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**ADOLESCENTS' SOCIO-DIGITAL ENGAGEMENT
AND ITS RELATION TO ACADEMIC WELL-BEING,
MOTIVATION, AND ACHIEVEMENT**

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Adolescents' socio-digital engagement and its relation to academic well-being, motivation, and achievement

Abstract

This thesis examined how adolescents' engagement with digital media is associated with academic and emotional functioning and the continuities and discontinuities between these two contexts. Towards that end, the gap hypothesis, that is, the hypothesis that students who prefer learning with digital media outside of school are less engaged in traditional school, was examined both cross-sectionally and longitudinally. Digital engagement was conceptualized as both socio-digital participation (i.e. adolescents' multidimensional practices of participating in digital contexts) and connected learning (i.e. self-regulated learning extended across time, space, and various contexts). Academic and emotional functioning was conceptualized as academic well-being (i.e. school engagement and burnout: exhaustion, cynicism, and inadequacy), motivation (i.e. achievement goal orientations), and academic achievement (i.e. grades). The first aim was to determine the multidimensional structure of socio-digital participation orientations that students' different digital activities reflect. The second aim was to examine the extent to which the orientations of socio-digital participation are related to academic and emotional functioning cross-sectionally and in different educational levels. The third aim was to examine the longitudinal relations of socio-digital engagement with academic well-being and academic achievement, especially focusing on the direction of the effects. This thesis consists of five original studies. In these studies, we used interview data, cross-sectional and longitudinal questionnaire data, and grades drawn from the registry. Various exploratory and confirmatory statistical methods, including both variable- and person-oriented latent variable modeling approaches, were used.

Study I was aimed at theoretically and empirically conceptualizing the components of socio-digital participation. In Study II, the hypothesized gap between adolescents' digital engagement, competencies, and academic motivation was evaluated. More precisely, we examined how students' profiles of achievement goal orientations are associated with socio-digital participation and skills. The goal of Study III was to extend the investigation of the differences in young peoples' approaches to socio-digital participation. First, the structure of the underlying orientations of socio-digital participation was examined across three samples of Finnish students. Second, we analyzed how these different orientations are associated with school engagement and burnout. In Study IV, the gap hypothesis was tested with longitudinal data. Finally, the goal of Study V was to expand our knowledge about how adolescents' socio-digital participation is longitudinally related to school

burnout and academic achievement. More specifically, Study V focused on the directions of effects among these constructs at the within-person level.

The first main finding was that the variation in digital activities can be explained with a complex structure of socio-digital participation orientations, which appear to be consistent across different age groups. Of all forms of digital participation, youths reported spending the majority of their screen time engaging in friendship-driven digital social networking. However, some adolescents reported socio-digital engagement that reached out to a wider audience, including sharing their art, providing a game server to facilitate other people's gaming activities, or building an extended network of developing expertise in the process. The second main finding was that there truly appeared to be a gap between adolescents' digital and academic engagement. The results revealed that motivationally indifferent students were more likely to engage in social media and gaming. Students who preferred digital learning but did not have the chance to digitally engage at school experienced a decrease in school engagement over time. Moreover, cynicism towards school and feelings of inadequacy predicted increased engagement with social media and action gaming. The third main finding was that digital participation yields both demands and resources and that these are tied together via multiple processes. Social media engagement was cross-sectionally related to lower study engagement and/or to higher symptoms of burnout, especially exhaustion. Longitudinally, social media engagement and emotional exhaustion were reciprocally related at the within-person level; exhaustion predicted an increase in social media engagement and vice versa. In turn, knowledge-oriented digital engagement was cross-sectionally related to higher study engagement, and digital learning preference predicted higher schoolwork engagement over time.

To conclude, adolescents' socio-digital engagement is fundamentally multidimensional and should be treated as such. The results showed support to the gap hypothesis, but the results also suggest that the manifestation of this gap is dependent on multiple factors, both individual and contextual. The gap might emerge because of out-of-school digital engagement that is not recognized in school or the gap might emerge due to problems in school leading to increased time spent with digital media. Intensive socio-digital engagement may also increase the daily psychological demands to such an extent that it hinders schoolwork, leading to symptoms of school burnout, but it can also increase the psychological resources supporting schoolwork given that congruence with academic practices is achieved.

