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Exploring Finnish fifth-grade pupils' academic peer assistance networks

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ABSTRACT

The study examined Finnish elementary school pupils' academic peer assistance and its relation to their demographic backgrounds of gender and language, social networking with schoolmates, and orientation toward sociodigital participation. The participants (188 fifth graders) responded to a social networking questionnaire on schoolmate and academic peer assistance networks and a questionnaire probing pupils' digital engagement. Our analysis indicated that pupils' schoolmate networks were denser than the academic peer assistance networks and less homophilic concerning pupils' language background than gender. There were no gender differences regarding academic peer assistance. We distinguished passive (n = 34), medium (n = 124), and active (n = 30) helpers, with no gender or language influence, other than homophily. The active helpers often participated in online social networking and were better connected with their peers than the passive helpers. We argue that spontaneously emerging academic peer assistance should be deliberately fostered by pedagogic support from teachers.

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Academic peer assistance; collaborative learning; digital engagement; social network analysis; sociodigital participation

1. Introduction

This study examined fifth-graders schoolmates and academic peer assistance networks. The former refers to networks based on friendship and joint "hanging out," and the latter to sharing mutual help related to schoolwork and academic studies. The study was conducted in a provincial digitalization program aimed at fostering technology-mediated collaborative learning and teaching in Helsinki, Finland. Peer collaboration and teamwork are considered essential twenty-first-century skills (Binkley et al., 2012), which should be cultivated by teachers and educational institutions from the onset of schooling. Digital technologies have socialized younger cohorts of pupils to hang out with extended networks of peers, and many are engaged in the peer-supported pursuit of learning and interests on the Internet (Gee & Hayes, 2011; Hietajärvi et al., 2016; Jenkins et al., 2006). In this regard, investigators have expressed concern about the deepening gaps between young people's ultra-social informal culture and individualist learning at school (Corneli et al., 2016; Hakkarainen et al., 2015; Hietajärvi et al., 2016; Ito et al., 2013). Indeed, longitudinal investigations reveal that active young sociodigital participants feel an increasing disengagement, alienation, and cynicism in schools from one year to the next (Hietajärvi et al., 2020). To overcome such

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challenges, it is critical to connect pupils' informal and formal learning better (Ito et al., 2013) by engaging pupils in mutually supporting each other's schoolwork. This study investigated pupils' academic peer assistance networks, which provide expanded social learning resources for supporting schoolwork. Here, we will review the educational value of peer relations, academic peer assistance, and sociodigital participation (SDP).

The importance of social relationships has been acknowledged for decades, especially for adolescents at risk of being segregated (Pavri & Lufting, 2001). There is solid evidence that strong peer-to-peer relationships promote inclusion in terms of social belonging, friendship, self-esteem, and confidence by reducing labeling or stigma (Sakerneh & Nair, 2014). Strong peer relations improve academic outcomes (e.g., Liem & Martin, 2011) by eliciting productive dialogues during collaborative learning activities (Barron, 2003) and helping to manage uncertainty with learning tasks (Jordan & McDaniel, 2014). Without appropriate social support, pupils at risk might develop a fragile academic and social self-concept (Pijl & Frostad, 2010; Vaughn et al., 1996). Previous studies indicate that pupils are aware of their social status within their peer groups, which affects their cognitive activities (Anderson et al., 2009; Pijl & Frostad, 2010). Stanovich et al. (1998) found that peer acceptance was significantly lower among pupils for whom the majority language was a second language. Although Finland is ethnically relatively homogeneous, a growing proportion of bicultural pupils speak at least one foreign language at home (Li et al., 2019). Thus, it is essential to understand that feeling socially excluded may have far-reaching effects on learning and development.

Providing academic peer assistance, such as teaching a peer what one has just learned, is an effective way of learning because it requires a deeper level of understanding than that which comes from mere personal learning (Duran & Topping, 2017; Sackstein, 2017). Although pupils' competencies are still evolving, they may adopt a pupil expert's role (Olson & Bruner, 1996) at school by answering questions, explaining issues, and providing practical guidance to their peers. It may be valuable to be advised by another pupil who is at the same level of understanding, whereas an adult expert could appear more distant. Because pupils' competencies are fragile, providing help may be a socioemotionally challenging experience (Packer & Goicoechea, 2000). Nevertheless, academic peer assistance is valuable because it provides a sense of contribution and enhances self-efficacy (Bandura, 2006; Barron, 2003). Although earlier research has shown that help-seeking is an important self-regulatory learning strategy (Karabenick & Berger, 2013), the role of friends in academic peer assistance has yet to be explored.

As indicated by Brechwald and Prinstein (2011), most dyadic relationships are nested within larger networks of friendships shaped by homophily, that is, a tendency to build connections, such as friendship and peer assistance with similar others (McPherson et al., 2001). Similarity may, for instance, relate to gender, ethnicity, or school achievement (Fortuin et al., 2014; Schwab, 2019). School achievements are differentiated in Finland according to gender (Torppa et al., 2018), with female pupils achieving more success than male pupils. Further, while girls indicate a higher general intention to seek help and a lower intention to avoid help-seeking, boys report significantly higher expedient help-seeking goals regarding avoiding hard work and obtaining quick answers (Kessels & Steinmayr, 2013). Gender homophily provides strong structures for pupils' networks in pre- or early adolescence, and there are some indications that academic peer assistance is likely to be shared with same-gender peers (Ryan et al., 2001). Friends have indicated similarities with each other in adaptive and avoidant help-seeking tendencies due to the selection of friends by a pupil and the influence of friends on him or her (Shin, 2018). Longitudinal studies indicate that pupils with more positive attitudes toward help-seeking get better grades and that assistance from classroom peers improves pupils' educational achievement (Marchand & Skinner, 2007; Whitmore, 2005). Pupils' dispositions, as well as the social climate of the classroom, affect avoidance of help-seeking (Ryan et al., 2001).

Our investigations indicate that pupils' practices of helping one another in schoolwork often emerge spontaneously, representing self- and co-directed ways of adapting to the challenges of

school learning (Li et al., 2017). Impactful changes emerge when practices of collaborative learning and mutual peer support are deliberately fostered by teachers (Duran & Topping, 2017; Sackstein, 2017). Nevertheless, pupils' desire for autonomy and efforts to avoid threats to competence (Ryan et al., 2001) may decrease their willingness to engage in academic peer assistance. Further, peer learning, or "peeragogy" (Corneli et al., 2016), appears how young people participating in digital culture learn (Gee & Hayes, 2011; Hakkarainen et al., 2015; Ito et al., 2010; Jenkins et al., 2006). Pupils who are active sociodigital participants outside of school report that they would put more effort into schoolwork if allowed to use digital technologies (Hakkarainen et al., 2000; Hietajärvi et al., 2020). However, cultivating digital competencies requires the active building of personal social networks, which provide access to relevant knowledge, tools, and competencies beyond the immediate social context (Li et al., 2017). Sociodigital technologies are, indeed, often used to support educationally valuable peer-to-peer learning (e.g., asking for and giving help with schoolwork), which serves as an important aspect of pupils' learning processes (Hietajärvi et al., 2016; Li et al., 2020). Agentic efforts to seek ideas, assistance, and social support from such networks are likely to expand a school helper's ecology of learning (Barron, 2004). Participation in prosocial peer assistance arguably increases the centrality of an individual's position in a pupil network. However, there is complex and partly conflicting evidence related to the question of how peer groups contribute to educational outcomes (Brechwald & Prinstein, 2011). This multiple case study aimed to examine how fifth graders' ties to their schoolmates are related to assistance seeking from their peers in schoolwork and whether academic peer assistance can be explained by pupils' similarity in some demographic properties, such as gender, language background, or SDP practices at school. The research aims are presented as questions follow:

1. How dense and centralized are fifth-grade pupils' schoolmate and academic peer assistance networks at the school level?
2. Does similarity (homophily) in pupils' gender or language background explain with whom they have ties?
3. Which pupils are active in academic peer assistance networks in terms of gender and language background?
4. How can pupils with varying levels of activity in academic peer assistance be grouped, and how do these groups differ regarding their gender or language background?
5. How are the groups of academic peer assistance related to pupils' SDP practices?

