interactions—network cohesion—in the ward.

The *compositional analysis* involved, for each person within each of the four ward-level teacher social networks, the calculation and evaluation of three measures of actor centrality in the network: degree centrality, closeness centrality, and betweenness centrality (see discussion in Findings Section, Research Question 2). Where the information was available, respondents were designated as head teachers, strong teachers, average teachers, or exemplary teachers (based on preliminary information provided by the Jifunze Uelewe project staff). These data were used to identify the persons and the characteristics of persons (based on above-named descriptors) who were in positions of potential influence in the network (based on their ranked performance on the set of centrality measures). These data were then combined with data from informant interviews to explore whether the differential characteristics of persons in positions of influence in the different ward networks were associated with more or less enthusiasm and uptake of new pedagogies, particularly formative assessment.

6. Because these options were presented on a per-school basis, school affiliation could be used as an anchor to group and then consolidate alternative spellings for a single off-roster person's name when they were listed by multiple respondents.

7. Note that teachers' selection of content was not mutually exclusive, so the topics that teachers talked about in their networks would include formative assessment as well as other content.

Findings

Research Question 1 – What Are the Characteristics of Teacher Social Networks in Rural Primary Schools in Tanzania?

In this section we present findings about the overall connectivity and cohesion of teacher social networks in selected wards in Tanzania’s Mtwara Region and discuss qualitative findings that help distinguish between ward-level networks that are more or less well connected and cohesive. These data combined inform opportunities in the school and ward that may help to strengthen educator relationships and interactions in sub-district clusters of schools such as a ward.

Using SNA, we calculated measures of cohesion and generated teacher sociograms for each ward network.⁸ To review, all available teachers from schools within selected wards completed the sociometric inventory. Each common teacher–contact dyad made up a single link (also known as a “tie” or “connection”) in an undirected ward-level teacher social network.⁹ In this report we will use the terms “link” and “connection” interchangeably to refer to the connections between teachers and headteachers who constitute each ward network.

Whom did teachers interact with about formative assessment?



Overall, teachers within a ward were strongly connected, with from 43% to 74% of their communications involving contacts outside of their own school. Respondents reported from 1–31 persons whom they had communicated with about formative assessment during the past month. In all four wards, respondent had on average, from approximately 6 – 12 contacts. Respondents mentioned very few contacts with teachers from schools outside of their ward, ranging from 1%–11% of the total links in the networks, depending on the ward. [Table 1](#) summarizes these characteristics of teacher social network links by ward.

⁸ The sociometric survey asked teachers to indicate what they had talked about with their contacts, including teaching practice, formative assessment, and personal-social matters; however, in this analysis we only included respondent-contact dyads where formative assessment was among the topics selected.

⁹ The survey asked teachers to name individuals with whom they communicated with in the past month, even if they themselves had been named by other teacher-respondents. For the undirected network, the communication between any two teachers made up one single link in the network. In this analysis, we were interested in the set of communications about formative assessment between two individuals in the network, not who named who, thus we chose an undirected versus directed network.

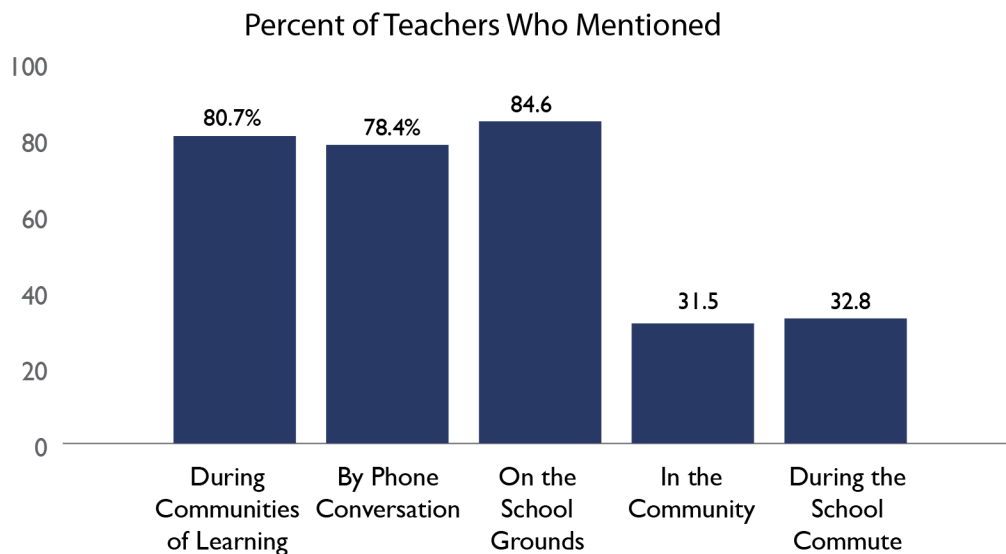
Table 1. Characteristics of Links in Teacher Social Networks by Ward

Ward	Total No. of Links in Network	Average No. Links per Respondent	Average % of Respondent Links in Same School	Average % of Respondent Links Outside School	No. (%) of Links Outside Ward	No. (%) of Links in Unknown Ward
Mbawala	151	6.43	57%	43%	2 (1%)	1(1%)
Madimba	207	6.37	52%	48%	23(11%)	-
Milangominne	267	12.42	26%	74%	7 (3%)	7 (3%)
Nitekela	158	9.88	32%	68%	3 (2%)	-

Where did the interactions take place, and how frequent and helpful were they?



For each of their contacts, respondents reported *where* they interacted with these persons (see [Figure 1](#)), *how frequently* they talked to this person, and *how helpful* the information exchange was. Respondents reported that they talked with their colleagues in a variety of contexts, especially during the CoL meetings, by phone, and on the school grounds. Approximately one-third of the respondents also indicated that they communicated with their peers in the community, for example at the market and during their school commute.

Figure 1. Contexts in Which Teachers Exchange Information

Note. Percentages are out of total respondent–contact links across all wards (n = 940).

Respondents were asked to indicate, for each of their contacts, whether they talked with this person “once,” “less than once per week,” or “more than once per week” in the past month. Overall, respondents reported talking with their contacts frequently. Except for in Nitekela ward, respondents reported communicating more than once per week for over 75% of their contacts. In Nitekela ward, respondents reported communicating more than once per week for 60% of their contacts.

Respondents were also asked to report, for each of their contacts, whether the information exchange was “not helpful,” “somewhat helpful,” or “very helpful.” For the majority (70% or more) of their contacts, respondents across wards judged their interactions to be “very helpful.” On average, 81% of respondent interactions were judged to be “very helpful,” 16% “somewhat helpful,” and only 1% “not helpful.”¹⁰

What are the opportunities that help build teacher relationships and teacher social networks?



Teacher informants interviewed in all four wards stated that they had developed strong relationships with fellow teachers in and outside of their schools, which is consistent with the SNA findings above. Data revealed that teachers shared norms, values, and perceived expectations with each other and their community. Teachers from all wards stated that they and their peers were expected to teach well and help students succeed academically and more broadly within society. Teachers shared the priority and responsibility for the wellbeing of students.

Teachers also stated that their role was inextricably linked to the communities they lived in, and they were expected to uphold the societal norms of their communities. When asked about what teachers perceived to be the consequences of not living up to these norms, several teachers said they would lose respect in their school and community or disappoint their community members.

Collegial relationships within a school were strengthened by the necessity and willingness to collaborate on academic tasks; for example, ensuring that all classes were covered if there were insufficient teachers, supervising and marking examinations, developing teaching aids, and supporting struggling learners. They also reported collaborating on tasks that were not related to teaching and learning yet essential to the operation and success of the school; for example, ensuring the availability of food for feeding programs, supervising the care of school farms, and other extracurricular activities.

¹⁰. The links between respondents were weighted according to derivation based on the helpfulness and frequency of interactions. A link was assigned a weight of “2” if the when the interaction was reported to be “very helpful” and reported a frequency of “more than once weekly”. Otherwise, the value of the weight was set to 1. The weights are based on the single directed contacts generated from the sociometric survey. The SNA software adjusts the assigned weights based on directed connections to accommodate an undirected network. The weights of the connections are reflected in the size of the lines connecting nodes in teacher sociograms. For this study we did not analyze weighted measurements generated in the SNA.



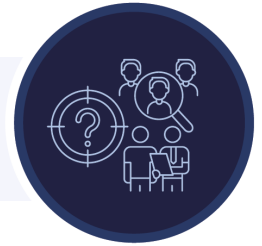
One teacher's commentary about collective decisions made in the CoL:

When we came out of the training, and we discuss about the new strategy; in this way we have post-strategy assessment. Some of them [the strategies] are too inappropriate so we will discuss first if we will use [them] in our school.

CoLs and peer coaching in the school—when available—also offer opportunities for strengthening within-school relationships and peer learning. Most teachers reported that they valued and benefited from school-level CoLs. Benefits mentioned by teachers included building confidence, acquiring new skills and knowledge, problem-solving with peers, and building relationships. Teachers characterized the CoLs as being discussion-based, places where teachers discussed what they had learned during ward trainings; however, only a few mentioned that the CoLs were used to model or practice new pedagogies. In some schools, teachers reported that they use the CoL to reach consensus on the value of a teaching technique and then collectively decide to apply or not to apply the new method). The frequency of schools' CoL meetings ranged from once a week for 20–30 minutes to once a month for 2 hours. In some schools, teachers had concerns about the irregularity of meetings, their length and timing, and the lack of concrete actions or follow-up.