Keywords: digital engagement, socio-digital participation, connected learning, school engagement, school burnout, academic motivation, academic achievement

Lauri Hietajärvi

Nuorten sosio-digitaalinen osallistuminen ja sen yhteydet kouluhyvinvointiin, motivaatioon, ja koulumenestykseen

Tiivistelmä

Tämä väitöstutkimus tarkasteli nuorten digitaalisen osallistumisen ja koulunkäynnin välisiä yhteyksiä, keskittyen erityisesti ”kuilu-hypoteesin” tarkasteluun. Kuilu-hypoteesi perustuu väitteelle jonka mukaan opiskelijat jotka ovat syventyneet oppimaan teknologiavälitteisesti koulun ulkopuolella, kokisivat alhaisempaa kouluintoa. Nuorten digitaalista osallistumista lähestyttiin sekä sosio-digitaalisen osallistumisen (moniulotteiset sosiaaliset digitaalisessa mediassa tapahtuvat osallistumistavat) että kytkeytyneen oppimisen (itseohjautuva oppiminen monissa eri konteksteissa) näkökulmista. Koulunkäyntiä tarkasteltiin sekä kouluhyvinvoinnin (kouluinto ja –uupumus), koulumotivaation (tavoiteorientaatiot) ja koulusuoriutumisen näkökulmista (arvosanat). Tutkimuksen ensimmäinen päätavoite oli analysoida, minkälaisia sosio-digitaalisen osallistumisen taustalla olevia orientaatioita nuorten toiminta digitaalisen median parissa heijastelee. Toinen päätavoite oli tutkia miten nämä sosio-digitaalisen osallistumisen orientaatiot ovat yhteydessä akateemisen hyvinvointiin ja suoriutumiseen poikkileikkausasetelmalla ja akateemisen polun eri vaiheissa. Kolmas tavoite oli kartoittaa minkälaisia yli ajan ulottuvia akateemisen hyvinvoinnin ja suoriutumisen muutosprosesseja voidaan tunnistaa suhteessa sosio-digitaaliseen osallistumiseen ja digitaalisen median käyttöön koulussa kolmen vuoden ajanjaksolla. Tämä väitöstutkimus koostuu viidestä osatutkimuksesta. Osatutkimukset perustuivat haastatteluaineistoon, poikittaiseen ja pitkittäiseen kyselylomakeaineistoon sekä lisäksi kerättiin rekisteripohjaisia arvosanatietoja. Aineistojen analyysiin käytettiin useita tilastollisia menetelmiä sisältäen muuttuja- ja henkilösuuntautuneita sekä eksploratiivisia että konfirmatorisia lähestymistapoja.

Osatutkimuksessa I tavoitteena oli tarkastella sosio-digitaalisen osallistumisen ulottuvuuksia sekä teoreettisesti että havaintoaineistoon perustuen. Osatutkimuksessa II keskityttiin tarkastelemaan informaalien teknologiavälitteisten käytäntöjen ja opiskelijoiden opintoihin liittyvien tavoiteorientaatioiden välistä kuilua. Tarkemmin kuvattuna tutkimuksessa II selvitettiin miten eri tavoiteorientaatioprofiileja edustavat opiskelijat eroavat toisistaan sosio-digitaalisen osallistumisen ja digitaalisten taitojen suhteen. Osatutkimuksessa III täydennettiin ensimmäisen osatutkimuksen luomaa perustaa ja palattiin analysoimaan nuorten sosio-digitaalisen osallistumisen moniulotteista rakennetta ja näiden ulottuvuuksien yhteyksiä kouluhyvinvointiin kolmessa eri aineistossa, jotka edustivat opintopolun eri vaiheita. Osatutkimuksessa IV syvennyttiin kuilu-hypoteesin testaamiseen. Tätä tarkasteltiin pitkittäisaineiston avulla. Lopuksi,

osatutkimuksessa V pyrittiin laajentamaan ymmärrystä sosio-digitaalisen osallistumisen ja kouluhyvinvoinnin ja -suoriutumisen välisistä yhteyksistä, keskittyen yhteyksien suuntiin yksilön sisäisellä tasolla pitkäjäsenäistä hyödyntäen.