2. Methods

2.1. Research setting and participants

The present multiple case study was conducted in the context of the digitalization program of Helsinki (School District Office of Helsinki, 2016). The program implemented in 2016–2019 involved schools signing up for the systemic transformation of their operational culture. This study was carried out in collaboration with Helsinki by the Growing Mind project funded by the Strategic Research Council of the Academy of Finland, which funds high-quality multidisciplinary research with significant societal relevance and impact (www.aka.fi/en/strategic-research/). The study was anchored on research-practice partnership (Coburn & Penuel, 2016) for supporting schools in systemic needs-based development of their operational culture. An essential aspect of the Growing Mind project was collecting self-report questionnaire data on pupils' learning, SDP, and well-being. Data collected in 2019 from 1,329 fifth-grade pupils (aged 11) across 42 schools included a section on social networking. This study focused on five schools with an adequate response rate (64%–71%) regarding the social networking component located at the end of the extensive questionnaire. In a few cases, we needed to remove classes that lacked an adequate response rate.

The final sample included 188 fifth-grade pupils, but in network visualizations, we included 253 pupils (with informed personal and parental consent) whom the participants mentioned; this sample is sufficient for the purposes of our analyses.

We focused on grade-level networks of the schools instead of classroom-level networks for two reasons: 1) both the digitalization program and our project aimed at supporting schools in the systemic transformation of their operational culture, presumably also shaping classroom practices and 2) teacher collaboration and co-teaching are emphasized in Finnish schools resulting to the occurrence of between-classroom ties that would have been lost if focused only on within-classroom networks. Table 1 characterizes the participating schools and their respective sizes together with describing each school's values related to collaborative learning and community building; this is relevant because Finnish schools have significant degrees of freedom to develop their school-specific curricula.

Table 1. Background information on selected schools.

School	School size	Sample	School values related to collaborative learning and community building
School A (Grades 1-6)	ca. 500 pupils	3 out of 5 fifth-grade classes 41 out of 83 pupils Final response rate 65.1%	Emphasis on - the pupil's perspective and development of social skills - respectful teacher-pupil interaction and home-school partnership - longitudinally built constructive community participation in classroom communities and at the level of the whole school - appreciating and noticing multiculturalism
School B (Grades 1-9)	ca. 750 pupils	2 out of 3 fifth-grade classes 33 out of 70 pupils Final response rate 70.2%	Emphasis on - pupils' active roles at school (e.g., student union) and in their own learning (e.g., setting learning goals and evaluating them throughout the school year) - learning life skills, self-knowledge, and personal growth - student-centered and collaborative learning activities and phenomenon-based studies
School C (Grades 1-6)	ca. 550 pupils	3 out of 5 fifth-grade classes 48 out of 104 pupils Final response rate 64.0%	Emphasis on - pupils' active roles at school (e.g., student union) and in their own learning (e.g., setting learning goals and evaluating them throughout the school year) - learning life skills, self-knowledge, and personal growth - student-centered and collaborative learning activities and phenomenon-based studies
School D (Grades 1-6)	ca. 100 pupils	1 fifth-grade class 11 out of 16 pupils Final response rate 68.8%	Emphasis on - the pupil's perspective and active role in learning - the pupil's self-awareness, self-expression, and interaction with others - learning life skills in relation to the ability to take care of oneself, others, and the environment - community participation when practicing life skills - activating students to take part in and affect school development, activity, and assessment - collaborative and reflective learning practices
School E (Grades 1-6)	ca. 450 pupils	3 fifth-grade classes 55 out of 77 pupils Final response rate 71.4%	Emphasis on - shared values in the everyday functioning of the school - the pupil's perspective, which is the starting point of all school activities - using multifaceted collaborative and participatory working methods to foster the development of interactive skills - a joyful atmosphere for educating active and thoughtful individuals

2.2. Methods of data acquisition

To answer the first and third research questions regarding schoolmate and academic peer assistance networks, we administered a roster social networking questionnaire (Borgatti et al., 2013) as a part of the comprehensive questionnaire. The participants were first asked to select the classes in which their schoolmates studied and were then shown a list with the names of all the members of those classes. Next, they were asked to select from the list of names those a) whom they considered their best friend(s) (friendship network), b) with whom they liked to spend time (hanging out network), and c) from whom they could obtain help with schoolwork if needed (academic peer assistance network). The participants were able to select as many names as they wanted. To answer the second question regarding which individuals were active in academic peer assistance networks, we utilized information collected on gender (male, female, other) and language background. Approximately half of the participants were girls ($n = 93$, 49.5%), and the other half were boys ($n = 93$, 49.5%). The language background variables were recoded into three categories: native-speakers who spoke only Finnish (the data did not include any pupils speaking Swedish, the other official language in Finland), bilingual pupils who spoke Finnish and at least one other language at home, and non-native-speakers who did not speak Finnish at home. In total, the participants included native-speaker pupils ($n = 151$, 80.3%), bilingual pupils ($n = 35$, 18.6%), and one non-native-speaker pupil (0.5%).

We utilized several parts of the questionnaire to answer the fourth research question regarding the interrelations between the level of academic peer assistance and SDP. First, we wanted to find out whether the active school helpers would also be active sociodigital participators and, therefore, more competent technology users. The pupils were asked to evaluate their academic and computational digital competencies using a five-step Likert-type scale (1 = not at all, 5 = very fluently). Academic competencies (Cronbach's alpha = 0.77) included six items, such as *I can use word processing programs* and computational competencies (alpha = 0.81), and four items, such as *I can code by using some block- or text-based programming languages*. Second, the participants were asked to assess to what extent digital study practices were experienced as being implemented at their schools using a Likert-type scale from 1 (never) to 7 (daily). The constructed sum variable, digital learning support (alpha = 0.77), included such items as *In class, we practice the basic use of digital technology (e.g., sharing a document, word processing, and using email and internet).* Third, pupils' orientation toward digital learning was examined using a five-step Likert-type agreement scale (Hakkarainen et al., 2000; Hietajärvi et al., 2020). A four-item composite variable was used to measure pupils' digital engagement (alpha = 0.85), such as their willingness to make an effort in developing digital competencies (e.g., *I am prepared to put in much effort to learn something related to digital technology).* Further, we used a four-item measure (alpha = 0.86) to assess the participants' desire for digital learning (e.g., *I am more enthusiastic about my schoolwork when I am allowed to use digital technology).* Fourth, five items (alpha = 0.77) were used to measure the intensity of social networking activity scale from 1 (never) to 7 (daily) in social media use and on the internet (e.g., *I look for and follow online information related to my interests*). These composite variables were constructed by relying on principal component analyses of the associated measures using the large ($N = 1{,}329$) dataset as reported in the project's prepublication (Korhonen et al., 2020).

2.3. Methods of data analysis

To answer the first research question, the data collected through the social networking section of the questionnaire were uploaded to UCINET (Borgatti et al., 2013) for analysis. The network data were coded into matrices, and a tie was considered to exist between two pupils (code "1") if a pupil had reported it; otherwise, we used "0". In total, we computed 15 matrices, one for each networking dimension in each school. The data included were only those from pupils who had research permissions, responded to the questionnaire, and were mentioned by their schoolmates. Further, to

get a better understanding of the density and centralization of the pupils' schoolmate networks, we combined and dichotomized (i.e., left the value of the tie away, only reporting whether there was a tie or not) the friendship and hangout networks and constructed an integrated schoolmate network. To describe the structures of both networks, we calculated how dense the network was compared to the maximum possible value, how many nominations the pupils had reported (outdegree) and received from their peers (in-degree), and whether the nominations focused on some pupil(s) only or were equally distributed among the pupils (centralization). To obtain the number of reciprocal ties in the schoolmate network, the network was symmetrized using the method of the minimum; thus, only ties reported by both participants existed. Regarding the academic peer assistance network, we used the maximum method to symmetrize the network. Symmetrized values were used in subsequent analyses if not otherwise indicated. Moreover, we calculated the size of the pupils' personal (egocentric) networks from the schoolmate and academic peer assistance networks.

