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A large, stylized sunburst graphic in a lighter shade of purple, positioned on the left side of the cover. It has a central vertical stem and several curved, fan-like segments radiating outwards.

SOCIO-DIGITAL
PARTICIPATION, FRIENDSHIP
AND ACADEMIC SUPPORT
AMONG SIXTH TO NINTH
GRADERS IN FINLAND

Shupin Li



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**SOCIO-DIGITAL
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ABSTRACT

This dissertation examined how Finnish students' socio-digital participation (i.e. engagement and practices with social media and the Internet on mobile devices and computers) is related to their friendships and academic support among peers. In particular, the purposes were to study the similarity effects between gender and across cultural backgrounds in face-to-face, Facebook contact and peer academic support networks; to uncover the effects of peer selection and influence in the development of students' peer friendship networks and their socio-digital participation; and to explore the different profiles of socio-digital practices related to social networks. Participants were students from grades six to nine in southern Finland. The data were collected using a social networking questionnaire, a self-reported questionnaire and semi-structured interviews. The data analysis was conducted with social network analyses, comparison between groups and content analyses.

Study I examined gender and cultural similarities among adolescents (109 seventh to ninth graders) in patterns of networking (i.e. face-to-face, Facebook connections and peer academic support) at a multicultural Finnish school. *Study II* investigated the peer selection and influence effects of 100 seventh graders (at Time 1) over one year in terms of the intensity of socio-digital participation and friendship ties. *Study III* aimed to identify different participation profiles among 253 sixth to ninth graders in various socio-digital activities and to assess systematic differences in social networking relationships.

The results revealed that gender and cultural backgrounds are important factors in differentiating students' networking patterns. Female students were more inclined to use Facebook to connect with other female classmates, whereas males were equally likely to connect with either gender via Facebook. On the other hand, bicultural students were the most likely to network with their classmates in face-to-face connections and Facebook contacts. Further, friendship dynamics with peers played an important role in influencing intensity of students' interest-driven socio-digital practices to become similar with that of peers. Yet, students were not likely to select peers as friends based on similar intensity of interest-driven socio-digital participation. In terms of academic support with peer, no gender similarities were found in academic support networks, although female students were more apt to engage in academic support than their male counterparts. Bicultural students appeared to engage in academic support with peers from majority and minority cultures. In addition, students with different profiles of socio-digital practices (i.e. basic participators, gaming-oriented participators and creative participators) presented distinct patterns in social networks and digital competences. In particular, the reciprocal values in hanging out, liking and media multiplexity were highest for creative participators, whereas gaming-oriented participators were less socially active than their peers. The socio-digital expertise of creative participators was socially recognized by larger groups of peers than in the other groups. Based on these findings, schools should provide systematic and structural support for students in terms of digital competences and creative use of digital technologies. To that end, it would be crucial to engage digitally competent students to share their skills by tutoring to make use of peer influences in interest-driven digital practices.

KEYWORDS: socio-digital participation, friendship, peer effects, peer academic support, digital technologies, social network analysis

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Kasvatustieteiden tiedekunta, Opettajankoulutuslaitos

LI, SHUPIN: Sosiodigitaalinen osallistuminen, ystävyys ja akateeminen tuki
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TIIVISTELMÄ

Väitöskirjassa tarkasteltiin kuinka suomalaisten oppilaiden sosiodigitaalinen osallistuminen, ts. tietokoneilla ja mobiililaitteilla internetissä sekä sosiaalisessa mediassa tapahtuva toiminta, liittyy ikätovereiden välisiin ystävyysuhteisiin sekä kouluapuun. Tarkoituksena oli tutkia erityisesti sukupuolten ja kulttuuritaustojen välistä samankaltaistumista henkilökohtaisissa Facebook- ja kouluapuverkostoissa. Lisäksi tutkimus pyrki selvittämään vertaisiin kohdistuvan valinnan ja vertaisten vaikutuksen seurauksia heidän keskenään muodostamiinsa ystävyysverkostoihin sekä sosiodigitaaliseen osallistumiseen. Lopuksi tarkasteltiin erilaisia sosiaalisiiin verkostoihin liittyviä sosiodigitaalisen osallistumisen profiileja. Tutkimuksen osallistujat olivat 6. – 9. luokkien oppilaita Etelä-Suomesta. Aineisto kerättiin kyselylomakkeiden ja haastattelujen avulla. Tutkimuksen aineisto analysoitiin verkostoanalyysin, ryhmien keskinäisen vertailun ja sisällönanalyysin menetelmin.

Ensimmäisessä osatutkimuksessa tarkasteltiin sukupuoleen ja kulttuuriin liittyviä samankaltaisuuksia murrosikäisten nuorten (109 oppilasta 7. – 9. luokilta) kaveriverkostoissa, Facebookissa sekä kouluapuverkostoissa yhdessä monikulttuurisessa suomalaisessa koulussa. Toisessa osatutkimuksessa tutkittiin sadan seitsemäsluokkalaisten vertaisvalinnan ja -vaikutuksen seurauksia heidän sosiodigitaaliseen osallistumiseensa ja ystävyysuhteisiinsa. Kolmas osatutkimus tarkasteli oppilaiden erilaisia sosiodigitaalisen osallistumisen profiileja ja eroja oppilaiden sosiaalisissa verkostosuhteissa. Tutkimukseen osallistui 253 oppilasta 6 – 9 luokilta.

Tulokset osoittivat, että sukupuoli ja kulttuuritausta ovat tärkeitä tekijöitä oppilaiden verkostosuhteiden erilaistumisessa. Tytöt hakeutuivat useammin Facebookissa yhteen muiden tyttöjen kanssa, kun taas pojat olivat yhtä suurella todennäköisyydellä yhteydessä molempiin sukupuoliin. Toisaalta kaksikulttuuriset oppilaat verkostoituivat kaikkein todennäköisimmin erilaisia taustoja omaavien luokkatovereiden kanssa sekä henkilökohtaisten yhteyksien että Facebookin kontaktien kautta. Ikätovereiden kanssa solmittujen ystävyysuhteiden muutokset edistivät oppilaiden sosiodigitaalisten käytäntöjen muuttumista samankaltaisiksi kuin ikätovereilla. Oppilaat eivät kuitenkaan tyypillisesti valinneet ikätovereita ystävikseen sosiodigitaalisen osallistumisen samankaltaisuuden perusteella. Kouluapuverkostot eivät valikoituneet sukupuolten samankaltaisuuksien perusteella, vaikka tytöt olivatkin poikia sitoutuneempia kouluapuun. Kaksikulttuuriset opiskelijat osallistuivat kouluapuverkostoihin yhtä lailla sekä enemmistökuultureita että kansainvälisiä taustoja edustavien ikätovereidensa kanssa. Lisäksi erilaisen sosiodigitaalisen profiilin omaavat oppilaat (ts. perusosallistujat, pelaamisorientoituneet osallistujat ja luovat osallistujat) erottuivat toisistaan selvästi verkostosuhteissaan ja digitaalisissa kompetensseissa. Erityisesti vastavuoroiset suhteet hengailuverkostoissa, suosio vertaisten keskuudessa ja median päällekkäiskäyttö oli tyypillisintä luovilla osallistujilla, kun taas pelaamisorientoituneet osallistujat olivat sosiaalisesti vähemmän aktiivisia kuin ikätoverinsa. Luovien osallistujien sosiodigitaalinen osaaminen oli sosiaalisesti tunnustetumpaa ikätoverien keskuudessa kuin muilla ryhmillä. Tutkimusten tulosten pohjalta voidaan esittää, että koulujen tulisi tarjota systemaattista ja rakenteellista tukea digitaalisten kompetenssien ja digitaalisten teknologioiden luovaan käyttöön. Tätä varten olisi välttämätöntä osallistaa digitaalisesti taitavat oppilaat tutoroimaan toisia oppilaita. Näin voitaisiin hyödyntää nuorten vertaisvaikutusta digitaalisissa ympäristöissä.

AVAINSANAT: sosiodigitaalinen osallistuminen, ystävyysuhteet, vertaisvaikutus, kouluapu, digitaalinen teknologia, sosiaalinen verkostoanalyysi

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List of Original Publications

This doctoral dissertation is based on the following original publications, which are referenced in the texts by their Roman numerals.

- I 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. *Young*, 27(2), 184–200. doi: 10.1177/1103308818766773

Li contributed to the study's conception and design, data collection, analysis and interpretations and was responsible for writing the manuscript. Palonen contributed to the study's conception and design, data analysis and interpretation and revision of the manuscript. Lehtinen and Hakkarainen contributed to the study's conception and design and revision of the manuscript.

- II Li, S., Kiuru, N., Palonen, T., Salmela-Aro, K., & Hakkarainen, K. (in review). Peer selection and influence: Students' interest-driven socio-digital participation and friendship networks.

Li contributed to the study's conception and design, data collection, analysis and interpretations and was responsible for writing the manuscript. Kiuru contributed to the data analysis and revision of the manuscript. Palonen and Salmela-Aro contributed to the revision of the manuscript. Hakkarainen contributed to the study's conception, data collection and revision of the manuscript.

- III Li, S., Hietajärvi, L., 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. doi: 10.1080/00313831.2015.1120236

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“Humans are ‘co-evolving’ with their phones to become a new species”.
Sherry Turkle (2015, p. 32)

1 Introduction

The purpose of this dissertation was to examine how young Finnish people’s socio-digital participation (i.e. engagement with and practices using social media and the Internet on mobile devices and computers; see Hakkarainen, Hietajärvi, Alho, Lonka, & Salmela-Aro, 2015) is related to their face-to-face and social media networks and academic support among peers. In this section, I will first introduce the background of the study. After that, theoretical concepts related to the dissertation will be elaborated upon to assist readers in theoretically anchoring this work to previous research.

Young students are spending an increasing amount of time in a technological world in which they are likely to be always connected online. In 1999, for instance, young people in the United States between the ages of 8 and 18 spent, on average, 7.29 hours per day using media. By 2010, the typical American youth spent almost 11 hours each day with some form of media (Rideout, Ulla, & Donald, 2010). More recently, research showed that 63% of adolescents use digital technologies (e.g. integrated systems of smartphones, computers and the Internet) once or several times a day to connect with their friends and family members (Madden, Lenhart, Duggan, Cortesi, & Gasser, 2013), while 95% of American adolescents have access to smartphones, and 45% of them reported being online “almost constantly” in 2018 (Anderson & Jiang, 2018). In Finland, almost two decades ago, only a quarter of upper elementary school students reported using computers every day (Hakkarainen et al., 2000). More recently, Finnish adolescents reported having intensive digital contact with their friends several times a day or having a continuous connection (e.g. 61.2% of elementary school sixth graders reported chatting at least daily, and 36.6% did so several times a day or “all the time”, while almost half [48.8%] reported using social media at least daily, and 23.8% did so several times a day or “all the time”) (Hietajärvi, Seppä, & Hakkarainen, 2016). The phenomenon of the youth digitalization has been changing dramatically in the past few years in terms of young people engaging in digital practices more intensively than ever before. Beyond connecting with friends, some young people participate in digital practices to pursue their interests (e.g. play video games, collaborate with peers on schoolwork) by searching for information on the Internet and asking peers to assist them online.

Some young people engage in even deeper creative pursuits of knowledge mediated by digital technologies (e.g. creating media artefacts). Such different levels of engagement profoundly reflect the complexity of socio-digital participation (Hietajärvi, Salmela-Aro, Tuominen, Hakkarainen, Lonka, 2019; Ito et al., 2010).

Finland is one of the most advanced countries with respect to the ability to boost competitiveness and well-being using digital technologies, and it ranked second out of 143 countries in 2015 and second out of 139 countries in 2016 on the Networked Readiness Index (Baller, Dutta, & Lanvin, 2016), which refers to the tendency of countries to investigate opportunities provided by digital technologies. Moreover, access to digital technologies is nearly universal in Finland (Niemi, Kynäslähti, & Vahtivuori-Hänninen, 2013). In spite of advanced technological infrastructures and almost equal availability of access to digital technologies, learning and instruction mediated by digital technologies is not intensively practiced in Finnish classrooms (Bulut & Cutumisu, 2018).

Digitalization in education includes digitalized instruction and digitalized learning. Finnish schools are free to develop their own local curriculum and pedagogical practices within national frameworks. Therefore, differences arise among schools, and they utilize digital technologies within their own practices of learning and instruction (Niemi et al., 2013). According to a comparative study of teachers' instruction with digital technologies across Finland, Denmark and Norway (Ottestad, 2010), most teachers applied digital technologies in their teaching practice only during confined periods of time and not on a daily basis. Finnish teachers reported little use of digital technologies in their instructions (Bulut & Cutumisu, 2018). Studies also show that most of the teachers lack the background knowledge (e.g. programming, issues related to privacy) that are needed with the increased digitalization of education (Mannila, 2018).