Ensimmäinen keskeinen tulos tässä väitöstutkimuksessa oli, että nuorten sosio-digitaalinen osallistuminen on rakenteeltaan perustavanlaatuisesti moniulotteista. Sama sosio-digitaalisen osallistumisen rakenne näytti olevan tunnistettavissa eri-ikäisillä oppilailla ja eri vaiheissa opintopolkua. Lähtökohtaisesti nuoret osallistuiivat aktiivisimmin ystävyyslähöiseen toimintaan, kuten sosiaalisten suhteiden ylläpitämiseen sosiaalisessa mediassa. Tästä huolimatta aineistosta oli tunnistettavissa myös nuoria, joiden sosio-digitaalinen osallistuminen oli syventynyt myös kattamaan laajempia kokonaisuuksia, heidän osallistumisensa sisälsi mm. omien taiteellisten teosten tuottamista ja jakamista, peliserverin ylläpitämistä sekä sitä kautta laajan oppimista tukevan verkoston osana toimimista. Toinen päätulos tässä väitöstutkimuksessa oli kuilu-hypoteesin todentaminen. Kuilu nuorten koulun ulkopuolisten käytäntöjen ja koulun välillä näyttää siis olevan olemassa. Tulokset osoittivat, että opiskelutavoitteiltaan välinpitämättömämmät nuoret osallistuvat aktiivisemmin sosiaalisessa mediassa sekä pelasivat digitaalisia pelejä intensiivisemmin. Ne opiskelijat, jotka olivat syventyneet teknologiavälitteiseen oppimiseen koulun ulkopuolella, mutta jotka samaan aikaan kokivat tarvetta hyödyntää digitaalista teknologiaa enemmän myös koulutyössä, kokivat kouluintonsa laskevan. Kynisyyden kokeminen koulua kohtaan sekä riittämättömyyden tunteet oppilaana sen sijaan näyttivät ennustavan lisääntyvää sosiaalisessa mediassa osallistumista sekä toimintapeliä pelaamista. Kolmas päätulos tässä tutkimuksessa oli, että sosio-digitaalisen osallistuminen näyttää tarjoavan nuorille sekä voimavaroja että vaatimuksia. Alakoulussa ja lukiossa intensiivisempi osallistuminen sosiaalisessa mediassa oli yhteydessä joko alhaisempaan kouluintoon tai korkeampaan uupumukseen. Osallistuminen sosiaalisessa mediassa oli vastavuoroisessa yhteydessä uupumuksen kanssa yli ajan, koulu-uupumus ennusti lisääntyntä sosiaalisen median käyttöä ja päinvastoin. Toisaalta, tietosuuntautunut digitaalinen osallistuminen näytti tuottavan voimavaroja; se oli yhteydessä korkeampaan kouluintoon ja suuntautuminen teknologiavälitteiseen oppimiseen ennusti lisääntyvää kouluintoa.

Nuorten sosio-digitaalisen osallistumien on luonteeltaan moniulotteista, ja tämä tulisi tunnistaa lähtökohtaisesti kaikilla tasoilla. Tulokset antoivat tukea kuilu-hypoteesille, mutta tulokset myös näyttivät kuilun ilmenemisen olevan riippuvainen useista muista tekijöistä sekä yksilön että ympäristön tasolla. Kuilu saattaa revetä, mikäli koulun ulkopuolella hankittua osaamista ei tunnisteta koulussa, mutta yhtä hyvin se voi syntyä seurauksena vieraantumiselle koulun käytännöistä. Intensiivinen sosio-digitaalinen osallistuminen saattaa kuormittaa nuorta, lisäten psykologisia vaatimuksia johtaan uupumukseen. Toisaalta se voi myös tarjota voimavaroja jotka tukevat koulutyötä, mikäli nuoren koulun ulkopuoliset käytännöt saadaan sopimaan koulun käytäntöjen kanssa.

Avainsanat: sosio-digitaalinen osallistuminen, kytkeytynyt oppiminen, kouluinto, koulu-uupumus, opiskelumotivaatio, koulumenestys

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Lauri Hietajärvi

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Appendix A. Summary of means, standard deviations, and internal consistencies of the scales used in the original studies.