Teacher relationships across schools in the ward may evolve through the various activities that teachers participate in outside of school, and how teachers across schools support each other. For example, one teacher stated, *“Teachers will contribute money to help a person to buy medicine or we will go in person as a team to visit a sick colleague, sick family member, attend a ceremony.”* Teachers reported that they use digital technologies such as WhatsApp groups to extend their interactions and stay connected with colleagues across the ward—for socializing as much as school-related matters. There are opportunities for some teachers to (1) attend formal ward-level trainings for new methodologies, (2) participate in ward-level CoLs, and (3) participate in school-to-school visits; however, the extent of these opportunities varied from ward to ward and teachers had mixed reviews of their effectiveness.

How do the teacher social networks differ across wards?



In this section we will describe and compare the cohesion of teacher social networks in the four wards, based on a set of measurements on network connectivity and cohesion, including size, average degree, density, average path length and average clustering coefficient. The definitions and relative importance of these measures to this study are below.

Size – The size of a network is the total number of actors (nodes) in a network; that is, the number of individuals who constitute the network in each ward.

Average degree – Average degree is the average number of direct links that individual actors (teachers or head teachers) have with each other. It is an expression of how central the individuals are to each other. The larger the average degree, the more connected the individuals in the network are.

Density – Density is related to the size of the network. It is the proportion of total number of links in the network out of the total number of possible links; for example, when density = 1, all individuals in the network are connected with each other. Density is a general measure of network cohesion.

Average path length – Average path length is the average shortest distance between any two actors in the network, with “distance” meaning the number of links one actor must go through to reach another actor in the network. For example, if the distance between Teacher A and Teacher C is 2, then Teacher A must pass through one other person (travel across two links) to reach Teacher C. The smaller the average path length, the more efficient information flows through the network.

Average clustering coefficient – The average clustering coefficient is a measure of the tendency for groups of actors to form close-knit pockets of interaction. It considers the direct links as well as the indirect links between actors in a social network.¹¹ The average clustering coefficient is the average of local clustering coefficients (i.e., clustering coefficients calculated for each actor in the network) and can impact the flow of information in a network.



¹¹. A cluster is made up of a triangle of connections, where one actor's direct contacts are also linked with each other (i.e., “my friends who are friends with each other”). For example Teacher A, B, and C form a cluster if Teacher A is directly linked to Teacher B and to Teacher C, and Teacher B is directly linked to Teacher C.

Table 2 presents these measures for each ward-level teacher social network. The teacher social networks in Milangominne and Nitekela demonstrated slightly more cohesion than the teacher networks in Mbawala and Madimba. On average, the teachers in Milangominne and Nitekela had approximately 1.5–2 times more links with other teachers in their wards than those in Mbawala and Madimba (see average degree) and had density scores more than twice as large.¹² As the teacher social networks in Mbawala and Milangominne are similar in size, with 47 and 43 teachers, respectively, the network density in these wards are more readily comparable and interpreted through visual inspection of the teacher sociograms (see **Figure 2**; details visible in later figures). The Milangominne density of 0.30 was over twice that calculated for Mbawala, which was 0.14.

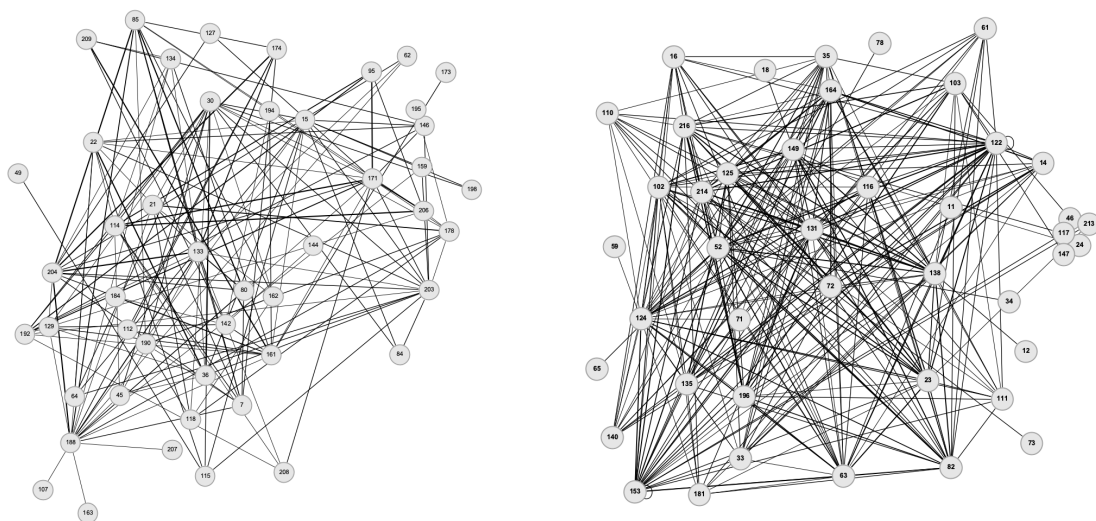
Table 2. Measures of Coherency among the Teacher Social Networks by Ward

Ward	No. of Ties	Size (No. of Actors)	Average Degree	Density ^a	Average Path Length	Average Clustering Coefficient ^b
Mbawala	151	47	6.43	0.14	2.33	0.53
Madimba	207	65	6.37	0.10	2.38	0.58
Milangominne	267	43	12.42	0.30	1.95	0.72
Nitekela	158	32	9.88	0.32	1.84	0.71

^a Density is impacted by the size and topic covered in the social network. Larger networks tend to be less dense.

^b The average clustering coefficient is based on normalized actor-level clusters and thus more comparable across wards.

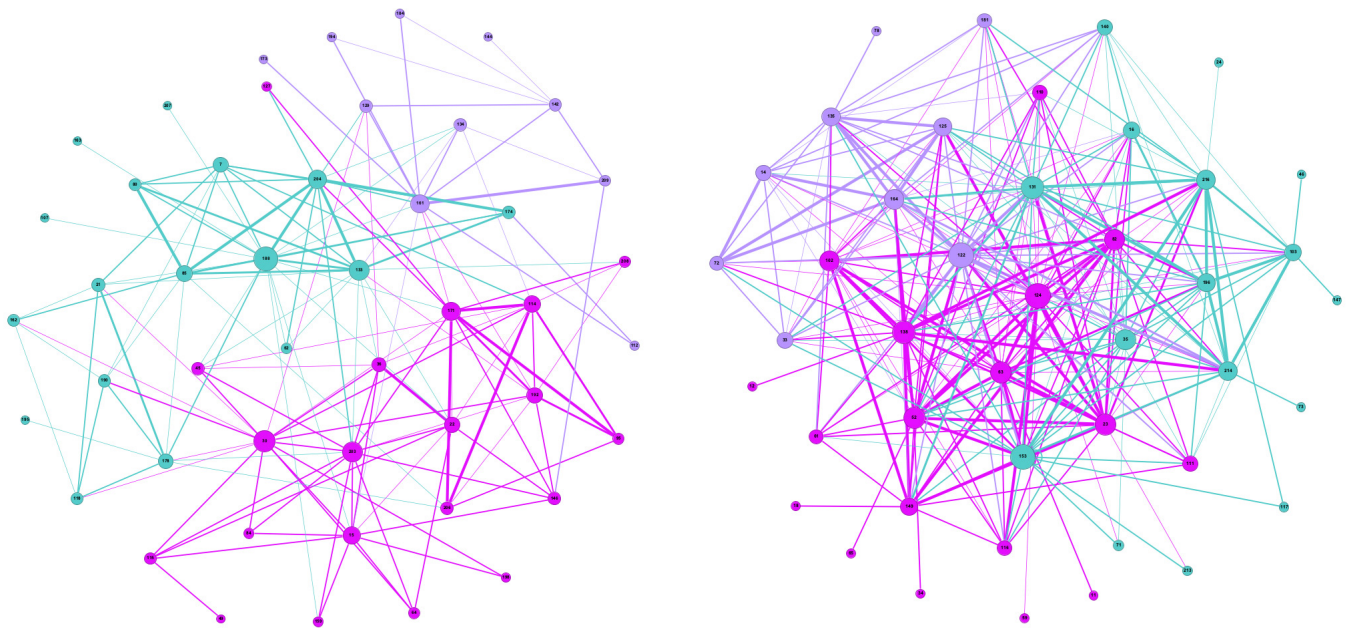
Figure 2. Comparisons of the Density of Mbawala Teacher Sociogram (Left) and Milangominne Teacher Sociogram (Right)



¹² The slightly higher density of the teacher network in Mbawala (compared to that in Madimba) and the slightly higher density of the Nitekela teacher network (compared to Milangominne) may be related to their relative size. Density tends to be higher in networks with fewer actors (i.e., smaller size). Given the similar size of the teacher networks in Mbawala and Milangominne, the density of these networks is readily comparable. Because they are normalized, the clustering coefficients for the four teacher networks provide a mechanism by which to compare the general network cohesion of these networks.