In an earlier study including over 500 Finnish students (11–18 years old), Hakkarainen and colleagues (2000) found that students' use of digital technologies at home had a strong influence on their overall technology use. Investigations further revealed that low use at school and high use during leisure time characterized Finnish secondary school students from 1999 to 2004 (Ilomäki, 2011). These results were derived from data that were collected approximately 20 years ago. More recently, sixth graders in the Helsinki area reported that the educational use of digital technologies in school was not sufficient for them to engage in learning (Halonen, Hietajärvi, Lonka, & Salmela-Aro, 2017). As such, there appears to be a gap between students' daily socio-digital participation and the typical educational practices in schools (Kupiainen, 2013).

Prior research has showed that students' academic achievements tended to be positively associated with computer use at home but negatively associated with computer use at school in most OECD countries, including Finland (Petko, Cantieni,

& Prasse, 2017). Particularly in Finland, students who liked to use digital technologies to pursue their interests by learning in virtual communities out of school appeared to disengage in traditional school both cross-sectionally and longitudinally (Hietajärvi, Salmela-Aro, Hakkarainen, & Lonka, submitted). During leisure time outside of school, different intensities of engagement in digital practices have brought students numerous opportunities for informal learning; young people collaboratively learn to develop their interests (e.g. support schoolwork, play games, create media) with digital technologies by sharing, discussing and tutoring. Qualitatively, the educational use of digital technologies is considered to be meaningful and motivating by students of both genders from ages 11 to 18 (Mylläri et al., 2011). The educational motivation for the present dissertation was to deepen the understanding of students' informal use of digital technologies so that schools can fill the gap between students' informal socio-digital participation and educational practices of schools by connecting young people's digital practices in school to their informal learning activities mediated by digital technologies.

In addition to the educational motivation mentioned above, the present dissertation was also motivated by the social aspects of socio-digital participation (Hakkarainen et al., 2015), which have only scarcely been previously studied. In a rapidly digitalizing world, digital technologies have facilitated young students having seamless connections with others, both individually and collaboratively. Such connections entail young people's social networks being different from those of older generations. That is, young people utilize different digital technologies to keep in constant contact with others whom they meet face-to-face and/or whom they only meet online (i.e. never face-to-face). Moreover, students are able to collaborate with peers to play games, support each other's schoolwork, discuss interests and/or collaborate on the creation of artefacts (e.g. photos, videos). Students' various types of socio-digital participation mentioned here involve social interaction with peers, parents, teachers and others. This dissertation focused on students' friendships with peers and peer academic support because young students spend greater amounts of time with their peers (Steinberg, 2005; Subrahmanyam & Greenfield, 2008), and learning is a major practice for students.

Digital technologies can be considered as crucial mediating tools in cognitive and social development. Various digital divides are found among Finnish students in terms of, for instance, the intensity and complexity of digital technology use (Hietajärvi et al., 2016), building of digital competences (Kaarainen, Kivinen, & Vainio, 2017) and engaging in digital practices during both school and leisure time (Niemi et al., 2013). Different levels of socio-digital participation may elicit and develop different sets of competences. For instance, keeping contact with peers on social media appears to be generally simple for adolescents. Editing photos requires corresponding digital graphic skills while creating games needs particular digital

competences in audio, 3D graphic design and programming skills. Thus, such unidentical levels of socio-digital participation may influence learning and networking as well as development (Subrahmanyam & Greenfield, 2011). This doctoral dissertation aimed to systematically examine how young students' socio-digital activities are related to their friendship networks and to peer academic support in Finland.

1.1 Three qualitative genres of students' socio-digital participation

The recently emerging integrated systems of mobile devices, computers, social media and the Internet enable constant and hyper-intensive online interaction and social sharing of all kinds of activities (Rheingold, 2012; Shirky, 2010). Socio-digital practices (i.e. engagement mediated by digital technologies) appear to have transformed how adolescents live their lives, as well as how they socially relate to one another and the world around them (Vasbø, Silseth, & Erstad, 2014). Socio-digital practices have blurred the boundaries between presence and absence, time and space of interaction, personal and mass communication, private and public, and the virtual and real worlds (Baym & boyd, 2012).

The parallel use of socio-digital technologies has been called media multiplexity (Haythornthwaite, 2005), which is using multiple media modalities for keeping up with virtual and face-to-face social connections. The concept of media multiplexity was, however, proposed at a time when parallel media use was not yet a common phenomenon. And social contacts that are maintained by a single medium (e.g. face-to-face interaction) are understood to be "thinner" (Haythornthwaite, 2005) than relationships that are connected by multiple media (e.g. face-to-face and text-based or audio/video based). With interaction via multiple media, including face-to-face interaction and communication mediated by technologies, virtual activities endlessly reshape what occurs in a face-to-face context (Baym & boyd, 2012).

Because Internet know-how is not randomly distributed among the population of adolescents in Finland (Hakkarainen et al., 2015), students utilize digital technologies with unequal intensity and levels of complexity. Most of them participate in shallow practices with digital technologies. For instance, they follow peers' updates on social media, listen to music and watch videos for recreation. Different levels of intensity and complexity in socio-digital participation can be distinguished, ranging from mere observation and follow-up to collective participation in creating media (Gee & Hayes, 2011; Ito et al., 2010; Jenkins et al., 2009).

Ito and colleagues (2010) conducted a year-long ethnographic investigation of 12- to 19-year-old adolescents' engagement with socio-digital practices and

distinguished three genres of participation: 1) friendship-driven use of digital technologies for “hanging out” with counterparts; 2) interest-driven “messaging around” with digital technologies to engage in learning and complex problem-solving, and 3) “geeking out” for seriously cultivating expertise related to digital technologies or creatively working with media. Adolescents’ practices around socio-digital participation are heterogeneous to the extent that these activities may simultaneously encompass features of all three genres. That is, there are no clear boundaries between the genres. Rather, young people “move fluidly” (Jenkins et al., 2015) between different genres of participation. It is not about categorizing individual students into fixed buckets but about recognizing the palette of availabilities that the phenomena show (Ito et al., 2010). Not every genre of socio-digital participation is accessible to every student, and not every genre of socio-digital participation is valued identically by all schools and teachers; some are counted as informal learning, while others are dismissed as a waste of time.

The basic assumption of adolescents being driven by either friendship- or interest-related aspects resonates strongly with the results of previous studies (e.g. Eynon & Malmberg, 2011; Kennedy, Judd, Dalgarno, & Waycott, 2010; van den Beemt, Akkerman, & Simons, 2011) that have addressed the variation in adolescents’ digital technology-mediated practices. A key finding is that the largest group of adolescents engages mostly in friendship-driven activities (e.g. chatting with friends) mediated by socio-digital technologies, whereas only a relatively small minority frequently participate in more demanding, creative activities via socio-digital participation (e.g. improving programming skills through intensive participation mediated by socio-digital technologies) (Ito et al., 2010). Mobile devices allow them to be “always on” (Baron, 2008) through intensive texting, instant messaging, emailing, lurking and commenting on their friends’ activities through social media. Young people find ways of maintaining their connections and will update their status numerous times per day, even when separated from one another temporally (e.g. in evenings) or spatially (e.g. being out of their neighbourhood when visiting relatives). Young people spend many hours practicing their skills and building up knowledge to pursue their own interests. School is, traditionally, a place where students can find like-minded peers and a community where they can share ideas, skills and knowledge (Kupiainen, 2013). Ubiquitous use of digital technologies expansively provides sophisticated “affinity spaces” (Gee, 2005), where young people express themselves, have discussions, collaborate and tutor one another (Evans, Won, & Drape, 2014) in pursuing their shared interests. And the minority of students who “geek out” beyond interests (Ito et al., 2010) engage in creative practices that lead to further academic and/or career opportunities.

It is noteworthy that excessive socio-digital participation may bring school burnout that can later lead to depressive symptoms among Finnish early adolescents

(Salmela-Aro, Upadyaya, Hakkarainen, Lonka, & Alho, 2017). Problematic socio-digital participation also negatively affects subjective well-beings (Stead & Bibby, 2017) and personality traits (Kircaburun & Griffiths, 2018). Thus, it is suggested to recognize both opportunities and challenges that socio-digital technologies may bring to young people.

1.2 Learning ecology and connected learning related to socio-digital participation

Adolescents' interactions with peers and their socio-digital participation are essential parts of their lives (Hakkarainen et al., 2015). In order to examine how digitalization has changed the environment of young people's cognitive socialization, this dissertation relied on the ecological framework of human development (Bronfenbrenner, 1994). The complete ecological framework of adolescent development of social and digital practices consists of individuals (with attributes of gender, cultural background and digital competence), four interacting subsystems ranging from micro to macro levels and a chronosystem that extends the four subsystems into the dimension of time (see Figure 1; Salmela-Aro & Lonka, 2016). The evolution of digital technologies is rapidly transforming the macro structure and exosystems of adolescent socialization. Such dynamic social contexts of development are likely to change the dynamics of microsystems mediated by emerging offline and online participation and interpersonal social relations. When adolescents have been participating in digital practices from a very young age in the extended social and cultural environment of the Internet and with distinct levels of intensity and complexity, relations from micro to macro spheres probably change. Young people's learning and development are not identically related to the effects of digitalization. Rather, they are mediated by a proximal interaction, a mesosystem (i.e. socio-digital participation) involving personal and social practices in using digital technologies. Because social interactions and socio-digital technology uses by adolescents are dynamic, longitudinal information about their patterns of digital technology use and the associated social relations with peers are required to understand the phenomenon studied in this dissertation.

The learning ecology (Barron, 2004), in particular, narrows down Bronfenbrenner's (1994) ecological framework of human development to an educational point of view. Adolescents' socio-digital participation is both constrained and facilitated by individual motivations, competences and expectations for technologies that react to and engage with the wider contexts of which they are a part. Context, in this sense, means many things: people (e.g. friends, parents and teachers), settings (e.g. school, home, friends' places, in transportation) and resources (e.g. the quality of Internet connection) (Eynon & Malmber, 2011). There

are numerous learning opportunities that may occur as a result of these interactions between the individual, their context and their socio-digital participation, including learning new things as a result of seeking needed information (Rieh, 2004), interacting and communicating on social media (Ross, 2007) and creating media content (Rollett, Lux, Strohmaier, Dösinger, & Tochtermann, 2007). This explicitly represents the learning ecology theory that learning extends across various social networks and tools, spatially and temporally situated in the interaction processes between the learners and their social ecologies (Nardi & O’Day, 2000).

Participation in a learning ecology is being socially connected, and learning is highly relational in nature (Ito et al., 2013). The concept of “connected learning” (Ito et al., 2013) is useful for understanding how ubiquitous use of digital technologies are sophisticatedly able to integrate informal and formal learning activities and processes. In particular, connected learning integrates three contexts for learning: peer-supported, interest-driven and academically oriented contexts. For instance, programmes of game jams that are organized in different geographic areas globally throughout the year enable the bringing together of young people who are passionate about making games to support one another in creating a new game, often over a weekend. Such peer-supported collaboration enables young people to utilize skills acquired in formal and/or informal learning contexts. In turn, interest-driven learning practices elicit the inspiration to learn related competences in school. When young people pursue passionate personal interests (Gee & Hayes, 2011) with the support of peers and caring adults, it allows for connected learning to link those interests related

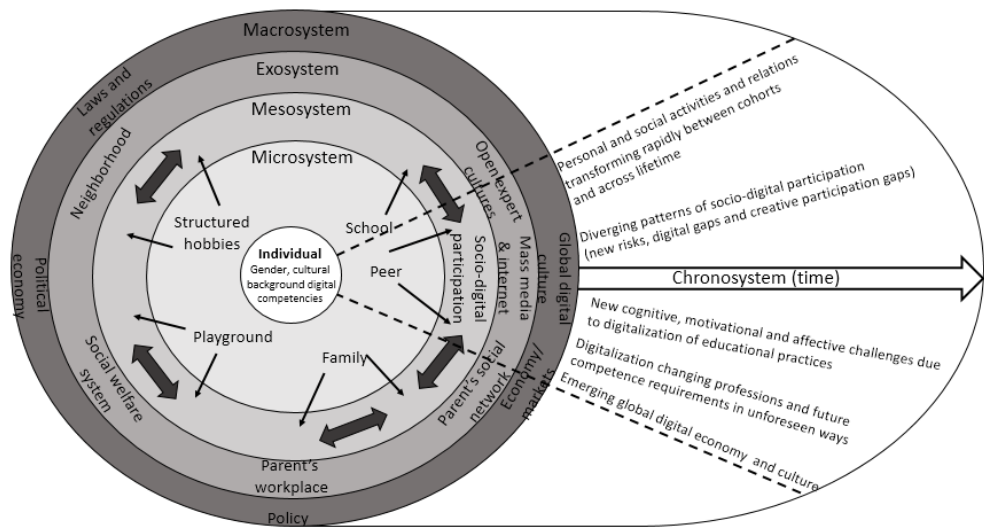


Figure 1. Transformed ecology of human development in digitalization (Salmela-Aro & Lonka, 2016)

to learning to empower academic achievement and even career possibilities (Pata, Lehtinen, & Sarapuu, 2006; Pata, Sarapuu & Lehtinen, 2005). In connected learning, digital technologies are able to 1) offer various forms of interaction and networking, 2) provide easier access to knowledge and the sharing of experience, 3) provide social support for learning through online communities and social media, and 4) offer links to more diverse knowledge and expertise for learning opportunities (Ito et al., 2013). Different environments can lead adolescents to connected learning, for example, schools, after-school clubs, home and among relatives. Peers, teachers, parents and others in diverse locations can potentially guide young people to connected learning, where they share interests with their peers, schools recognize and organize interest-driven and peer-driven learning practices related to schoolwork and when parents notice, encourage and provide resources. Examples of connected learning integrating interests, peers and educational pursuits include interest-driven educational programs (e.g. Innokas Network to promote students' digital competences, Korhonen & Lavonen, 2017).