List of original articles

This dissertation is based on the following five original publications, which are referred to in the text by their Roman numerals (Studies I-V):

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

Study II. Hietajärvi, L., Tuominen-Soini, H., Hakkarainen, K., Salmela-Aro, K., & Lonka, K. (2015). Is student motivation related to socio-digital participation? A person-oriented approach. *Procedia-Social and Behavioral Sciences*, *171*, 1156–1167.

Study III. Hietajärvi, L., Salmela-Aro, K., Tuominen, H., Hakkarainen, K., & Lonka, K. (2019). Beyond screen time: Multidimensionality of socio-digital participation and relations to academic well-being in three educational phases. *Computers in Human Behavior*, *93*, 13–24.

Study IV. Hietajärvi, L., Lonka, K., Hakkarainen, K., Alho, K., & Salmela-Aro, K. (submitted). Are Schools Alienating Digitally Engaged Students? Longitudinal Relations between Digital Engagement and Schoolwork Engagement.

Study V. Hietajärvi, L., Lonka, K., Maksniemi, E., Hakkarainen, K., Alho, K., & Salmela-Aro, K. (submitted). Adolescents' Social Media Engagement, Action Gaming, School Burnout and Academic Performance: A Multiple Indicator Random-Intercept Cross-lagged Panel Model Approach.

1 Introduction

Since the introduction of the “digital natives” metaphor (Prensky, 2001), there have been debates regarding whether today’s young people feel disengaged in more traditional schoolwork (Kumpulainen & Sefton-Green, 2012; Selwyn, 2006) or whether they represent a generation that has been socio-emotionally destroyed because of the introduction of mobile technologies (Twenge, 2017). The outcomes of adolescents’ engagement with digital media have been a topic of both public and academic discussion. This is not surprising as according to a series of surveys mapping the digital activities of children and adolescents in Europe “children are going online more, at younger ages, and in more diverse ways” (EU Kids Online, 2014). Similarly, the recent 2018 Pew Research survey ‘Teens, Social Media & Technology’ revealed that altogether 89% of US teens report their internet use to be at least several times a day (Anderson & Jiang, 2018).

This thesis contributes to the discussion by empirically tapping into the different ways that adolescents engage with digital technologies and how these different practices are related to academic functioning (Roeser, Eccles, & Freedman-Doan, 1999) from early adolescence to young adulthood. The main body of this thesis focuses on adolescence, as it is a critical phase in life characterized by various developmental tasks (Dietrich, Parker, & Salmela-Aro, 2012; Eccles, 2004; Mannerström, Muotka, & Salmela-Aro, 2019), including the psychophysiological maturation of cognitive, emotional, and social functioning (Burnett, Sebastian, Kadosh, & Blakemore, 2011; Steinberg & Morris, 2001). During adolescence students are also expected to perform successfully in school, make educational choices, and build competencies needed in the future. The above-mentioned and sometimes contradictory challenges can for some adolescents pose adjustment difficulties in terms of academic and emotional functioning, which appear to go hand in hand (e.g. Roeser, Eccles, & Sameroff, 1998; Roeser et al., 1999). Moreover, adolescence is a crucial period for the development of identity, building of social relations (e.g. Baumeister & Leary, 1995; Havighurst, 1948; Maurizi, Grogan-Kaylor, Granillo, & Delva, 2013), and individual interests (Barron, 2006) through activities that appear to be increasingly mediated by digital media (Hur & Gupta, 2013).

The possibilities and benefits of gaining and sharing thoughts, experiences, and information through digital media are hard to dispute (Allen, Ryan, Gray, & McInerney, 2014; Moorhead, Hazlett, Harrison, Carroll, Irwin, & Hoving, 2013; Skoric, Zhu, Goh, Pang, 2016), but there are also concerns regarding the psychosocial effects of intensive engagement with digital media. Generally, it is agreed that both positive and negative outcomes can emerge (see e.g. Allen et al., 2014; Hur & Gupta, 2013). Whilst in public discussion the harmfulness of digital