To understand the overall nature of the networks and to answer the second research question, we examined homophily, that is, one's tendency to have ties to others who are similar or different. Homophily related to gender and language background was measured using Yule's Q, which takes into account both ties and non-ties (i.e., others to whom an ego does not have ties) and thus controls the relative sizes of the different groups (Borgatti et al., 2013, pp. 273–274). Yule's Q measure varies from –1 to 1, where 1 indicates total homophily and – 1 total heterophily, and a value of 0 indicates a lack of networking preference. The individual-level network measures (i.e., self-reported and received ties), the number of symmetrized schoolmate and academic peer assistance ties, the size of the egocentric network, and Yule's Q values were also uploaded to IBM SPSS Statistics 28 for further analysis.

To analyze the third research question regarding different levels of activity in academic peer assistance networks, we categorized the participants into three groups based on how many times a pupil was named a helper. Thus, the grouping described how active or passive the pupils were in providing help with schoolwork to their peers. The threshold values were chosen in the way that the first and third groups (low and high levels of activity) had approximately the same size, and the second group (medium level of activity) had values around the average. The network visualizations were used to enrich the social network analysis with qualitative information and visually examine the variation among schools regarding the pupils' social networks highlighting those who were active school helpers. We used Gephi (http://www.gephi.org), an open-source software (Bastian et al., 2009), and applied Force Atlas 2, a force-directed spatial layout algorithm, to analyze the interactions that each pupil had with every other pupil in the network (Jacomy et al., 2012). The algorithm pulls strongly connected nodes together and pushes weakly connected nodes apart, forming smaller groupings within a given network, such as schoolmate and peer assistance groupings. In the network visualizations (see Appendix) each node represents a pupil, and a line between the two nodes represents their tie. In one-directional ties, an arrow appears at one end of the line, and in reciprocal ties, there is one at both ends. The pupils who were most frequently named as friends or school helpers (indegree) are represented with bigger spheres. The presented visualizations illustrate the kind of qualitative feedback that we provided to all five schools in accordance with the research-practice partnership (Coburn & Penuel, 2016).

For a more detailed school-level analysis, we excluded two schools due to incomplete questionnaire responses (in schools B and C, one class did not answer the peer assistance questions), and a third, relatively small school D, had only one class that responded. The selected two schools (A and E) were of an approximately similar size and had varying densities of academic peer assistance. However, one pupil was excluded from School A's schoolmate and academic peer assistance network visualizations, and seven pupils were excluded from School E's academic peer assistance network visualizations because they had no ties to their peers. Nevertheless, all the excluded pupils had nominated pupils or were nominated by pupils who did not have research permissions.

Finally, the fourth research question was analyzed, examining the relations between the groups and background variables (gender and language background) by cross-tabulation. Prior to

statistical analysis, the SDP items with background variables were screened for missing values. The missing value analyses showed that the overall proportion of missing values was only 1%, and for singular items was 0%–3.4%. Furthermore, Little's missing-completely-at-random (MCAR; Little, 1988) test indicated that the data were missing completely at random ($p > 0.05$). Thus, complete case analysis and listwise deletion were utilized, which was why the number of cases varied slightly from item to item, and the statistical power could be reduced. We also used the network visualizations of Schools A and E to enrich the statistical analysis described earlier.

Finally, to answer the fifth research question, we utilized the *t*-test and one-way or two-way analysis of variation (ANOVA) to compare between-group differences among the participants. First, we implemented a set of *t*-tests to identify the differences in schoolmate and academic peer assistance networks based on gender and language background (comparing only sizable groups of native and bilingual speakers). As a post hoc test for group comparisons, we used Scheffe's test. Second, we examined how different activity levels in academic peer assistance were related to gender, networking, sociodigital practices, and digital learning orientation. We conducted a two-way ANOVA for the schoolmate network and SDP measures to do this.

3. Results

In the following, we present the research results according to our research questions. In Section 3.1, we characterize the network-level features of schoolmate and academic peer assistance ties, and in Section 3.2, we describe the homophily of the networks. Section 3.3 reports on gender comparisons and network visualizations, and Section 3.4 presents results regarding different levels of academic peer assistance in relation to gender, language background, and schoolmate networks. Section 3.5 examines how pupils' academic peer assistance networks are related to SDP practices.

3.1. Density and centralization in school-level networks

In five elementary schools, we examined fifth-grade pupils' schoolmates and academic peer assistance networks. As indicated in Table 2, the density of a pupil's schoolmate network was roughly 10% in all schools, except in the smallest school, School D, where it was over 30%. The mean (M) of self-reported and peer-reported schoolmate ties varied from 3 to 6 across the schools. The number was 3 or 4 in smaller schools, whereas, in bigger schools, it was closer to 5 or 6. In

Table 2. Network measures of schoolmate and academic peer assistance networks by school.

Network Measures	School A ($n = 41$)	School B ($n = 33$)	School C ($n = 48$)	School D ($n = 11$)	School E ($n = 55$)
Pupils' schoolmate networks					
Density %	8.8	12.3	10.2	31.8	10.5
SD of density	0.28	0.33	0.30	0.47	0.31
Self-reported ties per pupil *M/SD*	3.51/2.20	3.94/1.50	4.79/2.65	3.18/1.75	5.67/4.16
Network centralization, self-reported ties %	19.2	9.9	13.5	42.0	38.3
Peer-reported ties per pupil *M/SD*	3.51/1.53	3.94/1.77	4.79/2.54	3.18/1.19	5.67/2.64
Network centralization, peer-reported ties %	6.4	9.9	11.3	20.0	13.8
Reciprocal ties per pupil *M/SD*	2.10/1.12	2.79/1.27	3.54/1.96	2.55/1.37	3.71/1.91
Network centralization, reciprocal ties %	7.4	13.6	9.7	27.0	10.0
Pupils' academic peer-assistance networks					
Density %	3.8	6.2	4.1	9.1	5.1
SD of density	0.19	0.24	0.20	0.29	0.22
Self-reported ties per pupil *M/SD*	1.51/1.56	1.97/1.78	1.94/1.71	0.91/0.90	2.76/3.09
Network centralization, self-reported ties %	11.5	16.2	8.8	23.0	25.0
Peer-reported ties per pupil *M/SD*	1.51/1.11	1.97/1.73	1.94/1.51	0.91/0.79	2.76/1.79
Network centralization, peer-reported ties %	6.4	16.2	11.0	12.0	9.9
Symmetrized ties per pupil *M/SD*	2.49/1.58	3.58/1.89	2.88/1.89	1.46/0.78	4.29/3.03
Network centralization, symmetrized ties %	9.0	14.3	13.3	17.0	22.1

the biggest school, School E, the self-reported ties' standard deviation (*SD*) was much higher than in the other schools. The average number of reciprocal schoolmate ties varied from 2–4, the largest in the two biggest schools (E and C). Table 2 shows the large differences in network centralization among the schools. In Schools D and E, the schoolmate ties, especially the self-reported ties, were more centralized than in the other schools. Overall, self-reported ties were more centralized than peer-reported or reciprocal ties; the exception was School B, where reciprocal ties were more centralized. The level of centralization in peer-reported and reciprocal ties was mostly relatively low.

Academic peer assistance networks' densities were lower than schoolmate networks (Table 2). Hence, pupils had more friendship-driven ties than academic peer assistance ties to their peers; roughly only 5% of all possible academic peer assistance ties existed (9% in the smallest School D). Depending on the school, the participants self-reported receiving help with schoolwork from an average of 1–3 peers. However, the variation (*SD*) in help-seeking was higher than in providing help. The average number of symmetrized ties (i.e., seeking and providing help regardless of the direction) varied roughly from 1 and 4. Moreover, the mean values and variation of the symmetrized academic peer assistance ties were highest in School E. In contrast, those values were lowest in School D. Furthermore, Table 2 indicates that the help-seeking and symmetrized ties were rather highly centralized in Schools D and E. In contrast, in the other schools, these were more equally distributed. Providing academic peer assistance was relatively little centralized, except in School B, indicating that many pupils helped their peers with schoolwork.