These connected learning environments are characterized by a sense of shared purpose, a productive focus and networks with peers that successfully embed participation and social support (Ito et al., 2013). Socio-digital technologies offer profound new approaches for young people to access connected learning that links informal and formal learning. The epicentres of connected learning environments are “affinity spaces”, or “communities of practice” (Gee, 2005) and expertise, that involve high levels of shared useful information and collective knowledge creation through peer interaction and open accessibility for new learners. Socio-digital participation thus profoundly links informal and formal learning domains (Pacheco, 2012) in a spherical connected learning environment that is characterized by feedback loops between the pursuit of individual learning and knowledge creation in a collective climate. In particular, socio-digital participation broadens access to connected learning environments by offering opportunities for adolescents to connect their social or recreational learning to academic subjects and pathways. A recent meta-analysis (Huang, 2018) based on 30 empirical studies found that the length of time young people spent on Facebook was slightly negatively correlated with their academic performance. Thus, as Ito and colleagues (2013) argue, connected learning environments may be able to bridge the gap between formal and informal learning so that students' digital practices might be more positive with their academic outcomes. Although I did not focus primarily on socio-digital participation in formal learning contexts, this doctoral dissertation offers a novel understanding of adolescents' informal socio-digital participation that educators can use for current digitalization reform efforts in Finnish schools.

1.3 Social networks related to socio-digital participation

In this section, I will introduce social network perspectives in general and several key network theories in particular (i.e. the homophily principle, social contagion, peer selection and peer influence) in order to systematically characterize the structure of cross-sectional and developmental networks with peers in socio-digital participation.

Social networks are relational in nature. Traditionally, young people were likely to socialize with peers during school and interact with neighbourhood friends outside of school. Socio-digital participation allows young people to expand their social connections and practices beyond the limitations of geography (i.e. connecting with people globally) and age (i.e. socializing with people younger or older than themselves). In this way, the social environment of young people's everyday activities has transformed; digital practices lead young people to become networked individuals (with extended possibilities for heterogeneous activities) rather than socially modelling only their immediate community (Rainie & Wellman, 2012). Partially due to the digital revolution, we have entered an era of personal social networks (Nardi, Whittaker, & Schwarz, 2002) that play an important role in the development of youth.

Vygotsky (1978) proposed at the end of the 20th century that cognitive development occurs in a social context mediated by the tools (e.g. socio-digital technologies in the current society) provided by the community and culture. Rheingold (2012) argued that the recent development of socio-digital technologies enables people who do not know one another personally to function as a community. For instance, people suffering a chronic disease may start sharing their experiences (e.g. PatientsLikeMe; Shirky, 2010). Similarly, young people interested in particular issues may start functioning as a "passionate interest group" (Gee & Hayes, 2011), sharing their experiences, building expertise and interconnecting participants across networked links. Such informal communities have very loose patterns of participation with varying intensity and complexity, yet such development may change the environment of young people's cognitive socialization. Socio-digital participation can be viewed as a network phenomenon that covers the totality of social relationships and resources that individuals have in their personal social networks.

The homophily principle, or similarity, refers to the tendency of social connections "to form between those who are alike" (Lazarsfeld & Merton, 1954, p. 23) and is generally considered to be one of the most important attribute-based criteria that lead people's networking practices. Such attributes include similar demographic profiles (e.g. gender) and behaviours (e.g. shared interests). A large body of research (e.g. Pearson, Steglich, & Snijders 2006; Smith, van Tubergen,

Maas, & McFarland, 2016) claims that gender and cultural background are significant determinants for the formation of social networking relations within traditional multicultural environments, such as North America. Yet, such segregation of gender and cultural backgrounds is, to some extent, likely to hinder the possible expansion to other social networks.

Previous research has reported mixed results in terms of gender similarity in adolescents' online connections. Some (e.g. Mesch & Talmud, 2007) found that young people are likely to socialize with same-gender peers on social media, following the line of similarity. However, with 2,567 cross-national participants, Thelwall (2009) showed that female students were more likely to be connected to peers of both genders on social media. In terms of cultural background, socio-digital participation is relevant to the cultural composition of school peer groups (Niemi et al., 2013). Cultural similarity has also proven to be an important factor in community contexts such as classrooms (Fortuin, van Geel, Zibera, & Vedder 2014). Mazur and Richards (2011) studied the MySpace profiles of 16- to 19-year-old adolescents in the United States and found that most online interactions involved people with the same cultural background. Conversely, in the face-to-face context, Bagci and colleagues (2014) showed that cross-cultural peer relations were more common than same-culture friendship connections among 684 students at grade seven (typically 11-year-olds) in the Greater London area. This finding is not in accordance with earlier findings that confirmed the similarity principle. Patterns of networking within the educational practice of the classroom matter to a great extent because interactions with peers who engage in school motivate students to become more actively engaged in academic activities (Juvonen, Espinoza, & Knifsend, 2012).

In order to deepen the understanding of cultural similarity within a Finnish educational perspective, I also examined cultural similarity in this dissertation. Traditionally, Finland has culturally been a rather homogeneous society. In spite of the fact that the population with foreign backgrounds has grown rapidly (Statistics Finland, 2016), multicultural issues in terms of an educational policy are still young (Ojala, 2010; Tani, Houtsonen, & Särkelä, 2018). There is a need to improve knowledge about social interactions in multicultural classrooms so that the perspectives of immigrant students, their parents and their families can be better taken into account. Multiculturalism in Finland is distinct from traditional immigrant societies (e.g. North American countries) in which populations with foreign backgrounds (i.e. minority cultures) have not yet segregated into distinct cultural communities with the same cultural identity. In my dissertation, students were categorized into three cultural groups based on where their parents were born (Fortuin et al., 2014): 1) majority-cultural students (both of the parents were born in Finland), 2) bicultural students (one of the parents was born in Finland) and 3)

minority-cultural students (neither parent was born in Finland). Such categories are likely to reflect the current Finnish multicultural context.

Students usually seek assistance from their peers, rather than teachers, when they encounter the inevitable difficulties of learning (Lempers & Clark-Lempers, 1992). Because they are studying the same themes and have recently gone through similar learning processes and various challenges, peers may offer the most valuable academic support (Altermatt, 2007). From a theoretical perspective, Mäkitalo-Siegl and Fischer (2013) illustrated that academic support among peers is a crucial self- and co-regulatory strategy for students in tackling learning difficulties. The significance of academic support among peers has also been highlighted in the resiliency literature (Garnezy, 1991). Young people discuss their learning challenges with their counterparts to collectively create solutions. In this regard, socio-digital participation seems to provide numerous opportunities for young people to efficiently collaborate towards overcoming such learning obstacles in a virtual space, without temporal and spatial limitations. In fact, social media and certain online learning environments were introduced for use in formal learning contexts. Obtaining support from peers for schoolwork both face-to-face and through digital technologies allows students to receive valuable information and cultivate sophisticated competences, strengthening their learning (Jelas, Azman, Zulnaidi, & Ahmad, 2016).

In terms of cultural background, young people with foreign backgrounds in the OECD countries are not likely to exhibit identical academic performances in school as their native-born counterparts (Hirschman, 2016). In the Finnish context, there is a gap between majority- and minority-cultural students, who report more cynicism about and exhaustion with their schooling than their native Finnish peers (Salmela-Aro, Read, Minkkinen, Kinnunen, & Rimpelä, 2017). Minority-cultural students are also more likely to encounter various cultural and linguistic challenges or obstacles related to their school studies. For instance, minority-cultural students generally need to spend some time becoming accustomed to the local curriculum, which is usually different from that in their native country. In addition, understanding teachers' implicit interpretations during instruction might be more difficult for minority-cultural students than for native peers.

A study conducted in Denmark indicated that cultural barriers experienced by minority-cultural students were likely to result in serious literacy-related challenges (Drotner & Kobbernagel, 2014). On the other hand, having grown up locally seems to offer cultural resources to majority-cultural students that enable them to interpret these implicit issues in the learning environment and negotiate relevant challenges. Therefore, in this respect, minority-cultural students seem to require more assistance with schoolwork than their peers, particularly with cultural interpretations of study materials, learning assignments and teacher expectations. Previous research has

further indicated that peers may offer important academic support for minority-cultural students (e.g. Fuligni, 1997). Thus, while not in line with similarity theory, I expected that minority-cultural students would engage with majority-cultural peers in social interactions for academic support because the latter would be more likely to efficiently offer assistance in tackling cultural educational challenges.

Social contagion has been considered a significant theory in developmental social networks, especially among adolescents. Adolescence is a dynamic period that is characterized by the strong motivation to fit in with peer groups (Hamm, Farmer, Lambert, & Gravelle, 2014). Studies have claimed that young peoples' behaviours and attitudes are likely to become markedly similar to the behaviours and attitudes of their peer group due to the effects of social contagion (see the recent review on social contagion by Christakis & Fowler, 2013). According to the homophily principle, people often interact with others who have similar behaviours (e.g. similar interests) and characteristics (e.g. gender, cultural background) as their own (Lozares et al., 2013; McPherson, Smith-Lovin, & Cook, 2001). Therefore, social networks are often homogeneous at the individual level and heterogeneous at the group level. Extending the earlier theory of the homophily principle, social contagion theory indicates that the similarities between young people and their friends are based on tendencies to affiliate with peers who behave similarly or have like-minded attitudes. This is also called the selection effect. In turn, the behaviours of adolescents in the peer group might become more similar over time, which is referred to as the influence effect (Brechwald & Prinstein, 2011). This influence does not occur only through imitation but also through the effects of social comparison and behaviour approximation. Recent research on peer influence has highlighted the association of dynamics and reciprocity with selection and influence in adolescent peer relations. In essence, social contagion theory underscores that young people increasingly invest in their peer group as a primary source of social support. Simultaneously, young people utilize feedback and acceptance from their peers in attempting to achieve a sense of identity. Adolescents are, therefore, likely to engage in practices that 1) are associated with high status in their peer group, 2) attempt to match the peer group's social norms relating to values and desires, 3) lead to extrinsic reinforcement of behaviour in the peer group, and 4) contribute to an intrinsic sense of a favourable identity as mirrored by the peer group (Brechwald & Prinstein, 2011).

Digital technologies have provided numerous opportunities for adolescents to virtually follow up and interact with their counterparts, from the sharing of experiences using multimedia (e.g. with photos and videos) to pursuing shared interests and hobbies and working on school projects. Adolescents' socio-digital participation occurs in a dynamic social sphere where actions are often immediately visible to counterparts (Hakkarainen et al., 2015; Rheingold, 2012; Shirky, 2010). This offers rich opportunities for social contagion of practices among peers. In most

cases, digital activities are social in nature, motivating peers' engagement through, for instance, social media and pursuing the same interests. Thus, the intensity and purpose of adolescents' practices when utilizing digital technologies are likely to be associated with their friendship networks. Based on homophily theory (McPherson et al., 2001), peer groups might also be similar in their socio-digital participation, and both selection effects and influence effects derive from the principle of homophily. Selection occurs when adolescents choose to affiliate with peer groups who engage in similar levels of digital practices. Conversely, influence effects occur when peer groups exert contagion on an individual member's level of engagement with digital activities, resulting in increasingly similar practices in the use of digital devices. It is suggested that selection and influence effects be estimated simultaneously in behavioural and network dynamics (Steglich, Snijders, & Pearson, 2010) because the selection and influence processes are likely to occur complementarily (Svensson, Burk, Stattin, & Kerr, 2012).