The findings in [Table 2](#) above show that the average clustering coefficients for Milangominne and Nitekela networks were higher than for Mbawala and Madimba networks and had smaller average path lengths. When there are high levels of clustering, the flow of information from one teacher to another will be more efficient. In other words, where many of the teachers' direct links are also linked to each other (forming a triangle in the sociogram) the flow of information from one person to another in the network requires fewer people to pass through before reaching everyone. As the Mbawala and Milangominne networks are more readily comparable because of their similar size (degree = 47 and 43, respectively), we present [Figure 3](#) to illustrate how these two networks vary on their tendency to develop pockets or clusters of communications among actors – depicted in the number of triangles in Mbawala and Milangominne sociograms in [Figure 3](#). The average path length calculated for the Mbawala (2.33) and Madimba (2.38) networks suggest that on average it takes between 2 to 2.4 steps (i.e., pass through from 2–2.4 links) for a teacher to share information with any other teacher in the network; that is, the information must go through one to two other teachers to get from any one teacher in the network to another. For Milangominne and Nitekela networks, with path lengths of 1.95 and 1.84 respectively, it takes on average slightly less than 2 steps and the information will only need to pass through one other person to get to any other.

Figure 3. Comparisons of the Clustering of the Mbawala Teacher Sociogram (Left) and Milangominne Teacher Sociogram (Right)



A well-connected and cohesive teacher network does not necessarily imply that the information being exchanged about a given topic—in this case, formative assessment—will promote the desired outcome, which would be the sustained application of the new pedagogy in the classroom. There are more interactions about a topic in a network with high density and information will spread faster in some networks because of the cohesion between teachers (i.e., when teachers tend to form pockets or clusters of interactivities with their colleagues). However, the information being exchanged (however efficiently) may also serve to spread and/or reinforce beliefs that the practice *is not useful* and obtain undesirable results, such as deterring teachers from taking the new pedagogies seriously or trying the new pedagogies out in their classrooms. An examination of the most centrally connected persons in the network (i.e., influencers) is needed to ascertain whether their influence supports or impedes desirable behavior.

What did we learn from teachers that helps explain the differences in the connectedness and cohesion of the teacher social networks across wards?



To help explain why the connectiveness and cohesion of teacher networks differed across wards, we will continue to contrast Mbawala and Milangominne because of their comparable sizes. (See Table 2 above). SNA findings showed that teachers in Milangominne are more well-connected and tend to form more pockets of interactivity, which allows for information, resources and support to be diffused across educators more efficiently in Milangominne versus Mbawala. In the following we will discuss findings from the informant interviews that help explain these differences.

All teachers interviewed from Milangominne ward reported benefiting from their school's peer coaching program, with some schools dedicating a full day each month to peer coaching. According to one informant, the WEO and head teachers work together to ensure a variety of rich experiences for collaborative learning across the ward. For example, the WEO and head teachers organize school-to-school visits (referred to as observational case studies) for teachers to exchange ideas and learn from each other. These school exchanges were mentioned by regular teachers in the ward, but also by formally designated exemplary teachers, who mentioned that they make regular visits to schools to provide training and support to teachers on new pedagogies. Furthermore, one informant stated that the WEO reviews the topics and meeting notes of school-level CoLs and discusses these with head teachers.

Most teachers also commented that their job was not only to teach, but to produce good citizens. One teacher stated,

I am supposed to produce better students so that they can serve their community.

Another teacher stated,

I am responsible [for producing] and expected to produce students with good behavior, discipline, and good grades so that they can be good citizens who also contribute to society.



Though teachers in Mbawala also reported having strong peer coaching programs within their schools, they did not mention having school-to-school exchanges across the ward. Mbawala informants gave mixed reviews about the school-level CoLs, with some saying the CoLs only took place when there was a problem, whereas others reported having regular meetings. Unlike teachers from Milangominne, teachers interviewed from Mbawala ward did not mention that there was WEO involvement in school-level CoLs.

Like in Mbawala, informants from Nitekela and Madimba wards reported fewer and less effective opportunities for developing peer relationships and strengthening teacher interactions. Informants in both Nitekela and Madimba wards mentioned that they did not feel the ward-level CoLs were helpful, reporting that the meetings were infrequent, far from their schools, and not well attended; these wards' informants also did not mention peer coaching opportunities. [Table 3](#) summarizes the comments made by the teachers interviewed in all wards about the opportunities for peer coaching in and outside of their schools.

Table 3. Teacher Comments about Opportunities and Benefits from Peer Coaching

<p>Mbwala</p> <p>The schools and teachers in Mbalawa ward seem to use peer coaching consistently and frequently. All four teachers interviewed mentioned peer coaching:</p> <p>“At first, I was not teaching in Standard [grade] 1 and I was not use to this. I didn’t have experience, so I used the peer coaching with Standard 2 teacher to learn and receive feedback on my Standard 1 lessons. Other times I will observe the Standard 2 teacher to learn and then I can practice what I have observed in my own lessons.”</p> <p>“We will do peer learning through observations and feedback two times a week for about an hour.”</p> <p>“We also meet face to face when we attend peer classes to do class and peer observation.”</p> <p>“I receive support from my fellow teachers through peer coaching. We have a routine to observe each other and then after we will provide feedback about what we observed.”</p>	<p>Milangominne</p> <p>All three teachers interviewed talked about peer coaching:</p> <p>“We have a special day for coaching among the teachers at the school.”</p> <p>“I attended a training that helped me to expand my level of understanding about teaching and various skills such as peer coaching.”</p> <p>“As the exemplary teacher, I also coach them [other teachers], and they give me feedback about my coaching.”</p>
<p>Madimba</p> <p>None of the teachers interviewed in Madimba ward mentioned peer coaching.</p>	<p>Nitekela</p> <p>None of the teachers in Nitekela ward interviewed talked about peer coaching.</p>

In summary, these findings show that formal opportunities for teachers to interact with each other, head teachers, and exemplary teachers—within and across schools in the ward—may lead to more well-connected and cohesive teacher social networks. In these close-knit teacher communities, information, resources, and support for adoption of new pedagogies flow efficiently. However, the information that flows through teacher networks can also reinforce resistance to adoption of new pedagogies particularly if there are social and behavioral factors influencing teachers to hold on to their previous ways of instruction. The SNA and qualitative findings above provide information about the flow of information in a social network and what factors may contribute to this, but it does not tell us whether the information being diffused supports or impedes adoption of new pedagogies.

Though the density of teacher social networks were notably different in Mbawala and Milangominne—perhaps because there were more opportunities for across-ward teacher networking in Milangominne compared to Mbawala—informants in both Mbawala and in Milangominne spoke favorably about learning and applying new instructional strategies in their classrooms. Findings from the influencer analysis in the following section provide some explanation for these shared favorable attitudes about new pedagogies despite differences in the connectedness and cohesion of the teacher social networks in these wards. The influencer analysis below also helps to explain why teachers and head teachers from Nitekela and Madimba wards were, according to informant interviews, less enthusiastic about new pedagogies in general and more resistant to trying out new methods in their classrooms.

Research Question 2 – Who Are the Potential Influencers in Teacher Social Networks in Rural Primary Schools in Tanzania, and How Might These Individuals Have Influenced the Adoption of Effective Pedagogical Innovations?

In this section we provide findings about the relative centrality of the individuals who make up the teacher social networks in Madimba, Mbawala, Milangominne, and Nitekela, based on the sociometric data from generated for each ward. Using SNA software, we calculated selected centrality measures for everyone in the network, ranked individuals according to these measures, and identified the individuals in the network who were the most connected to others (i.e., influencers).

We then combined these centrality rankings with teacher descriptive data, which were provided to the data collection team by Jifunze Uelewe project staff. Teachers were designated as one of the following: head teacher, exemplary teacher, strong teacher, average teacher, or unknown (if the named teacher was not on the original roster).¹³ The teacher sociograms for each ward allow a visual inspection of the influencers in the ward networks, denoting the centrality of the teachers in the network by size of the node and denoting the teacher attributes by the color of the node (see next section).

¹³. Head teacher and exemplary teacher were formal titles in the school and ward, and attribute of teachers' relative strength came from Jifunze Uelewe staff based on their work in the schools. Teachers in the school were identified as "strong," "average," or "weak." There were very few teachers identified as "weak" and therefore we compiled "average" and "weak" into one group as "average." Assignment of relative teacher strength was subjective and not based on any objective rating tool.



Who were the influencers in the teacher social networks?

For each person in each of the four ward-level teacher social networks, we calculated three centrality measures. Note that all the centrality measures were normalized to allow for meaningful comparisons among actors in a network. These are introduced below.

Degree and normalized degree – Degree is the number of links an actor in the network has with other actors in the network. The normalized degree provides more meaningful comparisons between actors in the network. Degree does not consider an individual's *indirect* links with others.

Closeness centrality – Closeness takes into account the *indirect* links each individual has; i.e., links with people who are connected with each other, or “friends of friends.” Being close to others in the network can be an advantage in that it may give a person earlier access to information or resources and/or increase the efficiency of how they spread information.