3.2. Homophily in gender or language background around pupils' (egocentric) ties

To answer the second research question, we calculated Yule's Q value for each participant and school means and *SD* values to examine how much network homophily existed in relation to gender and language background. Table 3 shows that there was strong homophily in relation to gender in both schoolmate and academic peer assistance networks (values close to 1) in all schools. However, Yule's Q values were lower and indicated less homophily regarding language background, while high *SDs* indicated a large between-pupil variation. Language-related homophily was lower in Schools A and E and higher in Schools B and C. Because all pupils were native-speakers, Yule's Q could not be calculated in School D. Furthermore, inside the schools, there were no big differences in homophily between the two investigated networks, except for School C, where the academic peer assistance network was more homophilic than the language-related network.

3.3. Gender and language background comparisons and network visualizations

We used *t*-tests to compare the differences in the number of ties in schoolmate and academic peer assistance networks across gender and language backgrounds to answer the third research question. The results revealed that girls had smaller ($M = 5.25$, $SD = 2.09$) egocentric (personal) networks

Table 3. Network homophily related to gender and language background by school.

	Yule's Q				
Network Measures	School A *M/SD*	School B *M/SD*	School C *M/SD*	School D *M/SD*	School E *M/SD*
Gender					
Schoolmate, reciprocal ties	1.00/0.00	1.00/0.00	0.87/0.44	1.00/0.00	0.92/0.27
Seeking academic peer assistance (self-reported ties)	0.82/0.48	0.83/0.54	0.89/0.39	1.00/0.00	0.83/0.44
Providing academic peer assistance (peer-reported ties)	0.87/0.40	0.95/0.14	0.85/0.48	1.00/0.00	0.75/0.40
Language background					
Schoolmate, reciprocal ties	0.01/0.85	0.67/0.64	0.43/0.85	-	0.34/0.66
Seeking academic peer assistance (self-reported ties)	0.06/0.90	0.51/0.76	0.66/0.72	-	0.24/0.78
Providing academic peer assistance (peer-reported ties)	0.14/0.89	0.63/0.69	0.66/0.73	-	0.11/0.74

than boys ($M = 6.65$, $SD = 3.98$) in schoolmate networks ($t = -3.00$, $df = 139$, $p < 0.01$). However, there were no statistically significant differences in the number of reciprocal ties in schoolmate networks between boys ($M = 3.05$, $SD = 1.94$) and girls ($M = 3.10$, $SD = 1.62$). Additionally, there were no significant differences in academic peer assistance by gender; on average, boys and girls helped and received help with schoolwork from two peers. Nevertheless, their egocentric networks of academic peer assistance included three pupils. No significant differences were found between native-speakers and bilingual pupils in schoolmate and academic peer assistance networks.

We performed a visual social network analysis for all the five schools that took part in the present study; here, we present a visualization of two similarly sized schools (A and E), but those of the three other schools are available in Appendix. The visualizations presented in Figure 1 illustrate the pupils' schoolmates and academic peer assistance networks. The received schoolmate and academic peer assistance nominations in both schools were distributed relatively evenly among pupils, so few were nominated more than others. The number of connective lines among pupils indicates that School E had more designated pupil connections in both networks. In School E, pupils had more schoolmates ($M = 5.7$) and peers with whom they exchanged academic peer assistance ($M = 2.8$) than in School A ($M = 3.5$ for schoolmates and $M = 1.5$ for academic peer assistance). In both schoolmate networks, the grade-level boys were more connected to each other than were the girls, who had more distinct class groupings. According to the visualizations, there were also more connections between pupils of the same gender in academic peer assistance networks, but the gender-based subgroups were closer. Especially in School A, the pupils from classes A3 and A4 formed cross-class gender-based subgroups. In particular, boys were grouped closer together than girls in the visualizations.

We also examined pupils' positions in the visual networks according to their language backgrounds (Figure 2). Most pupils were native-speakers in both schools (School A = 75%;

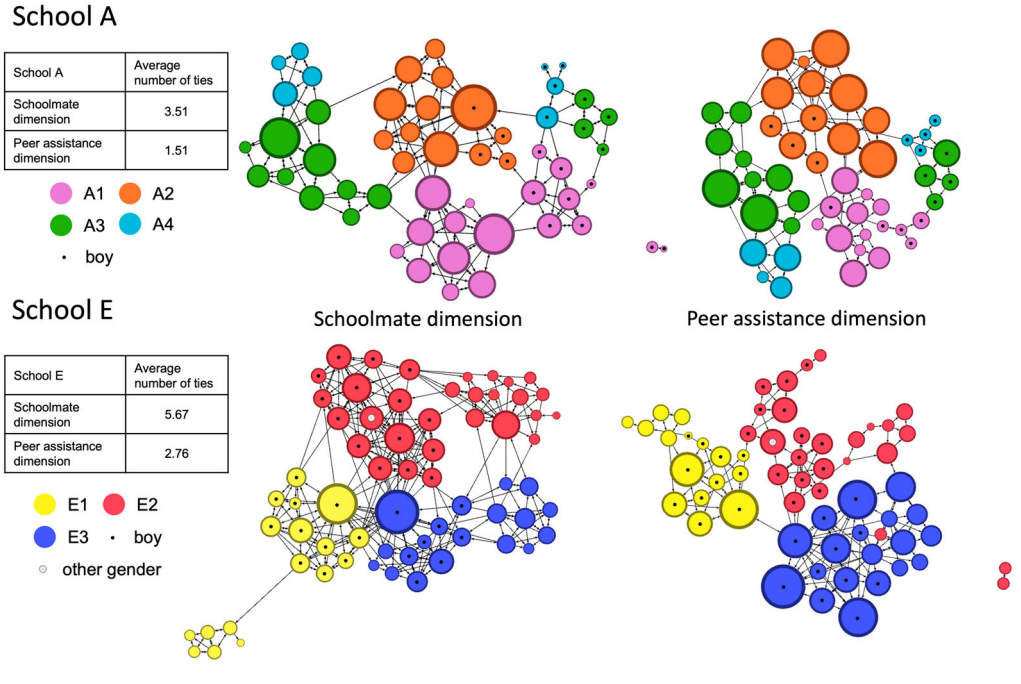

Figure 1. Visualizations presenting internal social networks in two different schools. The nodes represent pupils, the size represents the number of nominations made by other pupils, the lines between pupils represent ties, and the colors represent classes at the school. Strongly connected pupils are pulled together, and weakly connected pupils are pushed apart by Gephi's Force Atlas 2 algorithm.