2 Research questions

Socio-digital technologies play a highly dominant role in young people's lives. There are, however, controversial findings and interpretations of how the digitalized environment influences social development and learning. For instance, online video games appear to be a virtual playground for young players to experience the cognitive and social benefits of gaming (Granic, Lobel, & Engels, 2014). In contrast, some gamers spend more time than their peers on online video games, leading to a decline in the quantity and quality of offline social interactions (Hussain & Griffiths, 2009a). To better understand the role and opportunities of social networks related to socio-digital technologies for adolescent life and schooling, the aim of this dissertation was to examine the relationship between Finnish comprehensive school students' socio-digital participation and their peer relations as well as their peer academic support. The purpose was approached through the following research questions:

- 1) How much similarity of gender and cultural background occurring in a student's cross-sectional friendship network is related to their socio-digital participation? Do peer selection and influence exist in longitudinal friendship networks related to their socio-digital participation? (*Study I* and *Study II*)

The first research question aimed at examining the particular characteristics of youth's cross-sectional and longitudinal friendship networks in relation to their engagement with socio-digital practices. Similarity effects of gender and cultural backgrounds were assessed in students' cross-sectional friendship networks in socio-digital participation. That is, to what extent students socialized with peers of the same gender and similar cultural backgrounds when engaging in digital activities. The peer effects of selection and influence were tested in the context of longitudinal friendship networks related to socio-digital participation; that is, whether students selected friends based on their similar intensity of participation in digital practices (i.e. selection effect) and whether friendship ties influenced the intensity of engagement in digital practices to become similar to that of their peers (i.e. the influence effect).

- 2) How are students' peer academic support networks related to their gender and cultural background? What kind of moderating effect can be found in students' peer academic support related to the co-evolution of friendship dynamics and developmental socio-digital participation? (*Study I* and *Study II*)

Peer academic support referred to students assisting their peers with schoolwork issues. This research question attempted to uncover the extent of similarity of gender and cultural backgrounds in peer academic support networks. In addition, it examined whether self-reported peer academic support moderated the co-evolution of the development of friendships and the dynamics of socio-digital participation.

- 3) To what extent do structures and characteristics of school-related networks and personal networks differ among three genres of socio-digital participation (i.e. friendship-driven, interest-driven and creative participation)? (*Study III*)

This research question attempted to trace the networking structure of different profiles of socio-digital participation (i.e. friendship-driven, interest-driven and creative practices) with counterparts. Moreover, it also explored the networking features (e.g. network size) of three profiles of personal networks in and outside of school.

Study I examined the similarity of gender and cultural backgrounds among patterns of social networks with classmates for friendship and academic support at a multicultural Finnish school. *Study II* aimed to deepen the understanding of the developmental processes around the intensity of socio-digital participation and students' friendship networks with peers in the same grade at school, moderated by peer academic support. *Study III* identified different profiles of socio-digital participation among students and investigated social network features (e.g. network size) among profiles by examining them at both an overall network level and an individual level.

3 Methods

3.1 Settings and participants

Study I was conducted in the spring of 2012. Participants were from an international school in a suburban region of southern Finland. The community where the school is located has one of the largest multicultural populations in Finland. The sample school enrolls multicultural students at the elementary, lower secondary and upper secondary levels. Participants ($N = 109$, females: 56; 51%) were from two parallel classes in grades seven, eight and nine at the lower secondary level (i.e. six classes in total). The average age of the participants was 15 ($M = 14.94$; $SD = 1.00$). Based on the countries where the participants' parents were born (Fortuin et al., 2014), the students' cultural backgrounds were categorized into one of the following: 1) majority-cultural students ($n = 50$; 46%) when both parents were born in Finland; 2) bicultural students ($n = 26$; 24%) when one parent was born in Finland; or 3) minority-cultural students ($n = 33$; 30%) when neither parent was born in Finland (Munniksmä, Verkuyten, Flache, Stark, & Veenstra, 2015). This clustering approach corresponds to the categories that earlier studies have validated (e.g. Bochner, Hutnik, & Furnham, 1985) using the categories monocultural, bicultural and multicultural as distinct student cultural groups. In this study, categorizing the participants into majority-cultural, bicultural and minority-cultural reflected the actual context of various cultures in Finland. Each classroom had a slightly unequal number of students from the different groups. Nonetheless, as Vermeij et al. (2009) reported, conceptually, the cultural composition as a percentage of students in a class has no effect on students' choices for intercultural connections. Consequently, it can be assumed that the unequal number of students from each cultural group in the present sample did not affect the students' choices when contacting classmates from other cultural groups.

Students ($N = 100$) from a school in a city in southern Finland participated in *Study II* in the spring of 2013 (Time 1, T1; five classes) and 2014 (Time 2, T2; five classes). At T1, participants (female: 53, 53%) were at grade seven and the average age was 13.48 ($SD = 0.55$). *Study III* was conducted in spring 2013 in a multicultural school in southern Finland. Most of the students came from the suburb where the school was located. It involved 287 adolescents (females: 164; 57%) from grades six

to nine. The average age of the participants was 13.94 ($SD = 1.61$). *Study II* and *Study III* were parts of the Mind the Gap project (Hakkarainen et al., 2015).

3.2 Social network analysis

The study relied on a mixed-method design (Plano Clark & Creswell, 2008) in terms of using complementary quantitative and qualitative data collection and analysis techniques. A social networking questionnaire was utilized to detect students' peer networks, with different dimensions cross-sectionally and longitudinally, whereas a self-reported questionnaire mainly examined students' patterns of socio-digital participation. Further, interviews zoomed in to qualitatively investigate selected students' personal networks and their use of socio-digital technologies. This strategy of using complementary methods for triangulating the investigated phenomena appeared to provide an adequate basis for conducting the study in a systematic and rigorous way (Axinn & Pearce, 2006). Social network analysis was applied in *Study I*, *Study II* and *Study III*.

In *Study I*, the network data from each classroom were collected via a social networking questionnaire that included a complete class roster (Wasserman & Faust, 1994), where the first column presented a list of all the students in the class, and the other columns indicated the three network dimensions that were examined. Participants were asked to mark responses with an X to the following queries: 1) whom they considered to be their friends (Mollica, Gray, & Treviño, 2003), 2) whom they had contact with on Facebook, and 3) whom they asked for help with their schoolwork. These three network dimensions represented students' face-to-face ties, Facebook contacts and academic support networks, respectively. The method of using participant-reported network connections is generally considered to be reliable for such a small network size (Reich, Subrahmanyam, & Espinoza, 2012). The six rosters that corresponded to the six classrooms included a total of 128 students, of whom 109 responded to the network questionnaire, making the response rate 85.2%. The participants' demographic data (e.g. gender, parents' birthplaces, age) and information about whether they used Facebook were also collected with the social networking questionnaire.

A total of 94.5% ($n = 103$) of the participants reported using Facebook in *Study I*. For further analysis, values were calculated for in-degree, out-degree and reciprocal ties in face-to-face, reciprocal ties in Facebook and in-degree and out-degree ties of academic support networks for each participant. The in-degree values referred to the number of ties directed towards a student (thus being peer reports), while out-degree values indicate the number of connections that the responding student reported (Wasserman & Faust, 1994, p. 175). To symmetrize the Facebook network, the criterion of maximum was used. Accordingly, a connection between

two students was considered to be present if either end of the connection reported a tie. This choice was made due to the reciprocal nature of Facebook. To test how gender and cultural background related to each classroom's face-to-face contacts, Facebook connections and academic support network E-I index values were utilized. E-I index indicates the number of ties external to each respondent's own group (i.e. regarding gender and cultural groups) minus the number of ties that are internal to these groups, divided by the total number of ties (Borgatti, Everett, & Freeman, 2002). If the E-I index value was negative, then the participants mostly contacted peers of their own gender or cultural group; if the E-I index value was positive, then their counterparts came mainly from the other groups. E-I index values close to zero indicated that group membership did not matter much. Further, T-tests and Brown-Forsythe tests were applied to test gender effects and the effects of cultural groups (majority, bicultural and minority), respectively.

The peer friendship networks within the grade in *Study II* were collected at two time points through a social networking questionnaire with a grade roster. The question "Whom do you spend time with?" was asked to indicate friendship networks. Friendship networks were considered to be directed at both time points. Selection and influence effects in friendship networks with interest-driven socio-digital participation were assessed by using stochastic actor-oriented modelling (SAOM) (Steglich et al., 2010). RSiena (version 1.1-307) in R (version 3.5.1) (Ripley, Snijders, Boda, Vörös, & Preciado, 2018) was applied to estimate the model, and a method of moments procedure was utilized to estimate model parameters.

In *Study III*, the social networking data for each grade (six to nine) were collected through a grade roster social networking questionnaire, and four networking dimensions were examined: 1) with whom they hang out (hangout network), 2) whom they especially like (liking network), 3) with whom they are in contact through socio-digital technology (mobile phone or social media pages; mobile network), and 4) whom they know to be especially skilful in using socio-digital technologies (computers, social media; recognition of socio-digital expertise). I symmetrized the hangout, liking and mobile matrices using a method of maximum meaning that a tie existed when either student reported it. I did not symmetrize matrices of social recognition of socio-digital expertise because it was used only to indicate peer-reported evaluations of socio-digital competencies. I then calculated the degree values for each participant in each matrix.

In-degree values (Wasserman & Faust, 1994, p. 175) in matrices of social recognition of socio-digital expertise indicated how many peers coming from the same grade recognized a participant's socio-digital expertise. To obtain degree values of media multiplexity for each participant, I summed up the hangout matrix and mobile contact matrix of each respective grade and applied a method of

maximum to symmetrize the added matrix, meaning that out of two given values, I always took the highest one for each cell of the matrix. A non-metric multidimensional scaling (MDS) analysis was then applied to the hangout matrix of grade seven with UCINET 6 in order to make networking interactions visible and to possibly distinguish subcultures within the hangout network, following the earlier study of Demir and Urberg (2004). The visualization of MDS was based on the symmetrized adjacency matrix (Borgatti, Everett, & Johnson, 2013, p. 91) in the NetDraw program. The NetDraw visualization represented how participants in the grade network interacted with one another. The shorter the distance between two students in the MDS map, the more closely they interacted.

3.3 Self-reported questionnaire and statistical analysis

A self-reported questionnaire was applied in *Study II* and *Study III* to examine the various types of socio-digital participation. All measurement instruments applied in the studies were carefully piloted.

In *Study II*, the self-reported questionnaire was administered to examine intensity of interest-driven socio-digital participation during both T1 and T2. I relied on earlier measurements of adolescents' various interest-driven digital practices (e.g. Barron, Martin, & Roberts, 2007; Hakkarainen et al., 2000), and I also used items (Hietajärvi et al., 2016) that represented the relatively recent emergence of Internet-related activities in the Finnish context. The questionnaire used a Likert-type scale from 1 ("never") to 7 ("all the time") to assess the intensity of various interest-driven digital activities through the following 5 questions: "*How often do you search or follow new information about your hobbies or things that interest you?*", "*How often do you read blogs or forums?*", "*How often do you write and comment in forums?*", "*How often do you share pictures and picture updates that you took with your phone?*", and "*How often do you share music or 'mix tapes' you have made?*" The Cronbach's alphas of these items were 0.69 and 0.75 for T1 and T2, respectively. Additionally, in the self-reported questionnaire for T1, participants were also asked "*How often do you ask for help from friends on schoolwork related issues?*" and "*How often do you give help to your friends on schoolwork related issues?*" with a Likert scale of 1 "*never*" to 7 "*all the time*". Mean values of these two items were used as participants' engagement of peer support in T1.