Betweenness centrality – Betweenness centrality is a measure of an individual's ability to mediate relationships or information between pairs of individuals who are not directly connected; that is, a measure of the actor's potential to function as an intermediary. Individuals with high betweenness centrality may not be as well connected to others (as measured by degree and clustering), yet may still have a strong bridge position for transporting ideas between people who do not know each other.



Table 4 shows the persons in each ward who were ranked in the top five for any of the three centrality measures. The top five scores are shaded yellow for degree centrality (and normalized degree), blue for closeness centrality, and red for betweenness centrality. Head teachers or strong teachers who ranked in the top five are highlighted with gray shading to draw attention to potential “positive influencers” in each ward network. **Table 4** shows that in the Mbawala and Milangominne networks most (63% and 88%, respectively) of the persons ranked among the top 5 on centrality measures were head teachers or strong teachers in contrast to Marimba and Nitekela where most (83% and 71%, respectively) of the top 5 performers were average teachers or unknown teachers. We posited that if head teachers and strong teachers understand, value, and model new strategies, and they are hold the most centrally positioned in teacher networks, then they will be positive influencers who promote the value and uptake of new strategies. Through their direct and indirect links in the network, these influencers are also in a good position to learn about teachers' challenges in implementing new pedagogies and provide responsive support. The teacher sociograms for each ward shown in **Figures 3–6** provide a visualization of each teacher social network, the relative centrality of teachers in the network (given by the size of the node) and their respective attributes (given by the color of the node). In **Figures 3–6**, the nodes in the sociograms are labeled by their ID numbers given in the **Table 4** below. Therefore, the data in **Table 4** combined with the ward-level teacher sociograms can be used to understand the characterization of persons in positions of influence in the teacher social networks for each ward.

Table 4. Individuals Ranked in the Top Five for Three Centrality Measures

ID	School	Delineation	Degree	Normalized Degree ^a	Closeness Centrality	Betweenness Centrality
Mbawala						
188	Makome	Strong teacher	20	43.5%	0.622	0.255
30	Mbawala	Unknown	17	37.0%	0.529	0.136
133	Makome	Average teacher	15	32.6%	0.535	0.060
203	Mbawala	Head teacher	15	32.6%	0.529	0.069
161	Mailikumi	Head teacher	13	28.3%	0.548	0.200
171	Mduwi	Head teacher	13	28.3%	0.561	0.080
204	Makome	Head teacher	13	28.3%	0.548	0.061
15	Mbawala	Average teacher	12	26.1%	0.535	0.089
Madimba						
163	Madimba	Head teacher	32	50.0%	0.640	0.422
172	Madimba	Average teacher	30	46.9%	0.634	0.201
200	Madimba	Average teacher	25	39.1%	0.604	0.138
158	Madimba	Unknown	20	31.3%	0.552	0.181
70	Milumba	Average teacher	14	21.9%	0.421	0.110
123	Madimba	Unknown	12	18.8%	0.525	0.008
Milangominne						
122	Mkumbwanana	Head teacher	29	69.0%	0.737	0.041
124	Mnyahi	Unknown	29	69.0%	0.750	0.100
153	Mnyahi	Strong teacher	28	66.7%	0.724	0.098
131	Mkumbwanana	Strong teacher	24	57.1%	0.700	0.028
138	Milangominne	Head teacher	24	57.1%	0.689	0.071
52	Mnyahi	Head teacher	22	52.4%	0.636	0.103

Note. The top five persons for degree (and normalized degree), closeness, and betweenness centrality measures are highlighted for each ward.

^aDegree is the number of individuals in the ward that this person named as someone they talked to about formative assessment in the past month. The *normalized degree* is the percentage of all individuals in the network that this person named.

ID	School	Delineation	Degree	Normalized Degree ^a	Closeness Centrality	Betweenness Centrality
103	Mnyawi	Strong teacher	14	33.3%	0.560	0.096
216	Mnyawi	Strong teacher	19	45.2%	0.609	0.072
Nitekela						
168	Miule	Strong teacher	24	77.4%	0.816	0.154
176	Nitekela	Unknown	24	77.4%	0.816	0.098
180	Kitamabondeni	Strong teacher	19	61.3%	0.721	0.079
128	Chiwilo	Unknown	18	58.1%	0.689	0.045
175	Nitekela	Average teacher	18	58.1%	0.689	0.096
211	Chiwilo	Unknown	16	51.6%	0.660	0.108
46	Kitamabondeni	Unknown	14	45.2%	0.646	0.137

Note. The top five persons for degree (and normalized degree), closeness, and betweenness centrality measures are highlighted for each ward.

^aDegree is the number of individuals in the ward that this person named as someone they talked to about formative assessment in the past month. The *normalized degree* is the percentage of all individuals in the network that this person named.