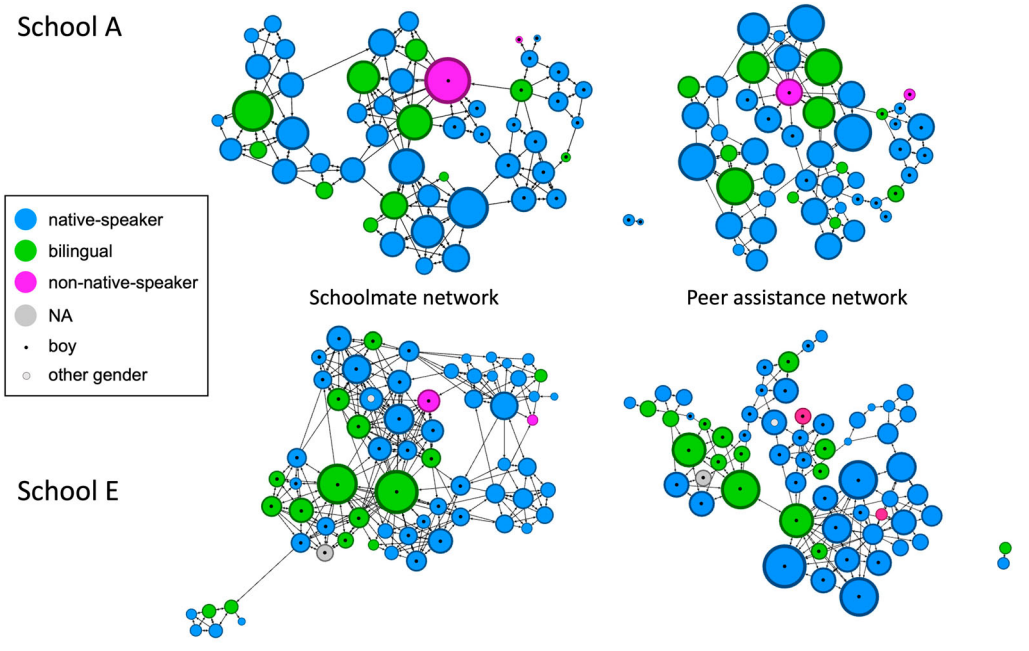

Figure 2. Pupils' social networks and language backgrounds. The nodes represent the pupils, the size represents the number of nominations made by other pupils, the lines between pupils represent ties, and the colors represent the pupils' language backgrounds. Strongly connected pupils are pulled together, and weakly connected pupils are pushed apart by the Force Atlas 2 algorithm of Gephi.

School E = 73%). The pupils with bilingual backgrounds were well connected to their native-speaker peers and a few non-native-speaker pupils. Many bilingual pupils had large social networks, including schoolmates from all language backgrounds, and they provided their peers with plenty of help with schoolwork. Emphasizing multiculturalism was one of School A's value principles. The visualization of School E suggests more cross-class connections between boys than between girls.

3.4. Levels of academic peer assistance in relation to pupils' gender, language background, and schoolmate networks

The fourth research question examined how pupils could be grouped based on their activity in academic peer assistance networks and how these groups were related to pupils' demographic backgrounds. We categorized the participants into three groups based on how often their peers named them helpers. In the first group, passive helpers ($n = 34$, 18.1%) did not get any nominations from their peers. In the second group, medium helpers ($n = 124$, 66.0%) got 1–3 nominations, and in the third group, active helpers ($n = 30$, 16.0%) helped at least four peers in academic matters. However, our research instrument did not allow us to examine the depth, frequency, or quality of the help received or provided, only the size of the network where peer assistance took place. After grouping the participants, we used cross-tabulations to examine how the clusters were related to gender and language background. The results showed no significant relationship between group membership and gender or language background. Of the passive, medium, and active helpers, 41.2%, 53.7%, and 44.8% were girls, respectively. Furthermore, of the passive, medium, and active helpers, 79.4%, 80.5%, and 83.3% were native-speakers, respectively, and the rest came from bilingual backgrounds, except for one passive helper who was a non-native-speaker and one medium helper whose language background was unknown.

Table 4. Factorial ANOVAs of the interrelation between academic peer assistance and networking.

Cluster	Gender				ANOVA[a]	
Schoolmate, reciprocal ties						
	Male		Female		Effect	*F*
	M	*SD*	*M*	*SD*		
Passive helpers	1.70	1.49	2.71	2.05	Academic peer assistance group	13.54***
Medium helpers	3.07	1.64	2.98	1.53	Gender	0.13
Active helpers	4.69	2.24	4.08	1.19	Academic peer assistance group x gender	2.07
Schoolmate, size of egocentric network						
	Male		Female		Effect	*F*
	M	*SD*	*M*	*SD*		
Passive helpers	4.35	3.12	5.29	1.94	Academic peer assistance group	10.61***
Medium helpers	6.65	3.14	4.92	2.04	Gender	4.58*
Active helpers	9.50	5.70	6.85	1.91	Academic peer assistance group x gender	3.37*

[a]Degree of freedom: reciprocal ties (2, 185), size of egocentric network (2, 185). *$p < 0.05$, ***$p < 0.001$.

To examine how the schoolmate networks of passive, medium, and active school helpers differed from each other, we performed a two-way ANOVA. As shown in Table 4, the number of reciprocal ties was only related to the academic peer assistance group, and there was no interaction effect between the groups and gender: The more pupils helped their peers with schoolwork, the more they had reciprocal ties to their schoolmates. With Scheffe's post hoc test, all group differences were statistically significant (passive vs. medium helpers $p < 0.05$, others $p < 0.001$). Moreover, the size of the egocentric network was related to academic peer assistance in that active helpers had bigger egocentric networks than medium and passive helpers, and boys had bigger networks than girls. The statistical differences were found between the active and passive helpers ($p < 0.001$) and the active and medium helpers ($p < 0.001$) by using Scheffe's test. In addition, there was also an interaction effect between these two factors: passive helper girls had bigger networks than medium helper girls and passive helper boys. These ANOVA results indicate that, on average, the active helpers had more schoolmates than their peers, who were less active in academic peer assistance networks.

The visual analysis of academic peer assistance (Figure 3) indicates that Schools A and E differed considerably. In School A, most of the pupils were identified as passive (15%) or medium (58%) helpers, and only two girls from the same class were identified as active helpers (4%). Most pupils

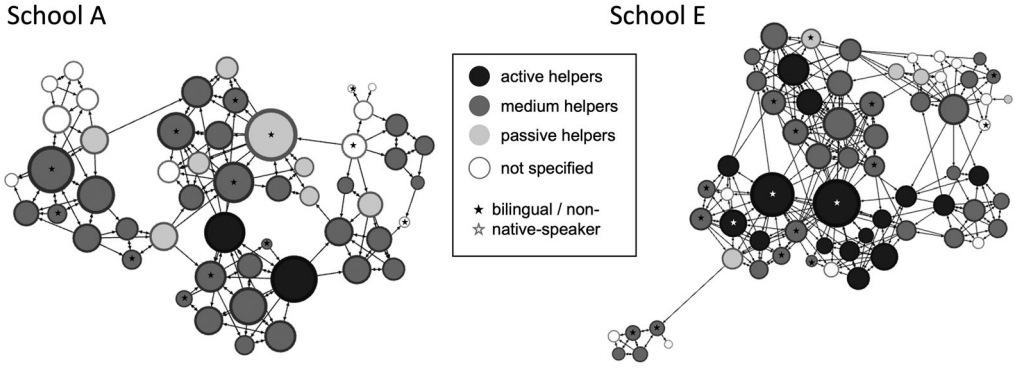

Figure 3. Visualizations of the schoolmate networks of Schools A and E, with different levels of academic peer assistance. The nodes represent the pupils, the size represents the number of nominations made by other pupils, and the lines between pupils represent ties. Active helpers are presented in dark grey, medium helpers in grey, and passive helpers in light grey. Strongly connected pupils are pulled together, and weakly connected pupils are pushed apart by the Force Atlas 2 algorithm of Gephi.

with bilingual and non-native-speaker backgrounds from School A were medium helpers, and none were identified as active helpers. In contrast, in School E, only five pupils (8%) were identified as passive helpers, but 52% of the pupils as medium helpers. Moreover, 24% of the pupils in School E were active helpers, which was the highest value among all the schools in our study. In School E, active helpers were distributed into four subgroups, including most active and medium helpers. Three pupils with bilingual or non-native-speaker backgrounds were identified as active helpers. School E emphasized multifaceted collaborative and participatory working methods (see Table 1, value principles), which appeared reflected in the number of active helpers.

3.5. Pupils' academic peer assistance activity in relation to SDP among fifth graders

To answer the fifth research question, we performed two-way ANOVA to examine how gender and academic peer assistance groups related to sociodigital competencies, the school's digital practices, digital learning orientation, and social networking (Table 5). Because online social networking was not related to gender in a statistically significant way and there was no interaction effect, interrelations between the groups and this measure were reported using one-way ANOVA. The boys self-reported higher academic digital competencies than girls, and the level of boys' academic digital competencies increased as a function of the academic peer assistance group. In the case of the girls, both medium and active helpers considered themselves more skillful than passive helpers, but medium helpers were slightly the most competent. However, with Scheffe's post hoc test, only the difference between the active and passive helpers groups was found to be significant ($p < 0.05$).