The purpose of the self-reported questionnaire in *Study III* was to identify patterns of students' socio-digital participation and their digital competences. To that end, the self-reported questionnaire was constructed by relying on some earlier measures (Barron et al., 2007; Hakkarainen et al., 2000; Hietajärvi et al., 2016) that aimed at accounting for the emergence of various socio-digital practices and digital

competences. After eliminating 34 cases due to more than 5% statistically random missing values, 253 cases were available for actual analysis. Participants with similar patterns of socio-digital participation were identified through latent profile analysis (LPA; Pastor, Barron, Miller, & Davis, 2007). Compared to more traditional clustering techniques, a benefit of this model-based method is that it provides a set of fit indices useful in statistically determining the most correct number of profiles. In this study, the main fit indices used were Bayesian information criterion (BIC) and the Vuong–Lo–Mendell–Rubin (VLMR) nested model comparison, which is a rather robust model selection test for fit between model k and $k-1$ (Lo, Mendell, & Rubin, 2001). LPAs were implemented using variables regarding the intensity of socio-digital participation for clustering. Prior to entering the LPA, the variables were standardized ($M = 0$, $SD = 1$). After identifying the socio-digital participation profiles (basic participators, $n = 161$, 64%; gaming-oriented participators, $n = 61$, 24%; and creative participators, $n = 31$, 12%), two-way ANOVA was conducted to examine group differences according to gender and socio-digital participation profile. Figure 2 shows the mean values of sum variables that were applied to categorize the three profiles.

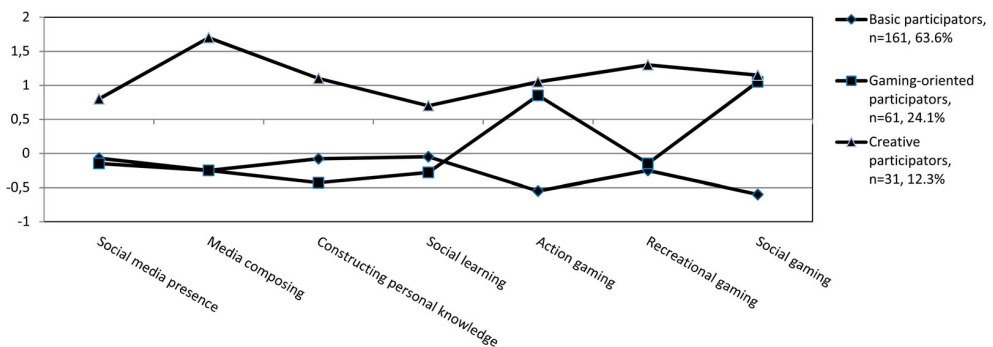


Figure 2. Mean values of standardized sum variables in three profiles of socio-digital participation.

3.4 Interviews and qualitative content analysis

A semi-structured theme (Brinkmann & Kvale, 2015) with egocentric network interviews (Hogan, Carrasco, & Wellman, 2007) was utilized in *Study III*. Based on the analyses of the self-report questionnaire and the social networking questionnaire, a gender-balanced sample of 35 students from grade six ($n = 15$) and grade seven ($n = 20$) was selected for semi-structured interviews according to the heterogeneity of their profile of socio-digital participation (i.e. basic participators, gaming-oriented participators and creative participators). The theme interviews addressed the students' friendship-driven practices of hanging out with their peers, their possible

interest-driven practices and competencies in using socio-digital technologies and their use of socio-digital technologies to support school learning in and outside of school. For examining personal social networks, a participant was given A2 paper and asked to 1) write down his or her own name in the middle, 2) write down the names of his or her network members around their name, and 3) describe what kind of knowledge and socio-emotional support was mediated with regard to each network member. A pilot interview was conducted to assist in determining the themes and content of the semi-structured interview. Participants were interviewed individually, face-to-face, in Finnish by Finnish colleagues; the interviews were audio recorded, took approximately 20 to 30 minutes and were transcribed word for word.

A qualitative content analysis (Krippendorff, 2004) was applied to the interview data. Although the main body of this data will be reported elsewhere, the results regarding one basic participator, one gaming-oriented participator and one creative participator were reported in *Study III*. The three reported cases were those where the size of their personal hangout network, as reported in the self-reported questionnaire, was the largest in respective socio-digital participation profile among all interview participants. The interview data were analysed with a focus on 1) patterns of socialization with friends mediated by socio-digital technologies, 2) approaches to pursuing personal interests integrated with socio-digital practices, and 3) ways of obtaining support for schoolwork mediated by socio-digital technologies.

3.5 Ethical issues in data collection and data analysis

When collecting various data from adolescents, it is very important to be sensitive concerning ethical issues. Student participation is voluntary, and all data collection is based on permissions from students, their parents and all relevant stakeholders. Students and their parents were given information of the aims and methods of present study. Anonymity of the students was strictly protected. Because of the specific nature of social network analysis, names of the participants and names they mentioned in networking related questions was replaced with codes at the very beginning stage of data analysis. In addition, identity information needed for longitudinal data collecting will be separated from the data used in practical analysis work. Personal information of participants and the data are carefully stored separately. Only my supervisors and I could access the personal information of participants in a locked storage.

I collected data for *Study I* in 2012 from a teacher training school. All students there have already signed the research permissions. Data of *Study II* and *Study III* were from Mind the Gap project (265528, Academy of Finland) that have gone

through ethical review of University of Helsinki and rigorous ethical practices were used.

Table 1. Overview of the methods used in the three studies

Studies	Participants	Time of data collection	Tools for data collection	Methods of data analysis
Study I: Face-to-face contacts, Facebook connections and academic support	<ul style="list-style-type: none"> • 109 students from grades seven to nine 	<ul style="list-style-type: none"> • Spring 2012 	<ul style="list-style-type: none"> • Social networking questionnaire within the same classroom 	<ul style="list-style-type: none"> • Freeman's degree measurements • E-I index • T-test • Brown–Forsythe test
Study II: Peer selection and influence: students' interest-driven socio-digital participation and friendship networks	<ul style="list-style-type: none"> • 100 students (grade seven for the first time wave, T1) 	<ul style="list-style-type: none"> • T1: Spring 2013 • T2: Spring 2014 	<ul style="list-style-type: none"> • Social networking questionnaire within the same grade (T1 and T2) • Self-reported questionnaire (T1 and T2) 	<ul style="list-style-type: none"> • Multivariate imputation method to treat missing data from self-reported questionnaire • Stochastic actor-oriented modelling
Study III: Adolescents' social networks in different socio-digital profiles	<ul style="list-style-type: none"> • 253 students in grades six to nine • 35 students for personal network interviews (grade six: $n = 15$, grade seven: $n = 20$) 	<ul style="list-style-type: none"> • Spring 2013 	<ul style="list-style-type: none"> • Social networking questionnaire within the same grade ($n = 253$) • Self-reported questionnaire ($n = 253$) • Personal network interviews ($n = 35$; three selected cases were presented in this study) 	<ul style="list-style-type: none"> • Exploratory factor analyses • Latent profile analysis • Freeman's degree measurements • MDS visualization • Two-way ANOVA • Qualitative content analysis

4 Overview of the studies

4.1 Study I

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. *Young*, 27(2), 184–200.

The purpose of this study was to examine similarities of gender and cultural background among lower secondary students' networking relations in a multicultural school in Finland. In particular, the study tested similarities of gender and cultural backgrounds across face-to-face networks, Facebook connections (the dominant form of social media at the time the data collection was conducted, in 2012) and networks for sharing academic support. By addressing classmate connections across these three networks, the study provided a comprehensive view of students' networks within the classroom.

The participants in this study consisted of 109 seventh to ninth graders. Based on the countries where the participants' parents were born, students' cultural backgrounds were categorized as 1) majority-cultural ($n = 50$; 46%) when both parents were born in Finland, 2) bicultural ($n = 26$; 24%) when one of the parents was born in Finland, and 3) minority-cultural ($n = 33$; 30%) when neither parent was born in Finland. This approach to classification represented the cultural composition of Finnish society, which had been a culturally homogeneous society. That is, cultural minorities in Finland had not yet formulated distinct cultural communities as in traditionally immigrant-based countries (e.g. North American countries).

A social networking questionnaire with classroom roster was administered to trace students' face-to-face, Facebook and academic support networks within each classroom. An E–I index (a statistic that indicates the extent of similarity that people connect with others regarding gender and cultural backgrounds) was also calculated for each student. Additionally, numbers were calculated for in-degree, out-degree and reciprocal ties in face-to-face networks, reciprocal ties in Facebook networks, and in-degree and out-degree ties of academic support networks for each participant. T-tests and one-way ANOVA were applied to test differences between gender and across cultural backgrounds in terms of the E–I index and the various degrees of values mentioned above.

The results of this study indicated that bicultural students were the most likely to network with their classmates in face-to-face connections, Facebook contacts and peer academic support. Meanwhile, majority-cultural and minority-cultural students did not present significant tendencies to interact with classmates of the same cultural group. On the other hand, female students were more inclined to use Facebook to connect with other female classmates, whereas males were equally likely to connect with either gender via Facebook. No gender similarities were found in academic support networks, although female students were more apt to engage in academic support than their male counterparts.

According to the findings of the study, male students should be encouraged to engage more in peer academic support so that students of both genders could collaborate in peer assistance with their schoolwork. In addition, educators in Finland should organize majority-cultural and bicultural student collaborations with minority-cultural students during classroom peer learning tasks in order to assist their classmates in addressing possible cultural barriers to learning. Substantial immigration has been an influential factor in many European countries for decades, but the increasing numbers of refugees who have settled in Europe over the last few years has rapidly increased the number of immigrants who live in countries that used to be primarily monocultural. Therefore, these findings on cultural similarities might also be applied in schools in other European countries where cultural minorities have not yet formed distinct cultural groups sharing cultural identities.

4.2 Study II

Li, S., Kiuru, N., Palonen, T., Salmela-Aro, K., & Hakkarainen, K. (2019). Peer selection and influence: Students' interest-driven socio-digital participation and friendship networks. (submitted)

This study aimed at investigating students' peer selection and influence effects over time between students' intensity of interest-driven socio-digital participation and friendship networks with peers, moderated by peer academic support. Peer groups often achieve great similarity in their intensity around interest-driven digital activities through the selection and influence processes. Selection occurs when students choose to affiliate with peer groups that endorse a similar intensity with digital activities. Influence processes, on the other hand, occur when peer groups exert an influence on each member's intensity of digital activities, resulting in increasing levels of similarity. As such, the processes of selection and influence may occur complementarily. Thus, both selection and influence were examined in the study. It was also examined that the moderating effect of peer academic support during the process of selection and influence among peers.

The participants for this study were 100 students (female: 53, 53%; mean age = 13.48, in grade seven in T1) in 2013 and 2014 in southern Finland. A social networking questionnaire with grade roster and a self-reported questionnaire tracing intensity of interest-driven socio-digital participation were simultaneously administered to participants in both time waves. First, the multivariate imputation method was applied to impute missing data in T1 and T2 intensity of interest-driven socio-digital participation and T1 peer academic support. Stochastic actor-based modelling was then applied to the estimation. The model included the selection and influence effects of intensity of interest-driven socio-digital participation, moderated by students' peer academic support.

The results indicated that friendship ties influenced the intensity of interest-driven socio-digital practices, which became more similar. However, students did not select peers as friends based on similar intensity levels of interest-driven socio-digital participation. I also found no moderation effects of peer academic support online. Adolescents who engaged more intensively in interest-driven socio-digital activities were likely to nominate more peers as friends, yet students who intensively engaged in peer academic support online were less likely to be nominated as friends.

Educational activities are increasingly mediated by socio-digital practices with peers, and it requires students to have sophisticated competences in virtual environments. The fact that students are able to influence their peers' intensity with interest-driven digital activities through their informal interactions provides a way for teachers to capitalize on students' social learning resources related to their shared interests when designing instruction.

4.3 Study III

Li, S., Hietajärvi, L., 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.

This exploratory study attempted to assess students' different levels of participation in various socio-digital activities and the different features of their social networks. In particular, different levels of intensity in socio-digital participation can be distinguished, ranging from mere observation and follow-up to personal participation in creating media. The purpose of this study was to identify different profiles of students' socio-digital participation and attempt to examine possible different features in the social networks across profiles.

The participants ($n = 253$) were grade six to grade nine students from a multicultural lower secondary school in Finland. Data collection was conducted with a social networking questionnaire with grade roster, a self-reported questionnaire and personal network interviews.

The study relied on the person-oriented analysis of patterns of socio-digital participation so as to cluster the participants in different groups and then examine between-group differences in terms of social networks and digital competences. First, a series of self-reported instruments for identifying adolescents oriented towards hanging out, sharing gaming-related interests and engaging in intensive use of diverse socio-digital technologies were developed using techniques of exploratory factor analysis. Groups of students representing qualitatively different profiles were identified using latent profile analysis. Different profiles of socio-digital participation were then compared across a number of personal characteristics (gender, socio-digital competence) and social networking practices. Finally, the personal networks of three cases, each representing different profiles of socio-digital participation, were presented.