Figure 4. Mbawala Ward Teacher Sociogram

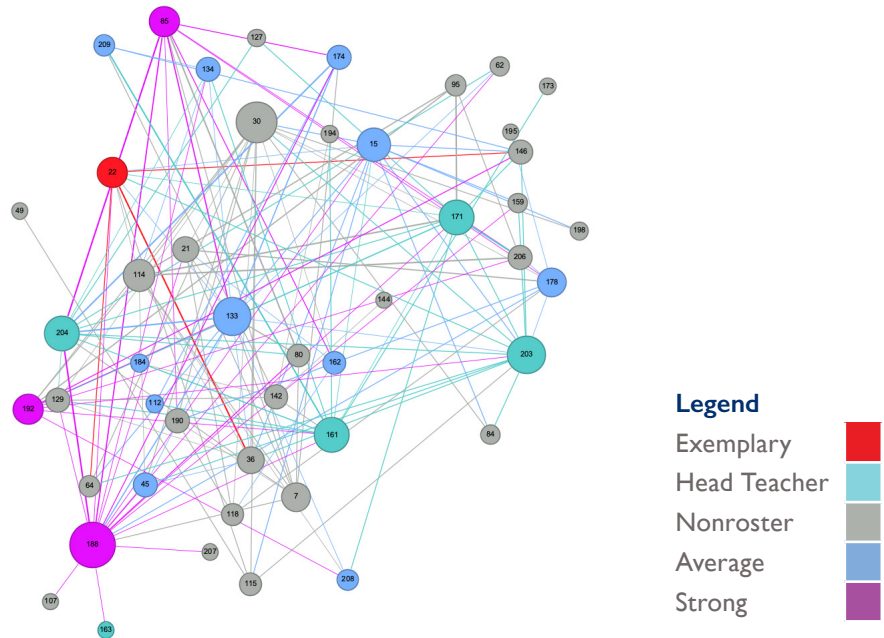


Figure 5. Madimba Ward Teacher Sociogram

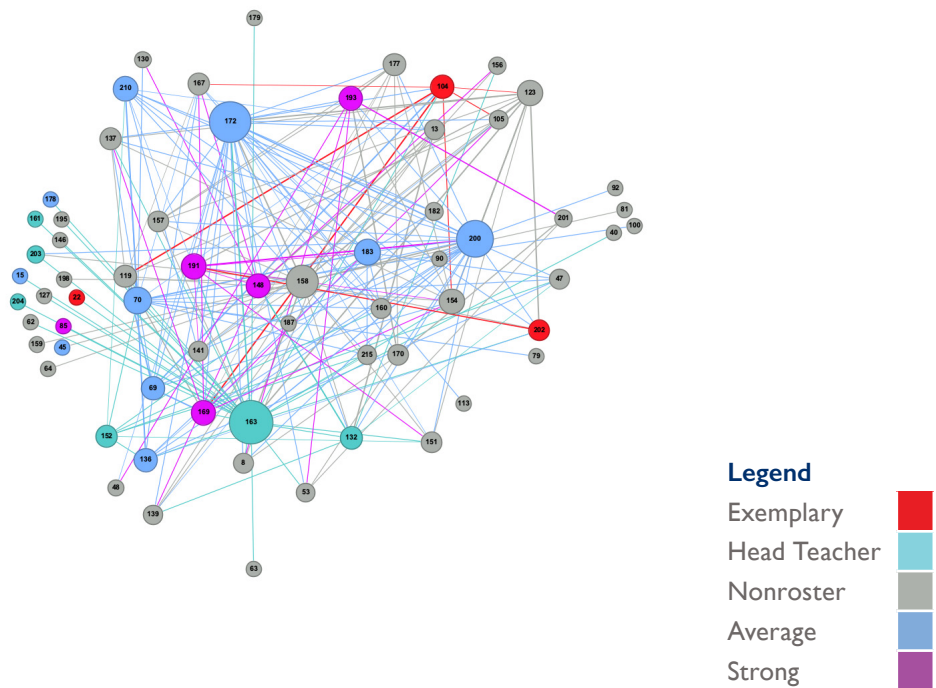


Figure 6. Milangominne Teacher Sociogram

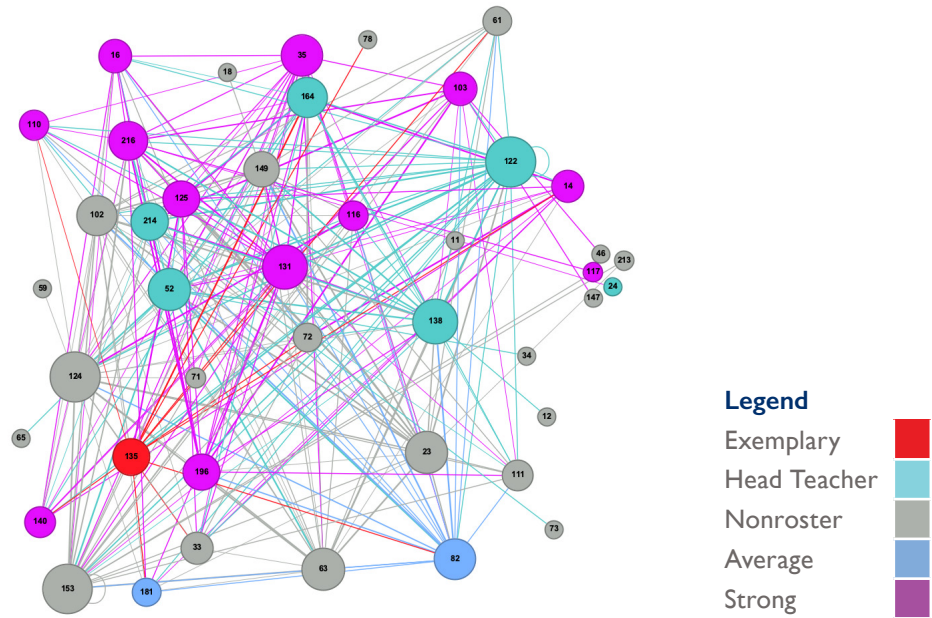
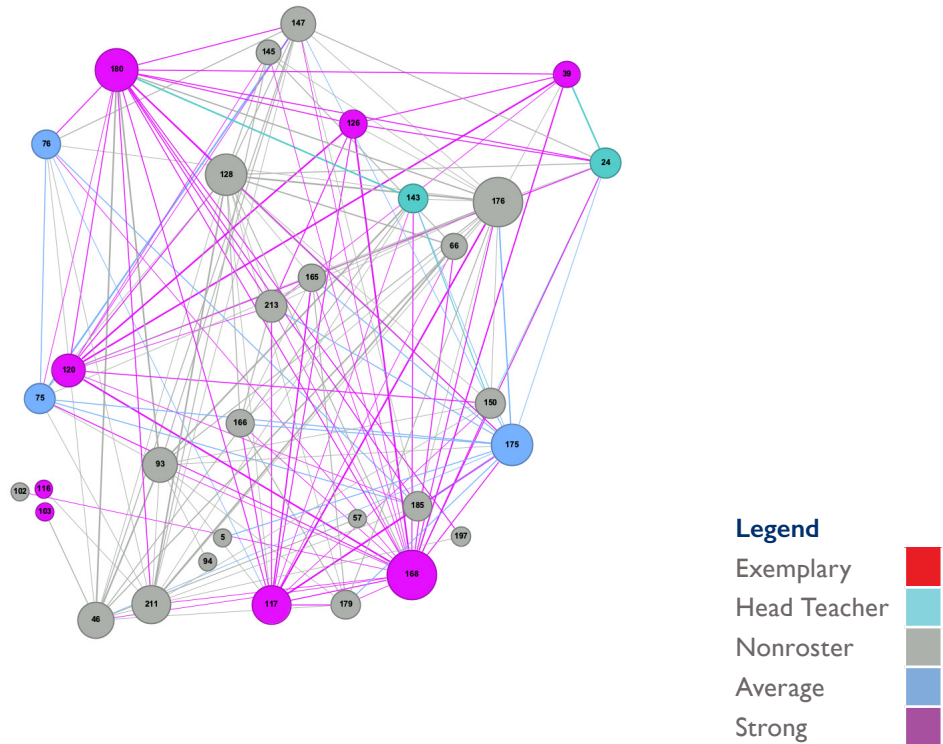


Figure 7. Nitekela Ward Teacher Sociogram





Exemplary teachers discuss their role:

I am expected to share various skills and techniques for teaching with other teachers... I am expected to be a role model in this ward because I have received training from the project and was selected as the exemplary teacher.

As an exemplary teacher, I am visiting other schools on my own when I am called by other teachers in the ward, and they are seeking my help. I will support a teacher when I visit the school and will help on whatever the topic. For example, a teacher needs help with teaching sounds so then I will model it for them.

An interesting finding was that none of the ward networks have exemplary teachers who were ranked among the top five performers for any of the three centrality measures (see [Table 4](#) and the teacher sociograms for each ward, above). This is surprising considering that exemplary teachers who were interviewed spoke about their role to share and model new teaching strategies with other teachers in the ward (see [textbox](#)). Given the skills and role of exemplary teachers, they could be strong positive influencers for promoting the uptake and effective implementation of new pedagogies—if the exemplary teachers were to become more extensively connected and central in the teacher social networks in their wards.

Another observation was that, except for Madimba ward, there were teachers who ranked in the top five for *betweenness centrality* who were not also ranked among the top five performers in *degree* or *closeness centrality*. These influencers may not have as many direct and indirect connections to other teachers in their wards, but they are in a strong position to mediate relationships or share resources with teachers in the network who are do not know each other. These influencers have influence because of their positions as intermediaries.

When head teachers and strong teachers have extensive connections to teachers in the ward, do they use these connections to positively influence the enthusiasm for and adoption of new instructional strategies, especially formative assessment?



[Table 5](#) below summarizes the comments that informants gave when asked about their attitudes and application of new pedagogies. These data suggest that when teachers designated as head teachers and strong teachers were centrally prominent in the teacher social network (e.g., 63% in Mbawala and 88% in Milangominne), then they used their connections to positively influence teachers' perceived value and uptake of new strategies, especially formative assessment. Teachers interviewed in Mbawala and Milangominne wards all commented on their enthusiasm for learning new instructional strategies, with at least two-thirds of teachers per ward mentioning specific benefits of using formative assessment in their classrooms.

In contrast, informants interviewed in Madimba and Nitekela wards—in which only 17% and 29% of the influencers, respectively, were head teachers or strong teachers—were generally less familiar with formative assessment and more hesitant or even resistant to implementing new instructional strategies. The influencers in Madimba and Nitekela wards were mostly designated as “average teacher” or “unknown teacher.” One informant from Madimba ward said that the teachers in their school have not taken up new strategies because they “do not work”, and two others mentioned singing songs and using local objects but did not talk about instructional methods. The other informant in Madimba did speak positively about formative assessment. None of the teachers interviewed in Nitekela ward mentioned formative assessment. The head teacher and all teachers in Nitekela mentioned that they were generally skeptical of applying new pedagogies because, as one teacher said, “It is always difficult to use or adapt because I am used to the old strategies and techniques.”

Table 5. Teacher Comments about the Value and Application of New Methods by Ward

<p>Mbwala</p> <p>All three teachers in Mbwala spoke positively about using new techniques and strategies. Two teachers even mentioned or described formative assessment.</p> <p>“Adapting a new strategy is good and it is useful. The context is changing and there are always new challenges arising so new strategies are useful in this way.”</p> <p>“I feel excited to try new strategies, especially formative assessment strategies; the formative assessment helps me to know each student and their needs and then I can involve all students in one lesson; for example, when I teach a particular topic, I might use various ways using group discussion method and use questions or quizzes while I’m teaching.”</p> <p>“It feels good since before training only few students in my class were able to understand subjects, but with new strategies more students get to understand my lessons including the slow learning. The inclusive strategy has worked well so I am happy.”</p>	<p>Milangominne</p> <p>An exemplary teacher in Milangominne talked confidently about using new techniques saying they are helpful and simplify the teaching process. This teacher also mentioned receiving and giving training on formative assessment. Two other teachers interviewed, one of whom received training from the exemplary teacher, discussed using new formative assessment techniques.</p> <p>“I attended training facilitated by exemplary teacher on formative assessment. I feel good about using these strategies because I am involving all students during the lesson and in this way, the students are loving the lessons and the subject.”</p> <p>“Students understand me when I use new strategies I have learned during training. I have used new strategies to recognize which student are slow or fast learners and the ways to teach these different learners, and I feel comfortable using these strategies because I can do an assessment of my students’ abilities and a reflection of myself and teaching process.”</p>
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Note. Teachers designated as head teachers or strong teachers were the most prominent influencers in the Mbwala and Milangominne teacher networks; teachers designated as average teacher or unknown were the most prominent influencers in Madimba and Nitekela.

Madimba

One teacher from Madimba described not implementing new strategies and techniques in their school because they do not seem to work.

“Some new strategies may be good, but they aren’t directly applicable to the context. For example, when I was taught about not using sticks for whipping or hitting children; it was a good idea, but honestly the students here are used to whipping so when I tried to introduce negotiation or counseling, the new strategies weren’t taken seriously by the students.”

A teacher in another school described uptake of formative assessment strategies:

“Formative assessment strategy was quite new to me and sounded very useful at first sight. It was worked well so I was comfortable using it.”

Nitekela

The teachers interviewed in Nitekela ward, which included a head teacher in one school, described uptake of new techniques with hesitancy. Interestingly, none of the teachers interviewed mentioned formative assessment when they discussed new techniques they have learned.

“At first, I am skeptical about the new strategy, especially if students don’t get it right away. But then I feel joyful if the new strategy works.”