Table 5. Factorial ANOVAs of the interrelation between academic peer assistance and digital engagement and competences.

Cluster	Gender				ANOVA[a]	
Academic digital competences						
	Male		Female		Effect	*F*
	M	*SD*	*M*	*SD*		
Passive helpers	3.87	0.87	3.27	0.58	Academic peer assistance group	4.39*
Medium helpers	4.05	0.62	3.73	0.62	Gender	23.14***
Active helpers	4.43	0.42	3.64	0.55	Academic peer assistance group x gender	1.73
School's digital practices: Digital learning support						
	Male		Female		Effect	*F*
	M	*SD*	*M*	*SD*		
Passive helpers	3.25	1.18	2.76	0.88	Academic peer assistance group	5.14**
Medium helpers	3.37	1.11	3.75	1.10	Gender	1.50
Active helpers	4.24	1.13	3.58	1.06	Academic peer assistance group x gender	3.59*
Digital engagement						
	Male		Female		Effect	*F*
	M	*SD*	*M*	*SD*		
Passive helpers	3.50	1.04	3.23	0.94	Academic peer assistance group	3.35*
Medium helpers	3.92	0.86	3.42	0.78	Gender	11.61***
Active helpers	4.38	0.66	3.52	0.82	Academic peer assistance group x gender	0.85
Desire for digital schoolwork						
	Male		Female		Effect	*F*
	M	*SD*	*M*	*SD*		
Passive helpers	3.58	1.14	3.34	1.30	Academic peer assistance group	4.04*
Medium helpers	4.10	0.80	3.62	0.93	Gender	6.39*
Active helpers	4.52	0.92	3.85	1.14	Academic peer assistance group x gender	0.35

[a]Degree of freedom: academic digital competences (2, 172), digital learning support (2, 172), digital engagement (2, 171), desire for digital schoolwork (2, 171). *$p < 0.05$, **$p < 0.01$, ***$p < 0.001$.

Further, the active peer assistance group helpers reported engaging in more frequent digital learning at school than the passive group. An interaction effect between gender and the peer assistance group was revealed: boys reported using technology more often to support their school learning than girls, except in the medium helper group, where the girls reported higher scores than the boys and even the active helper girls. However, Scheffe's test identified a significant difference only between the active and passive helpers ($p < 0.01$). The active helpers appeared to be oriented toward digital learning and, therefore, were sensitive to the digital learning opportunities provided. Further, the two-way ANOVA revealed statistically significant differences regarding gender and academic peer assistance for digital engagement and the desire for digital schoolwork. In accordance with expectations, gender differences were strong. The boys reported higher digital engagement (e.g., enjoyment in solving challenging digital problems) and a stronger desire to use digital technologies in their schoolwork. Nevertheless, digital engagement and desire for digital schoolwork increased with the level of academic peer assistance. With Scheffe's post hoc test, significant differences were located between active and passive helpers ($p < 0.05$). Finally, the results showed that gender was not related to social networking. However, the active helpers ($M = 4.48$, $SD = 0.92$) reported using sociodigital technology for social networking more intensively than the medium helpers ($M = 4.20$, $SD = 1.30$) and passive helpers ($M = 3.48$, $SD = 1.34$; $F(2, 173) = 5.19$, $p < 0.01$). With Scheffe's test, the differences between passive and medium helpers and passive and active helpers were statistically significant ($p < 0.05$).

4. Discussion

We investigated fifth-grade pupils' ($N = 188$) schoolmate and academic peer assistance networks in five schools sampled according to an adequate response rate for the social networking questionnaire; the sample size was relatively small but adequate for analyses. The questionnaire relied on pupils' self-reports, and consequently, it was subject to social desirability effects. Nevertheless, the social networking data enabled us to use peer assessment (in-degrees) to validate subjective indications of their networking role socially. Furthermore, we did not have data about pedagogical and peer-learning variations among the schools that would have helped to explain the results. However, the qualitative data of the pupils' networking patterns enabled the visualization of these networks in relation to relevant demographic and explanatory (level of academic peer assistance) variables. The present investigation was anchored on the digitalization program of the city of Helsinki. The program invited volunteering schools to sign in for becoming "smart schools" committed to using digital technologies to transform their operational culture according to local pedagogic or organizational considerations (e.g., inclusion, portfolio pedagogy, or collaborative learning and teaching). This context shaped the present results and cannot be straightforwardly generalized across Finnish schools. To support school transformation, we were committed to providing each school with research feedback, including the social network data, per the research-practice partnership (Coburn & Penuel, 2016). The visual comparison between schools A and E illustrates the type of feedback provided for all the schools in joint research-practice workshops. Further, we also focused on comparing schools rather than separate classes because Finnish schools have a great deal of between-class cooperation, for instance, in co-teaching (Paju et al., 2022). Although investigations have revealed the so-called class-teacher effect regarding learning achievement (Nye et al., 2004) and pupils' social and behavioral skills (Jennings & DiPrete, 2010), no specific studies are available regarding the teacher effect on academic peer assistance. The results rely on selections made and could be different if the analytic unit had been individual classes (f = 12) rather than schools (5). Although the results cannot be transferred to Finnish schools in general, we maintain that the findings regarding academic peer assistance, based on social network data, are credible and provide valuable guidance for improving educational practices.

4.1. Summarizing the research results

The first research question examined fifth-grade pupils' social networks and structures among schools. We analyzed the pupils' schoolmates and academic peer assistance networks separately in each school. In accordance with our expectations, the analysis indicated that schoolmate networks were denser than academic peer assistance networks. However, many pupils helped each other with schoolwork. The results for the second research question indicated that the networks were less homophilic in relation to language background than gender. Especially in School A, but also in School E, the level of cultural homophily remained low. However, among the schools, there were notable differences in the homophily of schoolmates and academic peer assistance networks in relation to language background. The results further revealed that although boys had larger egocentric schoolmate networks than girls, there was, on average, a similar number (three) of reciprocal schoolmates. Moreover, we did not find gender differences regarding asking for and giving academic peer assistance. The fourth research question focused on grouping fifth-grade pupils according to their activity in academic peer assistance. By choosing meaningful threshold values, we distinguished passive ($n = 34$), medium ($n = 124$), and active ($n = 30$) helpers from one another. Both girls and boys were distributed relatively evenly to all these groups, and there was no relationship between the groups and pupils' language backgrounds. The high level of academic peer assistance was associated with larger schoolmate networks across reciprocal ties and the size of the egocentric network, indicating that the active helpers were overall better connected with their peers.

These results are also shown in the network visualizations of Schools A and E (Figures 1 and 2). Although the schoolmate networks of both schools were largely homophilic in terms of gender, academic peer assistance networks involved more cross-gender linkages. In particular, School A had many mixed-gender groups in its schoolmate and academic peer assistance networks. In the network visualizations, one can see that those pupils studying in the same class tended to be in close contact with others. Network visualizations indicated that language background did not lead to the social exclusion of pupils; many pupils with a bilingual language background had large social networks. There were slightly more intercultural connections in School A, where the school values emphasized multiculturalism. The level of academic peer assistance varied significantly among the schools. Most pupils were categorized as passive or medium helpers, and only two female pupils were active helpers (4%) in School A. In contrast, almost one-fourth of the pupils (24%) were active helpers in School E. Table 1 indicates that a partial explanation for the difference may be diverging school values. Although the values of School A highlighted multiculturalism, they did not address the pedagogic practices of learning and teaching. In contrast, the values of School E emphasized collaborative working methods and pedagogies, which manifested as a high level of academic peer assistance among pupils. Further, the results indicate that bilingual pupils were actively engaged in academic peer assistance, which would have vast potential for supporting a culture of peer learning.