Three profiles of socio-digital participation were identified: friendship-oriented basic participators ($n = 161$, 64%), gaming-oriented participators ($n = 61$, 24%) and creative participators ($n = 31$, 12%). The results revealed systematic differences in social networking relations as a function of students' socio-digital participation profile and gender. The reciprocal values in hanging out, liking and media multiplexity were highest for creative participators, whereas gaming-oriented participators were less socially active than their peers. The socio-digital expertise of creative participators was socially recognized by larger groups of peers than in the other groups.

The study produced adequately functioning instruments for tracing students' patterns of socio-digital participation in terms of identifying the various profiles and comparing the associated social networking relations. Such methodological tools will be suitable for future collection of systematic longitudinal data regarding socio-digital practices among larger groups of young people.

5 Main findings and discussion

The aim of this dissertation was to examine how Finnish students' friendship and academic support among peers were related to their socio-digital participation (i.e. engagement and practices using social media and the Internet on mobile devices and computers). In this dissertation, the phenomenon of students' social networks with peers related to their socio-digital participation was examined from three perspectives: 1) features of friendship with peers related to socio-digital participation cross-sectionally and developmentally; 2) characteristics of gender and cultural background functioning in peer academic support and moderation effect of peer academic support in coevolution of students' friendship and socio-digital participation; and 3) different profiles of socio-digital participation and their distinct social networks. Overall, in the dissertation it was found that socio-digital participation among Finnish students from grade six to grade nine was closely related to their friendship networks. In particular, 1) bicultural students (those who had one parent born in Finland) were culturally the most open to networks of their classmates in face-to-face contacts and Facebook connections. Female students were more inclined to use Facebook to connect with other female classmates, whereas males were equally likely to connect with either gender via Facebook. In terms of network dynamics, students' friendship ties with peers were likely to influence their intensity of interest-driven socio-digital participation towards becoming more similar. This finding was derived from the intensity measures of students' interest-driven socio-digital practices in general rather than differentiating their multifaceted particular interests. 2) Bicultural students were also the most engaged in peer academic support with their classmates. Female students were more inclined to participate in academic support than their male counterparts. Yet, there was no moderation effect of peer academic support in the students' evolution of friendship networks and interest-driven socio-digital participation. 3) Systematic differences were found in social networking relations as a function of adolescents' socio-digital participation profiles (i.e. friendship-oriented basic participators, gaming-oriented participators and creative participators). As in *Study III*, the reciprocal values in networks of hanging out, liking and media multiplexity were greatest for creative participators, while gaming-oriented participators were less socially active than their peers, and the

socio-digital expertise of creative participators was recognized by larger number of peers than with other groups.

5.1 Cross-sectional and developmental friendship with peers related to socio-digital participation

In the following two subsections, I will present and discuss the main findings of the two sub-questions to the first research question in this dissertation: 1) How much similarity of gender and cultural background that occurred in cross-sectional friendship networks is related to socio-digital participation? and 2) What kinds of peer effects are in students' longitudinal friendship networks related to their socio-digital participation?

5.1.1 Similarity of gender and cultural background in cross-sectional friendship networks related to socio-digital participation

The first research question of this dissertation was to examine similarity effects between genders and across cultural backgrounds in face-to-face and Facebook contact cross-sectional networks. In particular, I attempted to examine the extent to which young people connect face-to-face and on Facebook with classmates of the same gender and with similar cultural backgrounds (i.e. majority-cultural, bicultural, minority-cultural). To answer this question, cross-sectional information about complete classroom networks for face-to-face and Facebook connections were analysed along with students' gender and their cultural backgrounds. When interpreting findings of gender similarity, age and context should also be taken into consideration. The results of *Study I* showed that female students were inclined to use Facebook to connect with other female classmates. The sample for *Study I* comprised seventh to ninth graders at the approximate mean age of 15. In general, young adolescents of this age appear to socialize with peers of the same gender, while older youth often start attempting to connect more with peers of the opposite gender (Wang & Degol, 2017). The findings of *Study I* follow the similarity principle and extend the knowledge that early female adolescents are also likely to network with female peers on social media, and this is, to some extent, in line with a study among Israeli youth (Mesch & Talmud, 2007), which found that young people in Israel were likely to connect with same-gender peers on the Internet. In terms of male students, the result of *Study I* showed that males were equally likely to connect with either gender via Facebook, which did not follow the previous study (Mesch & Talmud, 2007). However, this finding is in accordance with Thelwall's (2009) results that did not find evidence of gender similarity on social media. Female and

male students are likely to dominate school subject groups of low-scoring and high-scoring in math and science, respectively (Chow & Salmela-Aro, 2011). Thus, when teachers organize Internet learning environments in peer groups, a mixed-gender approach may bring more opportunities for students of both genders to support one another in different school subjects.

In terms of the similarity effect with cultural backgrounds, *Study I* showed that bicultural students were the most open to have networks of their classmates in face-to-face contacts and Facebook connections. Research of multicultural education suggests that biculturalism has a positive impact on students' social connections (Rutland et al., 2012). Theories of intercultural interactions claim that the more ground communicative partners share, the more they will be able to appropriately network with others (Fortuin et al., 2014). In this sense, bicultural students share certain cultural properties with both majority-cultural and minority-cultural students, thus providing them with advantages when connecting with classmates from either of the other groups. However, other studies have implied that the bicultural identity is full of contradictions, tension and frequent social strain (Vivero & Jenkins, 1999). This is understandable because bicultural students' parents were born in different cultural contexts, and thus, bicultural students may sometimes experience confusion in deciding which culture should dominate their social connections. Their cultural mix, on the other hand, allows them to understand their majority-cultural peers while, at the same time, opening connections with counterparts from minority cultures. Results of *Study I* are also in line with Rutland and colleagues' (2012) findings that students who adopt a bicultural identity are able to strategically "flag" their multiple identities within their multicultural peer groups in order to obtain acceptance among the maximum number of peers. Finland has been a country that is culturally homogeneous despite increasing numbers of residents with foreign backgrounds in the very recent situation of refugees in Europe. Unlike traditional immigrant societies (e.g. North American countries), immigrants in Finland have not yet formulated distinct groups sharing the same cultural identity. Instead, immigrants with different cultural backgrounds are likely to connect with one another. Thus, the division of majority-cultural, bicultural and minority-cultural groups seems to appropriately reflect the current cultural situation in Finland. Further, the findings of *Study I* regarding cultural similarity might also be applied in schools in other European countries where significant immigration is a rather recent phenomenon and where cultural minorities have not yet formed distinct cultural groups with shared cultural identities.

5.1.2 Developmental friendship with peers related to interest-driven socio-digital participation

Longitudinally, the first research question of this dissertation uncovered the peer effects of selection and influence between the development of students' friendship networks and their interest-driven socio-digital practices. That is, whether students select friends based on a similar intensity of interest-driven digital practices (i.e. selection effect) and whether friendship ties influence the intensity of interest-driven digital activities to become similar among peers (i.e. influence effect). To accomplish this, two time periods were analysed for repeated information about students' friendship networks with peers of the same grade and their intensities of interest-driven socio-digital practices. Stochastic actor-based modelling was applied to estimate the peer effects of selection and influence between friendship network dynamics and the development of interest-driven socio-digital participation. The results of *Study II* indicated that friendship ties influenced how intensively students participated socially in digital technologies related to their interests. That is, their intensity of interest-driven socio-digital participation was likely to become more similar to their friends over time. However, the students did not select one another as friends based on their similar intensity levels.

To the best of my knowledge, there have been few studies examining peer selection and influence effects related to adolescents' intensity of interest-driven socio-digital participation and their friendship network dynamics. The results of *Study II* regarding the peer influence effect are partially in line with previous studies that did not simultaneously estimate the peer selection and influence effects. Escardíbul and colleagues (2013) found that the intensity level of Spanish youth playing video games correlated with that of their peers. More recently, Amialchuk and Kotalik (2016) reported similar results with male American adolescents whose intensity of game playing was related to peers to become more similar. While these two investigations examined correlation on the intensity of video game playing with peers', *Study II* simultaneously measured peer selection and the influence of interest-driven activities. Moreover, the results of *Study II* suggested that these adolescents were not likely to select peers as friends based on their aligned intensity level of interest-driven socio-digital participation. It is critical to understand peer influence on interest-driven socio-digital participation in the context of the digital transformation of educational activities in Finland. Educational activities are increasingly mediated by digital practices with peers and require students to have fairly sophisticated digital competences in learning collaboration (Hakkarainen et al., 2015). The fact that students are able to influence their peers' interest-driven digital activities through their informal interactions could be utilized by teachers for establishing connected learning.

5.2 Similarity and moderation effects of peer academic support

The second research question of the dissertation was to examine the similarity effects between genders and across cultural backgrounds in cross-sectional peer academic support networks. In particular, I attempted to evaluate if adolescents are likely to engage in academic support with peers of the same gender or with those from the same cultural background. To that end, cross-sectional peer academic support networks within classrooms were analysed along with information about gender and cultural backgrounds. In addition, the second research question was also to investigate whether peer academic support moderated the two-time co-evolution of students' friendship networks with peers and their interest-driven socio-digital participation. To answer this question, peer academic support measured by a Likert scale at Time 1 was estimated as a moderator in the stochastic actor-oriented model (see method section) that represented the co-evolution of friendship network dynamics and developmental interest-driven socio-digital practices.

In terms of peer academic support between genders, the results of *Study I* were in line with the findings from Kessels and Steinmayr (2013) that female students may be more engaged in academic support than their male counterparts. This may, in a way, result in female students succeeding significantly better than male students in school achievements in the Finnish context (Torppa, Eklund, Sulkunen, Niemi, & Ahonen, 2018). The analysis of gender similarity in academic support with counterparts involved in *Study I* revealed no gender similarities, meaning that both female and male students are apt to engage in academic support with peers of both genders. This is in accordance with Bursal's result (2017) that there was no gender similarity in perceived peer academic support among Turkish students from the fourth through eighth grades. This means that the findings of both *Study I* and Bursal were not in line with theories of gender similarity. Although a large body of studies (e.g. McPherson et al., 2001; Wang & Degol, 2017) indicate that early adolescents are inclined to socialize with same-gender peers during adolescence, the result in *Study I* implies encouragingly that students are likely to engage in assisting counterparts with schoolwork regardless of gender.

On the other hand, similarity (i.e. homophily) among students' cultural backgrounds (i.e. majority-cultural, bicultural and minority-cultural) was not found in *Study I*, either. That is, the minority-cultural students were likely to seek assistance from both majority-cultural and bicultural counterparts. Previous studies (e.g. Drotner & Kobbernagel, 2014) have asserted that students from immigrant or cultural minority families may frequently encounter cultural obstacles. *Study I* found that bicultural students were the most open to networks with their classmates in peer academic support. Together with majority-cultural students, young bicultural people in Finland are inclined to provide peer support to their minority-cultural counterparts

in terms of, for instance, cultural interpretations of learning materials. Majority and bicultural students, in this regard, could assist their minority-cultural counterparts with the acquisition of knowledge of aspects of the majority culture. This would support them in learning to interpret the implicit experiences of the learning environment and to address related cultural barriers or challenges in the learning process. Based on this finding, teachers in multicultural learning environments might manage minority-cultural students to be seated near majority or bicultural counterparts during peer learning sessions so that minority-cultural students would have opportunities to seek peer support.

A moderating effect of peer academic support on the co-evolution of students' friendship and interest-driven socio-digital participation was not found in *Study II* of this dissertation. Friendship is vital for young people for various types of support. Yet, friends who are willing and competent to help with studying may matter more (Poldin, Valeeva, & Yudkevich, 2016). Perhaps adolescents seek help with their studies from peers who are not considered friends but are competent with schoolwork. This may explain why individual students with diverse configurations of peer academic support and interest-driven socio-digital participation (e.g. low engagement in support but high interest-driven socio-digital participation) did not differ in the extent to which they selected or were influenced by peers with high versus low interest-driven socio-digital participation.

5.3 Different social networking features among three profiles of socio-digital participation

The third research question of the present dissertation was with regard to the characteristics of social networks among different profiles of socio-digital participation. To answer this question, social networks with peers of the same grade were quantitatively analysed together with information about student practices mediated by digital technologies. Furthermore, students' personal social networks were qualitatively analysed.