“At first, it is always difficult to use or adapt because I am used to old strategies and techniques. But it will get better with time when I try and if the strategy works.”

Note. Teachers designated as head teachers or strong teachers were the most prominent influencers in the Mbawala and Milangominne teacher networks; teachers designated as average teacher or unknown were the most prominent influencers in Madimba and Nitekela.

Another finding from the informant interview data that may have strengthened the potential for positive influence by a head teacher influencer is leadership style. [Table 6](#) below summarizes the comments that teachers from schools in different wards gave about their head teachers’ leadership style. Teachers interviewed from Mbawala and Milangominne described their head teachers as being caring and supportive, providing guidance and supervision when needed while enabling teachers’ autonomy (i.e., one teacher said that their head teacher was “hands off/supportive”). All teachers interviewed in Madimba and Nitekela ward described their head teachers’ leadership style as “directive/supervisory,” yet did not see this as a negative quality because, as some explained, teachers need close supervision, and that the guidance was well meaning.¹⁴ Taken together, these data suggest that a more responsive leadership style enables head teachers to have more and perhaps more influential interactions with teachers in their wards, which in turn promotes stronger teacher appreciation and uptake of new pedagogies such as formative assessment.

¹⁴. Respondents could select as many options from a multiple choice list as applied to describe their head teachers’ leadership style.

Table 6. Teacher Comments about Their Head Teachers' Leadership Style by Ward

Mbwala

Three of the four teachers in Mbalawa ward described leaders with blended leadership styles: caring and friendly head teachers, but sometimes the style is directive and supervisory.

"The HT [head teacher] listens to the challenges of teachers and gives advice. [The] HT gives direction on how to do our responsibilities. The HT ensures that the teachers are working in a conducive environment."

"At times the HT will tell me the truth when I do something wrong or if I have a mistake; one time I came late to school, but it was not my fault because there was a challenge at home that made me late in coming to school. When the HT asked me about my reason then I was able to explain to the HT and then the HT even helped me to solve the problem that had caused me to be late."

Milangominne

One teacher interviewed in Milangominne ward described leadership in her school as hands off and supportive. Two other teachers described head teachers that were a mix of directive, caring, and supportive leaders.

"The HT gives teachers the opportunity to work freely without criticizing their work but will give support if a teacher needs help. The HT also used to teach us or model on how to teach math lessons because he is an expert on this subject. The HT will contribute some money to motivate teachers when they have to work outside of the normal working hours."

"Sometimes the HT gives directives and supervises, but sometimes supports us to do something on our own."

"The HT motivates us [teacher and students] with small gifts when the students perform well."

Madimba

All the teachers interviewed in Madimba ward described directive and supervisory leadership styles in their schools.

"It is hierarchy, but I would say in a positive way because the HT is not too demanding."

"It is more of directives and follow-up but also with support from the leader. He likes more of following up on items assigned."

Nitekela

All the respondents interviewed (two teachers and one head teacher) described their school's leadership style as directive and supervisory.

"The HT oversees things and giving guidance."

"The teachers at my school that I am leading they need close supervision for them to deliver their work."

One respondent talked about the school committee as part of leadership, indicating the committee is not supportive and the community members more generally are not progressive.

"The school committee is not very supportive and doesn't care about the school affairs, yet this committee is part of the school leadership. I find that some of the community members are not progressive."

Note. Teachers designated as head teachers or strong teachers were the most prominent influencers in the Mbwala and Milangominne teacher networks; teachers designated as average teacher or were unknown were the most prominent influencers in Madimba and Nitekela.

In summary, the SNA data on teachers' relative central position in their teacher social networks, in combination with data from informant interviews suggest that head teachers and strong teachers tend to be positive influencers. Teachers interviewed in wards where head teachers and strong teachers were in positions of influence, i.e., were prominent among the top rankings for degree, closeness, and betweenness centrality, were more enthusiastic about learning new strategies and more likely to mention specific benefits of using formative assessment. In addition, teachers in wards where head teachers were central persons in the network described their head teachers' leadership style as caring, supportive, and open to teacher autonomy—whereas teachers interviewed in wards where head teachers were not in these most central positions described their head teachers' leadership style as being directive and supervisory. An unexpected finding in the data was that exemplary teachers who had specific roles in spreading, modeling, and supporting teachers' implementation of good practices across the ward and who also talked in their interviews about the value of this role, were not among the most connected and central in the network.

Conclusions

One of the overarching findings of this study was that teachers were relatively well connected to other teachers and head teachers across the ward, not just within their schools, but have very few connections with teachers outside of their wards. Expanding on this general finding, this section summarizes factors that contribute to building cohesion teacher social networks and enhancing the composition of teacher networks to improve the spread of information, enthusiasm, and support for teachers' uptake of new pedagogies.

What Opportunities Promote Strong Teacher Professional Relationships?

The teacher social network in Milangominne ward was both dense and cohesive, with substantially more across-school links than the other ward networks. In Milangominne ward, on average, teachers communicated with 12.4 other teachers in the network, 68% of whom were teachers outside their own schools. Qualitative findings helped explain how this cohesive network may have evolved. Informants interviewed from Milangominne ward spoke about the abundance of diverse opportunities for teachers to interact with each other in and outside of their schools. These opportunities likely contributed to building a tightly knit community of teachers and could be considered as starting points for building teacher relationships in any group of schools, particularly for the purpose of improving the sustained adoption of new pedagogies.

1. Formal within and across-school structures for peer learning and exchange, including the following:
 - a. Opportunities for teachers to observe teachers in each other's classes and the time to discuss with each other what they have learned.
 - b. Opportunities for *all* teachers to visit other schools, observe instruction, and exchanges ideas about their respective practices, followed by opportunities to share what they learned with colleagues in their own school.
 - c. Collaboration between ward supervisors and head teachers to organize exchanges.
2. Regularly scheduled school-level CoL meetings that do the following:
 - a. Provide enough time for meaningful discussion and learning.
 - b. Take place on the school-day timetable, not after school.
 - c. Provide teachers with a chance to model and practice new pedagogies.
 - d. Engage in discussions about specific actions that teachers can take to improve their practice, using check-ins with teachers (e.g., principals with teachers, teachers with each other) to follow up on these actions.
 - e. Involve ward supervisors in collaborative planning and monitoring.

3. Regularly scheduled ward-level CoLs that do the following:
 - a. Are planned such that they are accessible to all teachers.
 - b. Involve collaborative planning by ward supervisors and head teachers.
 - c. Involve specific action and follow-up.
4. Collaborative planning involving exemplary teachers, head teachers, academic or subject teachers, ward supervisors and other potential positive influencers, i.e., planning of CoLs, school exchanges, and other opportunities for peer learning in the school and ward.

As we have described above and will discuss more in the following section, the social norms in a school and the values, beliefs, and practices of influencers in teacher social networks hold equal potential to undermine as much as to promote the utility of relationships and formal structures (e.g., CoLs) to promote uptake of new pedagogies.

What Are the Characteristics of Positive Influencers?

In the Mbawala and Milangominne teacher networks, head teachers and teachers designated as strong teachers were the prominent actors ranking among the top five performers on one or more of the three centrality measures calculated for each actor in their teacher social networks (i.e., head teachers or strong teachers made up the 63% of top five rankings in Mbawala and the 88% of the top five rankings for Milangominne). Teachers interviewed from these wards, in contrast to teachers interviewed from Madimba and Nitekela wards, were more enthusiastic about learning new instructional techniques, and at least two-thirds of the teachers in each of these wards specifically described formative assessment and how the practice had improved their instruction. Thus, in Mbawala and Milangominne wards, where head teachers or strong teachers were the persons in positions of influence, these positions of influence appeared to be used to mobilize the adoption of new strategies. They were “positive influencers.”

In contrast, in Madimba and Nitekela wards, where the persons in positions of influence were mostly average teachers or who had “unknown” designations, most teachers interviewed mentioned some resistance to taking up new techniques, mentioning that they were often skeptical at first or that it was difficult because they were used to their old ways of doing things—yet recognized that “it would be better with time.”

It could be that head teachers and strong teachers value new strategies more because of their position of authority, knowledge, or skillset, and thus, if they are well connected in a teacher social network, they may use their central position to positively influence the beliefs and practices of other teachers in the network. On the other hand, if the influencers in the teacher social network are less skilled or confident, they may be more inclined to hold on to their previous practices or reinforce the skepticism of others in the network and accept a return to more familiar pedagogies.

The findings also pointed to differential leadership styles among head teachers who were in positions of influence in the teacher social networks of their wards. As mentioned above, many of the head teachers from Mbawala and Milangominne wards were in these central and influential positions. Qualitative findings suggested that head teachers in these wards were characterized as being “caring, supportive, and more open to teacher autonomy.” In contrast, teachers interviewed teachers from Madimba and Nitekela wards (where head teachers were not the prominent positions of influence) described their head teachers as “directive and supervisory.” These findings suggest that school leaders who are characterized as caring and supportive may be more inclined to (1) build relationships with and support the diffusion of information and uptake of new pedagogies among teachers in their schools and in other schools in the ward, and (2) reach out and collaborate with ward supervisors and other head teachers in the ward.

How can policy development and program planning leverage teacher social networks to enhance the uptake of new pedagogies: Guiding principles for future research.