The fifth research question addressed how pupils' activity in academic peer assistance related to their informal and formal SDP practices. The results confirmed our expectation that active sociodigital participants were more active in peer assistance networks. The active helpers used digital technologies more intensively at school for digital learning support. They were more engaged in interest-driven social networking with the medium helpers than the passive helpers across both genders. Only academic digital competencies were related to academic peer assistance and, similarly to many studies (e.g., Hakkarainen et al., 2000; Hietajärvi et al., 2020), boys self-assessed being digitally more skilled than girls. The active helpers of both genders expressed higher digital engagement with school and a desire for more digital schoolwork than the passive helpers did. Although the differences were associated with gender in a way that corresponded to earlier research (Hietajärvi et al., 2020), ANOVAs (see Table 5) revealed that the effect of the academic peer assistance group was significant in digital engagement and desire for digital schoolwork. These findings are intriguing and consistent with intensive social learning characterizing young people's digital culture (Gee & Hayes, 2011).

4.2. Toward systematic facilitation of academic peer assistance at school

The present investigation revealed that relatively young pupils are able to build academic peer assistance networks. The peer assistance networks analyzed may have spontaneously emerged, representing spillover effects of the pupils' informal peer learning culture (Gee & Hayes, 2011; Li et al., 2017). It is also possible that some of the schools have made deliberate efforts to build a social learning culture. The active helpers reported better academic digital competencies than the passive helpers, and they indicated a higher level of learning-supportive informal social networking. An encouraging finding was that academic peer assistance was not associated with gender; girls and boys were equally active school helpers. Furthermore, the results indicated that the pupils' language backgrounds did not shape their practices of academic peer assistance; neither native-speakers nor bilingual pupils took an active part in academic peer assistance. Moreover, academic peer assistance relations appeared to be reciprocal in terms of pupils mutually fostering each other's learning rather than some advantaged pupils helping others.

The visual analyses of Schools A and E revealed that although pupils' networks were structured according to their school class and gender-based homophily, the networks were usually relatively well integrated. The findings highlight the importance of deliberately fostering and establishing practices of academic peer assistance within schools and providing pupils with access to their vast social learning resources. Such efforts should focus on reshaping the values and operational culture of each school (macro-level), local curriculum and enacted classroom practices (meso-level), and pupils' and teachers' personal practices of collaborative working and studying (micro-level). To foster academic peer learning, teachers must understand its pedagogic value (focus), explore corresponding pedagogies in their teaching (fiddling), and build internal and external supporting social networks (friends, Frank et al., 2011). Simultaneously, educators should be aware of the potential downsides of academic peer assistance (Kessels & Steinmayr, 2013), such as using peer support to minimize one's learning efforts. Building a genuine peer-learning culture that engages pupils in persistent personal and collaborative problem-solving is critical. Studying complex phenomena for which no one in the classroom, including the teacher, has pre-given answers appears to be especially suitable for collaborative learning, knowledge sharing, and partial knowledge and understanding pooling. To these ends, the present investigators are organizing co-invention projects in schools to engage teams of pupils using digital fabrication and traditional technologies to design and make complex artifacts (Riikonen et al., 2020). Academic peer assistance is inseparable from such integrative science, technology, engineering, arts, and mathematics (STEAM) projects. When moving forward with network studies on academic peer assistance, it would be important to collect observation, process, and interview data on peer learning practices in schools. Feeding the network visualization back to teacher practitioners in accordance with research-practice partnership assists teachers in becoming more aware of their pupils' academic peer assistance networks and, thus, better able to make corresponding adjustments in their pedagogy and practice.

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Data availability statement

The datasets generated and/or analyzed during the current study are not publicly available due to the limitations of the research agreement but are available from the corresponding author on reasonable request.

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References

Anderson, D., Thomas, G. P., & Nashon, S. M. (2009). Social barriers to meaningful engagement in biology field trip group work. *Science Education*, *93*(3), 511–534. https://doi.org/10.1002/sce.20304

Bandura, A. (2006). Toward a psychology of human agency. *Perspectives on Psychological Science*, *1*(2), 164–180. https://doi.org/10.1111/j.1745-6916.2006.00011.x

Barron, B. (2003). When smart groups fail. *Journal of the Learning Sciences*, *12*(3), 307–359. https://doi.org/10.1207/S15327809JLS1203_1

Barron, B. (2004). Learning ecologies for technological fluency: Gender and experience differences. *Journal of Educational Computing Research*, *31*(1), 1–36. https://doi.org/10.2190/1N20-VV12-4RB5-33VA

Bastian, M., Heymann, S., & Jacomy, M. (2009). *Gephi: An open-source software for exploring and manipulating networks*. International AAAI Conference on Weblogs and Social Media.

Binkley, M., Erstad, O., Herman, J., Raizen, S., Ripley, M., Miller-Ricci, M., & Rumble, M. (2012). Defining twenty-first century skills. In P. Griffin, B. McGaw, & E. Care (Eds.), *Assessment and teaching of 21st century skills* (pp. 17–66). Springer.

Borgatti, S. P., Everett, M. G., & Johnson, J. C. (2013). *Analyzing social networks*. SAGE Publishing.

Brechwald, W. A., & Prinstein, M. J. (2011). Beyond homophily: A decade of advances in understanding peer influence processes. *Journal of Research on Adolescence*, *21*(1), 166–179. https://doi.org/10.1111/j.1532-7795.2010.00721.x

Coburn, C. E., & Penuel, W. R. (2016). Research–practice partnership in education: Outcomes, dynamics, and open questions. *Educational Researcher*, *45*(1), 48–54. https://doi.org/10.3102/0013189X16631750

Corneli, J., Danoff, C. J., Pierce, C., Ricaurte, P., & Snow MacDonald, L. (2016). *The pedagogy handbook* (3rd ed.). PubDomEd/Pierce Press. http://peeragogy.github.io/.

Duran, D., & Topping, K. (2017). *Learning by teaching*. Routledge.

Fortuin, J., van Geel, M., Ziberna, A., & Vedder, P. (2014). Ethnic preferences in friendships and casual contacts between majority and minority children in The Netherlands. *International Journal of Intercultural Relations*, *41*, 57–65. https://doi.org/10.1016/j.ijintrel.2014.05.005

Frank, K., Zhao, Y., Penuel, W., Ellefson, N., & Porter, S. (2011). Focus, fiddle, and friends: Experiences that transform knowledge. *Sociology of Education*, *84*(2), 137–156. https://doi.org/10.1177/0038040711401812

Gee, J. P., & Hayes, E. R. (2011). *Language and learning in the digital age*. Routledge.

Hakkarainen, K., Hietajärvi, L., Alho, K., Lonka, K., & Salmela-Aro, K. (2015). Socio-digital revolution: Digital natives vs digital immigrants. In J. D. Wright (Ed.), *International encyclopedia of the social and behavioral sciences* (2nd ed., Vol. 22, pp. 918–923). Elsevier.

Hakkarainen, K., Ilomäki, L., Lipponen, L., Muukkonen, H., Rahikainen, M., Tuominen, T., Lakkala, M., & Lehtinen, E. (2000). Students' skills and practices of using ICT: Results of a national assessment in Finland. *Computers & Education*, *34*(2), 103–117. https://doi.org/10.1016/S0360-1315(00)00007-5

Hietajärvi, L., Lonka, K., Hakkarainen, K., Alho, K., & Salmela-Aro, K. (2020). Are schools alienating digitally engaged students? Longitudinal relations between digital engagement and school engagement. *Frontline Learning Research*, *8*(1), 33–55. https://doi.org/10.14786/flr.v8i1.437

Hietajärvi, L., Seppä, J., & Hakkarainen, K. (2016). Dimensions of socio-digital participation. *QWERTY – Interdisciplinary Journal of Technology, Culture, and Education*, *11*(2), 79–98.

Ito, M., Baumer, S., Bittanti, M., Boyd, D., Cody, R., Herr-Stephenson, B., Horst, H. A., Lange, P. G., Mahendran, D., Martínez, K. Z., & Pascoe, C. J. (2010). *Hanging out, messing around, and geeking out*. MIT.