In *Study III*, three profiles of socio-digital participation were identified based on diverse levels of intensity when engaging in different socio-digital practices: friendship-oriented basic participators, gaming-oriented participators and creative participators. In particular, basic participators engaged in shallow use of digital technologies (i.e. a relatively low level of intensity and/or low extent of complex use), while creative participators were found to be using digital technologies most intensively in creative practices (e.g. media composing and constructing personal knowledge) and with the highest level of self-reported and peer-recognized competences of digital technologies. Gaming-oriented participators, on the other hand, reported mostly engaging in various games (e.g. action gaming, social gaming

and recreational gaming). The quantitative classification of the above three profiles of socio-digital participation is in accordance with the three qualitative genres that Ito and colleagues (2010) found (i.e. friendship-driven, interest-driven and creative use of digital technologies). Both *Study III* and a previous study (Ito et al., 2010) pointed out that, among Finnish and American samples, most of the students participated in basic friendship-driven socio-digital practices, whereas the fewest students were engaged in creative activities with digital technologies.

In addition, a visualization of the complete hangout networks of all the students in grade seven in *Study III* showed that female students were clustered to one side and male students to the other side of the visualization, revealing that students tended to hang out within their respective gender group, demonstrating the homophily effect. While the three profiles of socio-digital participation were somewhat clustered together, interpretation of this result is difficult because there were many basic participators but only some gaming-oriented participators and even fewer creative participators in the sample for *Study III*. Based on earlier research on homophily (e.g. McPherson et al., 2001), gaming-oriented participators were expected to be the most cohesive group due to their shared gaming interest. Yet, they did not originate from the same social networking environment. Presumably, some interests are closer to each other, and it is not plausible to assume that all students who are interested in music, for example, would like a similar type of music.

Further, the analyses of *Study III* showed systematic differences in social networking relations as a function of adolescents' socio-digital participation profile and gender. Specifically, the reciprocal values in hanging out, liking and media multiplexity were highest for creative participators, which, in *Study III*, included participants who intensively used almost all aspects of digital technologies. Instead, they were ordinary students whose involvement was simply more intensive and extensive than their peers. Through intensive efforts, creative participators were likely to master various socio-digital competencies (McArthur, 2009) better than their counterparts. As Sugarbaker (1998) claimed, "Perhaps one of the identifying traits of creative media use participator culture is the fact that its participants are active rather than passive". Students categorized as creative participators in the *Study III* sample tended to have rather large personal social networks representing various profiles of socio-digital participation. Yet, some earlier studies indicated that these young people who intensively geek out are "socially awkward" (Baron-Cohen, 2008) and socially inept despite being regarded as smart. The creative participators were likely, however, to be oriented more towards messing around than actually geeking out with digital technologies (Ito et al., 2010). Since socio-digital participation is rather pervasive in the lives of adolescents, it appears natural for creative participators to network with peers outside of their own community. In *Study III*, the creative participators actively used social media. They were often involved in socio-

creative activities with other peers. Being active users of digital technologies in support of their academic studies also integrated their activities with those of other students, which may result in larger personal networks with counterparts.

Moreover, the results of *Study III* indicated that gaming-oriented participators were less socially active than their peers, meaning that gaming-oriented participators had smaller networks and were less well-connected socially than basic and creative participators. Previous studies have presented mixed results on the social relations of young gamers. Several earlier studies asserted that gaming leads to diminished social relations (e.g. Dengah, Snodgrass, Else, & Polzer, 2018; Huvila, Holmberg, Ek, & Widén-Wulff, 2010; Trepte & Reinecke, 2011). The results of *Study III* partially support these findings, and indeed, having just a few reciprocal networking relations may not provide sufficient support for an adolescent's well-being and development. It has been demonstrated that excessive and obsessive game playing may increase the risk of isolation (Grüsser, Thalemann, & Griffiths, 2007) and lead to the erosion of offline friendships (Kraut et al., 1998a). Social isolation is often highlighted as a possible consequence of hyper-intensive online gaming (Domahidi & Quandt, 2015). Further, other studies have expressed fears that gamers could neglect their real-life friendships if they play too much (Wan & Chiou, 2006). At this point, the findings of *Study III* correspond to those of previous studies to a certain extent.

However, other studies have indicated that gaming has a positive impact on adolescents' social relations. For instance, Williams and colleagues (2006) showed that gaming may extend a player's pre-existing social relations. Game players report that the social side of gaming is crucial for them and one of the strongest motivations to engage in gaming (Frostling-Henningsson, 2009). In addition, a small but notable body of research on the transformation of social relations from the gaming environment to a real-world context (e.g. Trepte, Reinecke, & Juechems, 2012) or vice versa (Shen & Williams, 2011) suggests that this might help individuals in creating more social interactions. Because the participants' social competencies were not actually measured in *Study III*, the data provided only suggestive indications concerning reasons for the observed differences between the socio-digital participation groups' patterns of networking. However, it has been suggested that the use of digital games may provide additional options for expanding the users' social networks in both offline and online contexts (Trepte et al., 2012). Social online gamers play digital games together in a social context via the Internet; many of them play these social games regularly, and these players can meet new friends in the game, get to know them beyond the game, or bring their offline friends into the game (Klimmt & Hartmann, 2008).

5.4 Theoretical implications

This dissertation has theoretical implications regarding the understanding of adolescents' digital practices and their networking patterns. First, the present finding that young people's patterns of socio-digital participation are heterogeneous supports the claim made by Ito and colleagues (2010), based on an extensive ethnographic investigation, that students enact diverse practices of socio-digital participation that vary from hanging out with friends to messing around and geeking out with technologies. Young people cannot be described as a homogeneous generation of digital natives (Prensky, 2001) because students participate in different genres of digital practices with varying intensity and complexity. This unequal engagement elicits distinct differences between friendship-driven, interest-driven and creative participation that are related to digital divides (Hakkarainen et al., 2015) and creative participation gaps (Jenkins et al., 2009). In terms of intensity, youth spend different amounts of time on various genres of socio-digital participation. Those who are involved mostly in friendship-driven activities often socialize with peers using socio-digital technologies. Those who intensively participate in interest-driven practices seem to generally discuss and collaborate on their shared interests via socio-digital technologies. Creative participation requires frequent engagement at higher levels of utilization of socio-digital technologies than friendship- and interest-driven activities, and they simultaneously require more digital competences. In regard to complexity, young people may engage in single or multiple genres of socio-digital participation with unequal intensities, although there are distinct differences among the three genres of participation. Consequently, the socio-digital participation profiles may partially capture the genre of socio-digital participation that has relatively high intensity. The boundaries between the three genres are, however, blurred in practice, as indicated by Ito and her colleagues (2010). It cannot be claimed that students who engaged in geeking out (i.e. creative participators in *Study III*) did not participate in friendship-driven practices. Due to the complexity of youth's socio-digital participation and the rapid development of socio-digital practices, investigators have reasons for continuing to study young people's socio-digital participation.

Second, the present dissertation implies that investigating students' socio-digital practices and competences should address the networking aspect of digital activities. Adolescents' social networks mediate socio-digital participation, and different profiles can be traced by examining social networks. Similar to socio-digital participation, digital competences are also multifaceted and heterogeneous. Young people acquire different levels of digital skills from various sources of expertise: friends, family, schooling and people with more expertise on the Internet (Barron, 2004; Hakkarainen et al., 2000; Hietajarvi et al., 2016). The heterogeneity of digital competences partially derives from how many resources of expertise a

youth's social networks can cover. That is, it matters how large social networks are for providing resources that allow students to develop their digital competences. As a result, digital competence is a network phenomenon. Reaching high levels of digital competence requires networks to provide sophisticated, near real-time tutoring and/or collaboration so that networked expertise (Hakkarainen, Palonen, Paavola, & Lehtinen, 2004) can be cultivated among the participants. Further, a high level of digital competence presupposes considerable network resources, elicits social recognition among peers (e.g. creative participators in *Study III*), thereby, expands a youth's social networks. This means that active socio-digital participation may foster the rich-get-richer phenomenon (Desjarlais & Willoughby, 2010) in terms of young people who are already supported by their social connections seeking additional possibilities to socialize through socio-digital practices. Networking provides access to advanced socio-digital practices and the development of digital competences, and it may lead to further expansion of networks eliciting the creative use of digital technologies. Providing young people with access to the networking resources required by the advanced use of digital technologies does not occur spontaneously, but rather, is likely to require structured support from parents, teachers and educational institutions.

Third, the theory of homophily (similarity) appears to explain phenomena around social networks related to socio-digital participation. Similarities in gender and culture orientate students' socio-digital participation. Homophily, the fundamental theory of social networks (McPherson et al., 2001), implies that people are inclined to socialize with those who are similar to them in terms of various individual attributes (e.g. gender, cultural background). In this dissertation, gender similarity in socio-digital activities was found among early adolescents at comprehensive school. Gender similarity appears to be age-dependent, meaning that adolescents tend to socialize more with peers of the opposite gender as they become older (e.g. in high school). Thus, gender similarity in socio-digital participation found in the present dissertation may not be generalized to other age cohorts (e.g. mid- or late adolescence). In terms of cultural background similarities, Finnish society has been culturally fairly homogeneous in nature. Similar to other Nordic societies, it is in the process of becoming increasingly multicultural. More and more immigrant students are being enrolled in comprehensive schools. When cultural similarity occurs, multicultural students appear to socialize with peers of foreign cultural backgrounds in socio-digital practices. This may hinder peers' collaborative learning in a multicultural classroom context, especially in terms of the current computer-supported learning that is being adopted by more Finnish schools. Fortunately, cultural similarity in socio-digital participation among students was not found in this dissertation. Due to the networked nature of young people's emergent socio-digital practices, fundamental network theories (e.g. homophily, preferential

attachment) importantly need to be assessed so that the emergent and rapidly changing digital phenomenon can be better understood from a viewpoint of social networks.

Fourth, based on similarity (homophily) theory, the effects of selection and influence turn out to be theoretically of importance for understanding and explaining the co-evolution of behaviours and social network development. The present dissertation provides new knowledge regarding peer effects on the co-evolution of friendship network dynamics as well as with interest-driven socio-digital participation over time. A majority of the existing studies have examined the peer effects of students' disruptive behaviours (Delay, Laursen, Kiuru, Salmela-Aro, & Nurmi, 2013), academic achievements (Gremmen, Dijkstra, Steglich, & Veenstra, 2017) and school engagement (Wang, Kiuru, Degol, & Salmela-Aro, 2018). Yet, research examining peer effects on socio-digital participation is scarce. The effects of selection and influence are examined simultaneously in the dynamics of social networks and behaviours. In social network development, individual behaviours (e.g. intensity of participation in interest-driven socio-digital practices) and social connections (e.g. friendship) are related to each other across time. That is, students may choose to connect with peers at a similar level of individual behaviours (i.e. selection effect). In turn, individual behaviours may become more similar due to adolescents' social ties (i.e. influence effect). This dissertation did find that young people's friendships influenced their intensities of participation in interest-driven socio-digital practices, which then became more similar to each other over time. Nonetheless, adolescents did not select friends based on a similar intensity level in interest-driven practices mediated by digital technologies. Admittedly, young people do not tend to socially connect with others based on similarity in one particular dimension of individual attribute or behaviour. Instead, multiple dimensions of attributes or behaviours may interdependently function to elicit social network connections (Block & Grund, 2014). In addition to similarity (homophily) theory, other fundamental network theories also contribute to the formation of social network connections. For instance, preferential attachment (Barabási, 2003) is another basic theory regarding establishing social network ties, stating that newcomers to the network are more likely to attach to well-connected members (i.e. those who have more social connections within the network) than to less connected ones. Consequently, the formulation of network connections is likely to be oriented to multiple factors.

5.5 Methodological implications

The purpose of this dissertation was to examine how sixth to ninth graders' socio-digital participation is related to their friendship and academic support with peers.

Particularly, similarity of gender and cultural background among classmates was cross-sectionally investigated in students' face-to-face, Facebook and academic support connections. It also studied the peer effects (selection and influence) between the development of interest-driven socio-digital participation and friendship dynamics. In addition, this dissertation investigated students' social networking patterns related to the different profiles of socio-digital participation. A mixed-method design was used that included collecting social networking, quantitative and qualitative data. The social networking data were used to cross-sectionally and longitudinally trace students' complete networks within classrooms and within grades. In addition, individual semi-structured interviews measured students' personal social networks both in and beyond the school context. Moreover, a self-reported questionnaire aimed to examine young people's socio-digital participation and digital competences.