Research on teacher social networks in a low- or middle-income countries is limited, therefore these findings, while inconclusive, provide a good platform from which to generate ideas for future research, including research to inform implementation. There is one observation and three suggestions that researchers should consider as they plan future related studies:

- 1** Teachers in rural government schools in Tanzania's Mtwara Region have extensive social and professional networks with supervisors and colleagues in their own schools and across schools in their wards.
- 2** To understand and leverage teacher social networks to improve uptake of new pedagogies and learning outcomes, it is important to understand both the overall cohesion of teacher social networks and the characteristics of the persons in positions of influence in these networks.
- 3** SNA, social network graphics, and qualitative inquiry should be used together to analyze and interpret teacher social networks.
- 4** Data on teachers' implementation of new pedagogies and learning outcomes data will allow for analyses that could shed light on the relative impact of teacher social networks, including such as correlational studies that investigate relationships between teacher social networks (a) the uptake of new pedagogies and/or (b) learning outcomes.
- 5** Teacher networks are defined in part by the kind of information that is exchanged. Respondents in this study were asked to identify a variety of topics that they had discussed with each of their contacts, including the exchange of advice. An illustrative example of a future study would be using SNA to analyze who in the network were most likely to give advice or to receive advice.
- 6** SNA is also designed to provide information about the strength of the connections between actors in a network through user-defined weights. Questions such as the frequency respondents interacted with their contacts or how useful the information exchange are examples of questions from which a research team could derive these weights. If a weighting of the links is desirable, thoughtful decisions about how the strength of the links should be derived and the questions that would be included in the sociometric inventory would be made during the design process.



Lessons Learned

In this section we discuss the lessons learned from this study related to research design and methodology, training of data collectors, and data collection.

Research Design: Refine the Research Questions

This study addressed two overarching research questions, one addressing the overarching structure of the network and the second more focused on the influencers in the network. This was a good beginning, but there is a need for more research on how teacher social networks can be enhanced to promote sustained implementation of new pedagogies. More specificity in research questions are needed. The following provide some examples:

- If it is of interest to understand the diffusion of innovation in education, then what are the *specific innovations*—information, resources, and practices—that are of interest?
- What differentiates the *nature of influence* that central actors in a teacher social network have? How can positive influence be enhanced, and negative influence deterred?
- How can preferred communication modalities and the contexts in which teachers interact be leveraged to enhance effective peer exchanges and learning?
- What information needs to be collected alongside the social network data that help explain the network phenomenon and its utility for education outcomes? For example:
 - More objective information about the characteristics of teachers that could help to explain the types of information and influence that flows through the network.
 - Knowledge, attitudes, and beliefs about the topic of study.
 - Existing levels of teacher adoption and school performance outcomes.
 - Opportunities for enhancing teacher exchanges and peer learning within a school and across schools in a ward and the effectiveness of these opportunities.

Methodology

Limitations

All available teachers in a school completed a sociometric survey in which they either identified contacts (from a roster of names) or named contacts (if not included in the roster). Therefore, off-roster contacts did not have a chance to complete the survey. This was not a serious factor because we analyzed the data as an undirected network. However, this situation precluded the analysis of reciprocity. Directed networks would be particularly useful in better understanding the exchange of advice among teachers, head teachers, and ward supervisors. Future researchers should investigate who the individuals in the network are who give advice on new pedagogies.

We advise future studies to make a deliberate effort to include all the head teachers, exemplary teachers, and ward supervisors.

The data collection team was concerned about respondents' fatigue and potentially recall bias. Future studies should take special care to reduce these biases as they refine the sociometric survey instrument.

In this study, we included two survey questions that respondents answered for each person they communicated with to help us weigh the relative importance of the interaction. The survey asked respondents to complete a multiple question about the helpfulness of the communications with this person and the frequency of their encounters. Both questions are important but should be refined through cognitive interviews prior to data collection.

Instrument design considerations

Respondents were able to effectively use tablets to complete the survey, including the navigation of the space-saving tabular layout of the form. However, it is not clear whether this success was the result of significant support by the trained data collection team, or whether the teachers already had sufficient experience in using tablets and could quickly adjust to an unconventional format.

Teacher-respondents were willing to name a considerable number of individuals (e.g., a few named more than 90). We suggest investing in building a Tangerine® (open-source data collection software) capability that leverages an input roster (all the teachers' names) and Tangerine's "repeatable groups" function (to define a standard set of questions into which teachers' names would be injected); or a non-roster approach, which is limiting if one is interested in analyzing a complete teacher social network.

Teachers were quite willing to name off-roster contacts. We learned that harmonizing these names was not especially difficult because they were nested within schools. In keeping track of unique off-roster names, researchers found it useful to use the last four digits of their phone numbers. For example, we found that off-roster contacts who were clearly the same person were frequently listed with different phone numbers.

An improved workflow for dealing with teacher movement and reassignment between schools would be helpful.

With more refined hypotheses and research questions, a more aligned qualitative guide could be developed to gather qualitative data that more directly inform interpretation of SNA findings.

Implementation training and data collection

One of the most important learnings was that the team could, in just 7 days, collect a large amount of data on teachers' social networks using the self-administered tablet-based survey instrument and a very small data collection team (two local consultants and one supervisor). The sociometric survey instrument was administered to 110 respondents across a total of 20 schools in four wards in Tanzania and structured informant interviews were administered to one teacher in each of 14 schools across the four wards. Group administration of the tablet-based self-interview for the social network data made this possible.

Just two local consultants were primarily responsible for this data collection; there were two underpinning factors in their success. First, the local consultants both had strong research skills and substantial research experience. Second, the implementation supervisor was actively assisting on location. We recommend future studies include an additional local consultant to support the qualitative inquiry.

Importantly, a similar study should include a well-organized second round of field work to engage participants themselves in discussions about the interpretation of findings. Focus group discussions, for example, should be held after the findings are drafted, to verify those findings that are in line with local knowledge and experience, but even more so to enrich interpretation.

Analysis

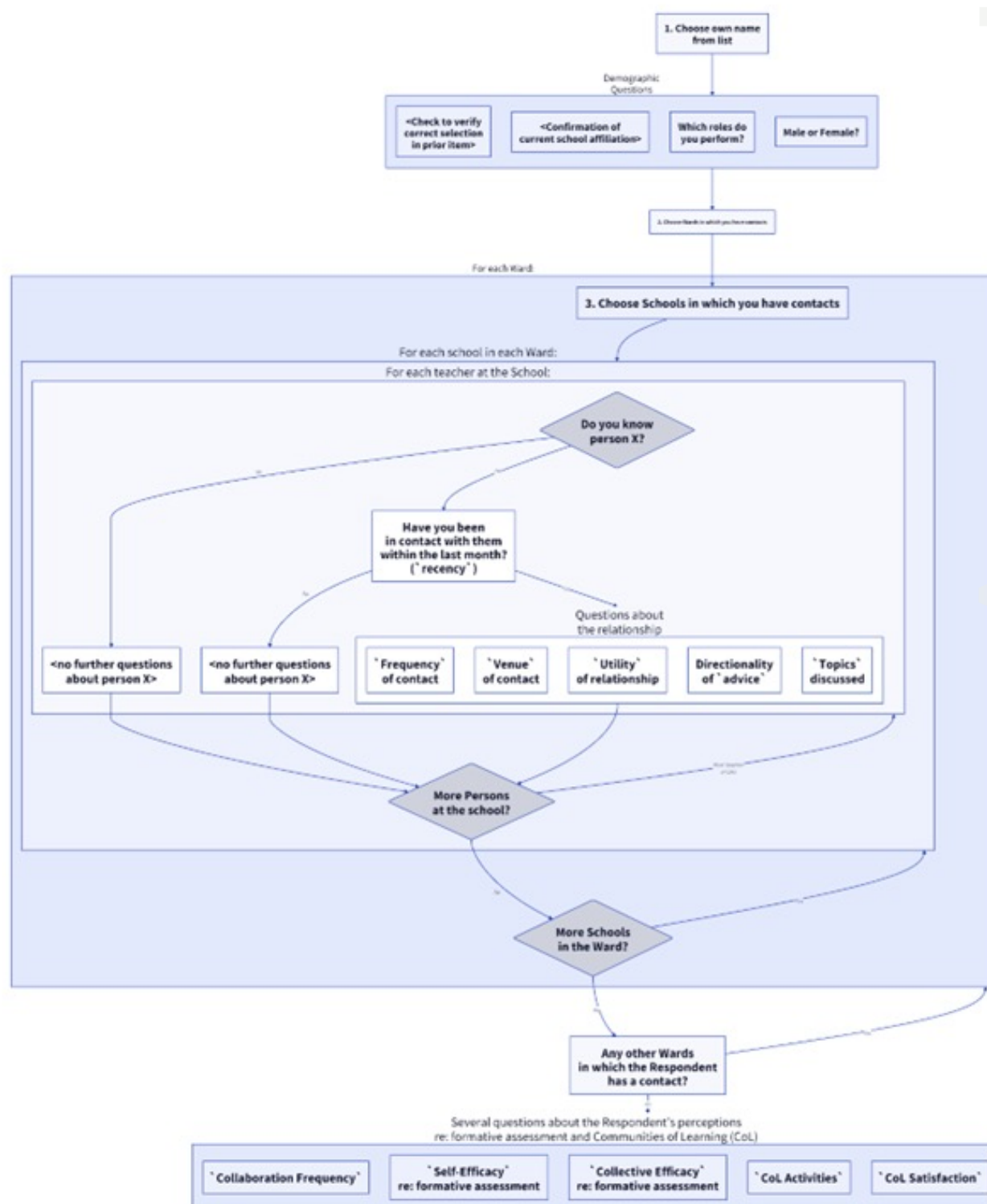
One of the greatest limitations in the analysis was that ward supervisors (WEOs) were not available to complete the sociometric inventory and therefore were not included in the SNAs. Therefore, we did not learn about WEOs' relative influence in the teacher social networks in their wards.