Ito, M., Gutiérrez, K., Livingstone, S., Penuel, B., Rhodes, J., Salen, K., Schor, J., Sefton-Green, J., & Watkins, S. C. (2013). *Connected learning: An agenda for research and design*. Digital Media and Learning Research Hub.

Jacomy, M., Heymann, S., Venturini, T., & Bastian, M. (2012). *Force Atlas 2, a graph layout algorithm for handy network visualization*. https://medialab.sciencespo.fr/publications/Jacomy_Heymann_Venturini-Force_Atlas2.pdf.

Jenkins, H., Clinton, R., Purushotma, R., Robinson, A. J., & Weigel, M. (2006). *Confronting the challenges of participatory culture*. MacArthur Foundation.

Jennings, J. L., & DiPrete, T. A. (2010). Teacher effects on social and behavioral skills in early elementary school. *Sociology of Education*, *83*(2), 135–159. https://doi.org/10.1177/0038040710368011

Jordan, M. E., & McDaniel, R. R. Jr. (2014). Managing uncertainty during collaborative problem solving in elementary school teams: The role of peer influence in robotics engineering activity. *Journal of the Learning Sciences*, *23* (4), 490–536. https://doi.org/10.1080/10508406.2014.896254

Karabenick, S. A., & Berger, J. L. (2013). Help-seeking as a self-regulated learning strategy. In H. Bembenutty, T. J. Cleary, & A. Kitsantas (Eds.), *Applications of self-regulated learning across diverse disciplines* (pp. 237–261). Information Age.

Kessels, U., & Steinmayr, R. (2013). Macho-man in school: Toward the role of gender role self-concepts and help seeking in school performance. *Learning and Individual Differences*, *23*, 234–240. https://doi.org/10.1016/j.lindif.2012.09.013

Korhonen, T., Tiippana, N., Laakso, N., Meriläinen, M., & Hakkarainen, K. (2020). *Growing mind: Sociodigital participation in and out of the school context. Students' experiences 2019*. University of Helsinki, Department of Education.

Li, S., Kiuru, N., Palonen, T., Salmela-Aro, K., & Hakkarainen, K. (2020). Peer selection and influence: Students' interest-driven socio-digital participation and friendship networks. *Frontline Learning Research*, *8*(4), 1–17. https://doi.org/10.14786/flr.v8i4.457

Li, S., Palonen, T., Lehtinen, E., & Hakkarainen, K. (2019). Face-to-face contacts, Facebook connections, and academic support: Adolescents' networks between and across gender and culture in Finland. *Youth*, *27*, 184–200.

Li, S., Palonen, T., Salmela-Aro, K., & Hakkarainen, K. (2017). Adolescents' social networks: Exploring different patterns of socio-digital participation. *Scandinavian Journal of Educational Research*, *61*(3), 255–274. https://doi.org/10.1080/00313831.2015.1120236

Liem, G. A. D., & Martin, A. J. (2011). Peer relationships and adolescents' academic and non-academic outcomes: Same-sex and opposite-sex peer effects and the mediating role of school engagement. *British Journal of Educational Psychology*, *81*(2), 183–206. https://doi.org/10.1111/j.2044-8279.2010.02013.x

Little, R. J. A. (1988). A test of missing completely at random for multivariate data with missing values. *Journal of the American Statistical Association*, *83*(404), 1198–1202. https://doi.org/10.1080/01621459.1988.10478722

Marchand, G., & Skinner, E. A. (2007). Motivational dynamics of children's academic help-seeking and concealment. *Journal of Educational Psychology*, *99*(1), 65–82. https://doi.org/10.1037/0022-0663.99.1.65

McPherson, M., Smith-Lovin, L., & Cook, J. M. (2001). Birds of a feather: Homophily in social networks. *Annual Review of Sociology*, *27*(1), 415–444. https://doi.org/10.1146/annurev.soc.27.1.415

Nye, B., Konstantopoulos, S., & Hedges, L. V. (2004). How large are teacher effects? *Educational Evaluation and Policy Analysis*, *26*(3), 237–257. https://doi.org/10.3102/01623737026003237

Olson, D., & Bruner, J. (1996). Folk psychology and folk pedagogy. In D. Olson, & N. Torrance (Eds.), *The handbook of education and human development* (pp. 9–27). Blackwell.

Packer, M., & Goicoechea, J. (2000). Sociocultural and constructivist theories of learning: Ontology, not just epistemology. *Educational Psychologist*, *35*(4), 227–241. https://doi.org/10.1207/S15326985EP3504_02

Paju, B., Kajamaa, A., Pirttimaa, R., & Kontu, E. (2022). Collaboration for inclusive practices: Teaching staff perspectives from Finland. *Scandinavian Journal of Educational Research*, *66*(3), 427–440. https://doi.org/10.1080/00313831.2020.1869087

Pavri, S., & Lufting, R. (2001). The social face of inclusive education: Are students with learning disabilities really included in the classroom? *Preventing School Failure: Alternative Education for Children and Youth*, *45*(1), 8–14. https://doi.org/10.1080/10459880109599808

Pijl, S. J., & Frostad, P. (2010). Peer acceptance and self-concept of students with disabilities in regular education. *European Journal of Special Needs Education*, *25*(1), 93–105. https://doi.org/10.1080/08856250903450947

Riikonen, S., Seitamaa-Hakkarainen, P., & Hakkarainen, K. (2020). Bringing maker practices to school: Tracing discursive and materially mediated aspects of student teams' collaborative making processes. *International Journal of Computer-Supported Collaborative Learning*, *15*(3), 319–349. https://doi.org/10.1007/s11412-020-09330-6

Ryan, A. M., Pintrich, P. R., & Midgley, C. (2001). Avoiding seeking help in the classroom: Who and why? *Educational Psychology Review*, *13*(2), 93–114. https://doi.org/10.1023/A:1009013420053

Sackstein, S. (2017). *Peer feedback in the classrooms. Association for Supervision and Curriculum Development*.

Sakerneh, M., & Nair, N. A. (2014). Effective teaching inclusive classroom: A literature review. *Journal of Education and Practice*, *5*(24), 28–35.

School District Office of Helsinki (Helsingin kaupungin opetusvirasto). (2016). *Helsingin kaupungin opetuksen digitalisaatio-ohjelma vuosille 2016–2019. Koulutuksen ja oppimisen digistrategia*. School District Office of Helsinki (Helsingin kaupungin opetusvirasto).

Schwab, S. (2019). Friendship stability among students with and without special educational needs. *Educational Studies*, *45*(3), 390–401. https://doi.org/10.1080/03055698.2018.1509774

Shin, H. (2018). The role of friends in help-seeking tendencies during early adolescence: Do classroom goal structures moderate selection and influence of friends? *Contemporary Educational Psychology*, *53*, 135–145. https://doi.org/10.1016/j.cedpsych.2018.03.002

Stanovich, P., Jordan, A., & Perot, J. (1998). Relative differences in academic self-concept and peer acceptance among students in inclusive classrooms. *Remedial and Special Education*, *19*(2), 120–126. https://doi.org/10.1177/074193259801900206

Torppa, M., Eklund, K., Sulkunen, S., Niemi, P., & Ahonen, T. (2018). Why do boys and girls perform differently on PISA Reading in Finland? The effects of Reading fluency, achievement behaviour, leisure Reading and homework activity. *Journal of Research in Reading*, *41*(1), 122–139. https://doi.org/10.1111/1467-9817.12103

Vaughn, S., Elbaum, B., & Schumm, J. S. (1996). The effects of inclusion on the social functioning of students with learning disabilities. *Journal of Learning Disabilities*, *29*(6), 599–608. https://doi.org/10.1177/002221949602900604

Whitmore, D. (2005). Resource and peer impacts on girls' academic achievement: Evidence from a randomized experiment. *American Economic Review*, *95*(2), 199–203. doi:10.1257/000282805774670158