The methodological limitations of the present dissertation warrant consideration. First, although all three studies of this dissertation utilized adequately functioning measurements to trace patterns of socio-digital participation, young people are not markedly identical in this respect. The range of their experiences, motivations, interests and values is so wide that it is often difficult to discuss them as a whole in any meaningful way (Jenkins et al., 2015). Most of the measurement items in these three studies relied on an intensity scale with various types of socio-digital participation outside of school; that is, the frequency of students' engagements in targeted digital practices. Yet, it did not systematically offer sufficient information on the complexity of socio-digital practices in and outside of school. Second, while *Study I* investigated the homophily principle of gender and cultural background in networks of face-to-face contact, Facebook connections and academic support, different individual attributes are likely to be unequally related to young people's social relations (Block & Grund, 2014). Thus, multidimensional individual attributes could be used for examining the homophily principle more accurately. In addition, data collected for this dissertation were in the same school, albeit a school that enrolls both Finnish and international classes from the comprehensive level to high school. The sample could have been expanded to other schools. Further, *Study II* examined the dynamics of both socio-digital participation and peer relations at two time points. Information could have been collected at additional time points to measure development across longer spans of time. Readers should take these methodological limitations into consideration when interpreting the results of this dissertation.

The reliability of the quantitative data was satisfactory as measured by Cronbach's alpha. Further, the quantitative data appeared to succeed in addressing the targeted phenomenon of adolescents' socio-digital practices. Yet, the socio-digital participation of young people is a rapidly transforming phenomenon, along

with markedly developed socio-digital technologies. Moreover, different cohorts of adolescents appear to have their own age-specific socio-digital practices (Hietajärvi et al., 2019). As a result, new quantitative instruments should be developed to measure emerging socio-digital practices in targeted cohorts. In terms of the qualitative aspect, the present dissertation applied semi-structured interviews to trace students' personal social networks in and outside of school contexts (Hogan et al., 2007; Palonen & Hakkarainen, 2014), aiming at capturing participants' complete personal networks related to socio-digital participation. This approach appeared to be trustworthy and rigorous (Golafshani, 2003).

This dissertation has several methodological implications. First, adopting a mixed-method strategy enabled acquiring a quantitative and qualitative understanding of these social networks. The socio-digital practices of youth are dramatically dynamic across time and cohorts. Due to the rapid development of socio-digital technologies, novel applications emerge every now and then. Accordingly, students' socio-digital practices have been mediated by emerging technologies, and investigators are aiming at moving targets. In addition, socio-digital participation is a network-based phenomenon; it is mediated by peer interactions and networking activities. Consequently, investigating such rapidly changing phenomena requires applying multiple complementary methods. In *Study III*, a cross-sectional complete classroom network approach and self-reported intensities of various socio-digital activities provided the basis for selecting participants to be interviewed about their personal networks. Young people's face-to-face networks often overlap with virtual communities to a certain extent so that they are able to socialize in both face-to-face and virtual contexts. What's more, students' virtual social networks are not necessarily the same as face-to-face connections. Further, online connections sometimes can be expanded to face-to-face social contexts. Due to the complexity of transitions between face-to-face and virtual networks, examining adolescents' personal networks beyond the school community is especially important. On the other hand, the mixed-method design appears to be rigorous that data collected with different methods can validate each other (Plano Clark & Creswell, 2008). In addition, information of peer perceived digital competences was provided by social network data, validating the quantitative data from participants' self-reported digital competences.

Second, collecting and analysing cross-sectional and longitudinal social network data deepened the understanding of how social connections among adolescents are associated with their socio-digital participation and academic support. Because of the stable nature of gender and cultural backgrounds, similarities of these factors in friendship and academic support networks were examined with cross-sectional network data. Such an investigation enables an examination of how dyadic attributes from social networks are related to self-reported monadic attributes.

By capitalizing on dyadic and monadic information from the same participants, the way that individual monadic attributes predict the probability of formation of network ties can be modelled (e.g. exponential random graph models; see Robins, Snijders, Wang, Handcock, & Pattison, 2007). Yet, the limitation of assessing both dyadic and monadic measures applied in the present dissertation is that it did not quantitatively trace networking partners beyond school. Real-time data collection with experience sampling (Inkinen et al., 2013) or sociometric badges (Kim, McFee, Olguin, Waber, & Pentland, 2012) is critical for advancing the field. On the other hand, using longitudinal complete-grade networks, the co-evolution of peer effects (i.e. selection and influence) between friendship networks and interest-driven socio-digital participation were assessed at two time points. This design can be improved by extending data collection to more time waves, increasing the sample to include other cohorts and schools and ensuring a high response rate (e.g. motivating schools and teachers to involve all of their students to participate).

5.6 Educational implications

This dissertation has several educational implications. Young people's friendship dynamics were found to influence their school engagement to become more similar (Wang et al., 2018). Through networking with school-oriented peers, academically oriented students have even tighter connections to school engaged students, whereas the alienated students hang out with others who are disengaged from school, leading to an increased lack of motivation to engage in schooling (Wang et al., 2018). Further, there appears to be a gap between young people's digital and educational practices (Kumpulainen & Sefton-Green, 2012; Salmela-Aro, Muotka, Alho, Hakkarainen, & Lonka, 2016; Selwyn, 2006) in terms of students who prefer digital learning becoming less and less engaged in school. Hietajärvi and colleagues (submitted) further support this gap hypothesis cross-sectionally and longitudinally among Finnish early adolescents. Students who prefer to apply digital technologies to developing their interests by learning in virtual communities outside of school appeared to disengage in traditional school. These out-of-school interests and skills are not well recognized (Rajala, Kumpulainen, Hilppö, Paananen, & Lipponen, 2015), and informal learning and knowledge obtained outside of school are different from those within the school environment so that there is a mismatch between learners and the formal learning contexts (McFarlane, 2015). In particular, research shows that students' structured and creative practices mediated by digital technologies and characterizing the knowledge work are rare in Finnish schools (Halonen et al., 2017; Paavola & Hakkarainen, 2014). Being aware of the unequal digital competences across different profiles of socio-digital participation (one of results in *Study III*), schools should structurally and systematically support students

in developing their digital competences as well as in academic and creative practices using digital technologies. The overall level of digital technology use in Finnish schools is rather low, and schools often focus on basic digital competences (OECD, 2015). However, young people need systematic support from school in developing advanced digital competences related to productively applying various novel tools (e.g. digital working competences, digital production skills) so that students are able to prepare for the knowledge society with competence in solving complicated problems independently and collaboratively using novel tools and methods (European Commission, 2017; European Parliament, 2015).

Cultivating the educational practice of peer tutoring could be another way for developing digital competences (Pata et al., 2006; Riikonen, Seitamaa-Hakkarainen, & Hakkarainen, 2018). Young people's heterogeneously distributed digital competences can be capitalized upon to facilitate peer learning and tutoring in digital technologies. Peer tutoring could be implemented within a classroom/grade or across grades (e.g. older students tutoring the younger ones). Such peer digital tutoring could partially rely on gamers and geeks (i.e. creative participators) who are likely to be high digitally competent but are often unrepresented or even negatively characterized and marginalized in formal learning contexts (Ito et al., 2010). In order to engage the learning of gamers and geeks, educators in formal learning environments should acknowledge and socially recognize the affirmed digital competence of gamers and creative participators. It is critical to trace the dark side of Internet use and identify the potential negative psychosocial implications of excessive gaming or social media use. Meanwhile, it is also important to avoid too hasty negative characterization of intensive socio-digital participators as digital addicts.

On the other hand, because students' friendship-based peer networks influence their interest-driven socio-digital participation to become more similar, connected learning (Ito et al., 2013) should be promoted to integrate informal and formal learning to bridge the gap between students' interests and educational practices. Through digital technologies (Maul et al., 2017), connected learning is viewed as "a social construct that emerges in interaction while learners engage in various social practices mediated by different artefacts" (Kumpulainen & Sefton-Green, 2012). For instance, integrating school community-based, curriculum-based and out-of-school practices has been proved to blur the boundaries between formal and informal learning in media production (Kupiainen, 2013). Practices of connected learning provide students with numerous opportunities to be "agents", bringing their digital practices in formal learning to establish new learning ecologies at school. Admittedly, there are huge differences between traditional school culture and youth culture. Connected learning can be considered as a bridge that connects schools and youth cultures. When connected learning is operated systematically, the learning

ecology of a school expands and becomes more interest-driven and relevant for students' daily lives. In turn, significant knowledge flows and social networks expand from schools to students' daily lives and vice versa. That is, rather than a closed, undialectical or immobile space, school becomes an open, dynamic and multifaceted learning ecology with different connections (e.g. knowledge, social relationships, learning artefacts) to students' everyday practices and learning.

Further, connected learning methods should be rooted in schools to enable collaborative learning with heterogeneous peers in terms of gender, cultural background and school achievements. Such learning should focus on fostering competences in the creative use of digital technologies, such as with maker culture projects (Korhonen & Lavonen, 2017). Maker culture is an approach of learning by doing in social contexts, and in particular, it is based on informal, peer-supported learning in social interactions to create novel artefacts and applications with digital technologies. This approach often utilizes methodologies that combine traditionally separate domains (e.g. different types of artwork) with versatile working methods (e.g. textile work) and digital methods (e.g. videography and programming) (Kangas, Seitamaa-Hakkarainen, & Hakkarainen, 2013). Maker culture has been developed mostly in informal practices and contexts in which young people create artefacts that are personally and socially valued according to their interests, and in that sense, it can be viewed as an interest-driven practice. Introducing elements of maker culture to educational practices can engage students' learning motivation and inspire learning across the areas of integrated science, technology, engineering, arts and mathematics (STEAM) studies (Seitamaa-Hakkarainen & Hakkarainen, 2017).

Altogether, this dissertation suggests that schools should provide systematic and structured support so that digital technologies can support learning in and beyond school. In addition, schools should attempt to take into consideration interests pursued by students outside of school when designing formal learning contexts so that connected learning (Ito et al., 2013) can bridge the gap of students' socio-digital participation outside school and educational practices in the classroom.

5.7 Directions for future research

The results of this dissertation raise new research questions for future studies. First, digital technologies are emerging so rapidly that it is necessary to develop novel methods to detect students' use of digital technologies. Because the frequency of daily use of digital technologies is increasing remarkably, retrospective self-reports of using digital technologies are likely to become less and less reliable. Therefore, survey methods have to be complemented by diary methods in detailed time or repeated-experience sampling methods (experience sampling studies, Inkinen et al., 2013) along with the use of wearable sociometric badges (Kim et al., 2012) that trace

participants' real-time social interactions with peers. In addition, more research is needed to better understand the variation in students' competences to translate their time spent on socio-digital participation into favourable offline learning outcomes (Kaarakainen et al., 2017; van Deursen & Helsper, 2015). Further, the phenomenon of students' socio-digital participation is so heterogeneously complex that researchers should concentrate on particular practices and/or specific profiles of socio-digital participation rather than considering them to be a homogeneous population (Hakkarainen et al., 2015). Moreover, future research needs to focus more on examining related individual psychological attributes (e.g. personality, self-esteem; for a meta-analysis, see Liu & Baumeister, 2016). Also, more detailed information on the classroom settings (e.g. whether there are permanent small groups) should be taken into consideration during data collection.

Second, this dissertation has revealed gaps for future research directions about the particular patterns of adolescent peer academic support mediated by digital technologies as well as possible variances among different profiles of socio-digital participation among comprehensive school students. This is vital not only for teachers to improve their instruction in digitalization reform but also for them to assist students in cultivating competences to engage in collective learning support in an increasingly digitalized era. In fact, competence at engaging in peer support seems to be a crucial 21st-century skill (i.e. ways of thinking, working and living in a digitalized world) (Binkley et al., 2012) because being connected is one of the primary social norms of digitalization (Ito et al., 2013). Advantaged competence with engaging in support of counterparts facilitates the sustainability of lifelong learning so that young people are able to pursue their emerging interests for either personal hobbies or career paths, using digital technologies across their lifespan.

In addition, the principle of homophily in gender and cultural background related to various peer relations at a dyad level was examined in *Study I*. Heterogeneity at a group level has been hypothesized to be another extension of the homophily principal other than peer selection and influence. Future studies could attempt to categorize students into groups based on individual attributes (e.g. different interests or hobbies) so that social relations within and between groups can be tested for the homogeneity of student behaviours at a group level.

Finally, the content analysis of personal network interviews in *Study III* indicated that there are likely to be several levels of closeness between adolescents in personal networks. Because people are inclined to have unequal closeness with different ties, future studies could extend the networking questions from having ties or not to scaled ties or no ties when collecting network data with social networking questionnaires.

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