Additional SNA analyses could be conducted using these same data by including a wider range of or different topics that respondents and their contacts talked about. For example, the sociometric inventory asked respondents to indicate if they received or gave advice during their interactions. An SNA that included respondent-contact dyads that included information about exchanging advice would allow for directed network analysis to learn about who in the network were most likely to advise teachers and who in the network were most likely to receive advice.

Another limitation of the analysis is related to that the strength or weights of the interactions, though assigned for visualization in the sociogram, were not included in the SNAs. One reason for this is that the weights were assigned somewhat subjectively (based on the reported helpfulness and frequency of respondent interactions with their contacts). Weight-related improvements in the sociometric inventory would provide for more objective criteria in which to assign weights.

More objective information about teachers' attitudes and uptake of new pedagogies and information about learning outcomes would allow additional analyses that quantify the relationships between certain network properties and these outcome variables.

Appendix A. Flowchart of Administration of the Sociometric Inventory for the SNA



Appendix

Appendix B: Final Structured Informant Interview Guide

On Before the Observation

Greet the participant. Find a quiet place to sit where you and the participant can conduct the interview. Give about 45 mins – 1 hour.

PARTICIPANT CONSENT FORM

Hello, my name is _____. I'm here with RTI International to learn about the instructional support you have available to you at your school such as formal and informal teaching networks. Thank you for taking the time to talk with me today. We'd like to observe your class and then have a follow-up interview with you.

- We will be observing your class, taking notes and making a video recording of the lesson on this tablet.
- Your name will NOT be recorded on this form, nor mentioned anywhere in the data or findings.
- Your participation is very important, but you do not have to participate if you do not wish to.
- If you agree to participate, I will ask you some questions about your values and beliefs about teaching, the instructional support you receive at school, and your professional communications/networks with your colleagues.
- We believe there is no risk to you in participating in this research.
- You will not personally benefit from participating in this interview.
- Are you willing to participate? Once again, you do not have to participate if you do not wish to. Once we begin, if you would rather not answer a question, that's all right. Can we get started?

Participant provided consent: ☐ YES ☐ NO

Section 1: Background information

Age of participant

Position in school / Ward

Gender

School and/or Ward

Grade if currently teaching

Year of teaching experience?

How many years have you been in this current position?

Qualification

Participant's relationship to Tusome Pamoja/JU Project

Conducted training, attended training, trained by another teacher who attended training/
participates in COL, other?

Primary Question	Secondary Questions for Consideration
Theme: Values, Beliefs and Perceived Expectations” Importance of shared and/or individual values/vision/beliefs	
1. What do you believe is expected of you as a teacher? What do you feel might happen if these expectations are not met? Please give an example.	<ul style="list-style-type: none"> • If needed, probe for more clarity on what the teacher feels would be happen if they teaching expectations were not met. • Do you think that other teachers and administrators in your school share these expectations? Why or why not?
2. There are always pupils who are struggling to keep up in any classroom. Addressing the needs of struggling pupils is a very challenging task! We understand that! Do you feel it is your responsibility to ensure that these struggling learners keep up with the others?	<ul style="list-style-type: none"> • In your view, how well are you addressing the needs of struggling pupils in your classroom? How do you feel about this? [Note to interviewer: You may want to use a specific example] Say you have a student who is really struggling to learn in your class. <ul style="list-style-type: none"> – What actions do you take? • Whom do you seek assistance from when you need help assisting a struggling pupil in your class? How do you connect with this person to get help? • Do you feel you get the assistance you need to address the needs of struggling learners?
Theme: Communication and Support for Adoption: Formal and Informal Support	
3. Following initial training on a new teaching strategy, how comfortable do you feel about using the new strategies in your classroom? Please describe how you and your peers are assisted in using new strategies in your classrooms? Could you please give examples of this support and what is and is not helpful?	<ul style="list-style-type: none"> • If needed, probe for more details about how teachers are supported and how useful this support is. [Note to interviewer: You may want to use a specific example such as the use of the new strategy formative assessment.] For example: <ul style="list-style-type: none"> – Think about the introduction of the use of formative assessment. As an example of a new strategy please explain how you have developed your confidence and ability to use formative assessment in your classroom. We realize that some teachers still struggle to use formative assessment in the classroom. If so, do you feel this challenge was because of the assistance you were given? Please explain

Primary Question	Secondary Questions for Consideration
4. How do you interact with teachers at your school? Could you please give examples of this?	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide more details; for example, where the interaction(s) takes place, how often they are, and how helpful are they? • If the teacher talks most about formal structures (e.g., CoLs) <ul style="list-style-type: none"> – Probe for opportunities that teachers interact informally (e.g., at break) • If the teacher talks most about informal interactions with their colleagues (i.e., meeting at break) <ul style="list-style-type: none"> – Probe for formal structures (e.g., CoLs, staff meetings) for interaction
5. How do you interact with teachers in other schools? Could you please give examples of this?	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide more details; for example, where the interaction(s) takes place, how often they are, and how helpful are they? • If the teacher talks most about formal structures (e.g., CoLs) <ul style="list-style-type: none"> – Probe for opportunities that teachers interact informally (e.g., at break) • If the teacher talks most about informal interactions with their colleagues (i.e., meeting at break) <ul style="list-style-type: none"> – Probe for formal structures (e.g., CoLs, staff meetings) for interaction
6. What topics are most commonly discussed with your fellow teachers?	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide more details about the topics mentioned • Probe for more examples. “Can you think of other topics you and your peers talk about?”
Theme: Communities of Learning (CoLs)	
7. Could you please tell me about the Community of Learning that you participate in? Please describe a typical COL session. What do you enjoy most about the CoL? What do you dislike about the CoL?	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide more details: <ul style="list-style-type: none"> – About their description of the CoL; for example, How are the topics for the CoL determined? An example of activities that usually take place in the CoL, How is the CoL facilitated? – About what the teacher “enjoyed most” and “dislikes” about the CoL; for example, “Tell me more about _____”; “Do you think most teachers feel the same as you about what they like & don’t like about the CoL?” – What could improve the CoL?

Primary Question	Secondary Questions for Consideration
Theme: Opportunities and Content of Collaboration	
<p>8. In the previous questions, we talked about the ways you communicate with your peers.</p> <p>Now, let's talk about any times that you have collaborated on something with your colleagues. By collaboration we mean working together with one or more colleagues to complete a task, project, activity such as planning a school event, developing teaching aids or supplemental materials, developing schedules/plans, conducting peer observations, etc.</p> <p>Tell me about any times/examples that you have collaborated with your peers on something.</p>	<ul style="list-style-type: none"> • Prompt the teacher to provide more details about the example(s) given such as when, where, how did the idea for collaboration come about? • How often do you engage in collaborative activities? Is it more, less, about the same as other teachers at your school? • Would you like to have more opportunities for collaboration with your peers? Why or why not? • If the teacher does not share an example, probe about if other teachers at the school collaborate on tasks, projects, activities.
<p>9. Do you feel collaborations change the way you feel about teaching or the way you feel about your job?</p> <p>Are you comfortable when teachers come together to collaborate on something? Please explain.</p>	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide more details about how collaborative activities make them feel; for example, as a result of collaboration, <ul style="list-style-type: none"> – do teachers feel more connected to the school or – do these connections enhance their sense of wellbeing and/or enjoyment in teaching?
<p>10. Think about a colleague at your school that you enjoy collaborating with on a project or school activity.</p> <p>What are the qualities of this individual that makes working with them enjoyable?</p>	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide an example.
Theme: leadership (school and more) – knowledge transfer/facilitation of learning/ leadership style	
<p>11. Which of the following best describes the leadership style at your school? Encourage teachers to explain their choice, with an example if possible.</p> <p>a. .Directive and supervisory</p> <p>b. Hands off but provides support if needed.</p> <p>c. Caring and friendly</p> <p>d. Uncaring and absent</p>	<ul style="list-style-type: none"> • Probe for more information about their head teacher's provides instructional support? <ul style="list-style-type: none"> – What does the head teacher do that is most helpful? Least helpful?
<p>12. Do you feel the Head Teacher is interested in your personal wellbeing? Why do you feel this way. Can you give me an example</p>	<ul style="list-style-type: none"> • If needed, prompt the teacher to provide more details and give an example about: <ul style="list-style-type: none"> – How the Head Teacher supports or does not support their wellbeing – What the Head Teacher could do to be more supportive of their personal wellbeing?