engagement is often justified, claiming that it displaces such activities as sleep or physical activity, research indicates that this claim is inaccurate at best (Melkevik, Torsheim, Iannotti & Wold, 2010; Przybylski, 2019). Moderate engagement with digital tools and media, as proposed in the “Goldilocks Hypothesis” (see Przybylski & Weinstein, 2017), appears to have positive outcomes in relation to peer-group relations and, for instance, identity formation (Mannerström, Hietajärvi, Muotka & Salmela-Aro, 2018), social connectedness, and less feelings of loneliness (Allen et al., 2014; Wang, Frison, Eggermont & Vandenbosch, 2018). Even being highly engaged in digital activities (e.g. gaming) does not necessarily include negative outcomes (Brunborg et al., 2013). Excessive or addiction-like engagement with digital media, in which the balance in life is severely compromised, appears, however, to be related to negative psychological well-being such as depressive symptoms (Brunborg et al., 2013; Etchells, Gage, Rutherford, & Munafò, 2016; Holmgren & Coyne, 2017; Krossbakken et al., 2018; Liu, Wu & Yao, 2015; Przybylski & Weinstein, 2017). The research at this point, however, concludes that the contextual factors and qualitative differences related to different digital activities with regard to excessive digital engagement have received little attention (Anderson, Steen & Stavropoulos, 2017).

If we move beyond the hypotheses related to the time-frequency domain of digital engagement, it is also likely that the differing digital participation practices (e.g. Jenkins, 2009) are more or at least as important to well-being as the total time spent with screens. For instance, a study using objective Facebook log-data indicated that communication with close friends online was related to better psychological well-being, whereas merely passively scrolling content was not (Burke & Kraut, 2016). That said, longitudinal studies are scarce and limited in their scope of digital engagement. However, some recent longitudinal studies report an association in adolescence between depressive symptoms and an increasing trajectory of social media use (e.g. Coyne, Padilla-Walker, Holmgren, & Stockdale, 2018). In turn, a rising trajectory of depressive symptoms has been found to be related to increased screen time (Houghton et al., 2018). Moreover, pathological gaming appears to have a reciprocal relation to both depression and loneliness (Krossbakken et al., 2018). On the general level of “screen time”, it is concluded that these effects are mostly negligible (Huang, 2017; 2010; Orben & Przybylski, 2019) and that the majority of adolescents appear to engage with digital technologies without experiencing major negative effects on general well-being (Coyne et al., 2018; Przybylski & Weinstein, 2017). However, as adolescents’ digital engagement is not unidimensional, it can be assumed that the outcomes of digital engagement are also not unidimensional. In other words, to rely on a simplified and unidimensional concept of “screen time” will lead to biased inferences (see Bell, Bishop, & Przybylski, 2015). Accordingly, the approach to digital engagement in this thesis relies on a more nuanced understanding of young peoples’ digital participation.

1.1 The conceptual framework

The conceptual framework adopted here on digital engagement accepts the premises that students are active agents in their varying practices of digital participation, thus capable of developing skills and competencies within their digitally mediated learning ecologies (Barron, 2006, EU Kids Online, 2014, Ito et al, 2010; 2013), but can also engage in harmful practices that might have repercussions on their cognitive and socio-emotional functioning (Allen et al., 2014; Firth et al., 2019; Hur & Gupta, 2013). Accordingly, this thesis adopted conceptual tools from different fields (Table 1). From the socio-culturally oriented field of connected and informal learning (Erstad & Sefton-Green, 2013; Ito et al, 2013), studying adolescents' informal and self-regulated engagement with digital media, we utilized concepts such as socio-digital engagement (Hakkarainen, Hietajärvi, Alho, Lonka & Salmela-Aro, 2015) and connected learning (Kumpulainen & Sefton-Green, 2012) described in Section 1.2. Henceforth in this thesis the concept of digital media is used as an umbrella term referring to the abundance of digital technologies and applications. Furthermore, as one of the starting points of this thesis was to examine how informal out-of-school learning via digital engagement spills over into academic contexts, this thesis also adopted concepts from the field of educational and developmental psychology, representing academic and emotional functioning (Eccles, 2004; Roeser et al., 1998; 1999), by utilizing concepts of academic well-being (Salmela-Aro, 2017), motivation (Tuominen-Soini, 2012), and achievement (Pintrich, 2000) described in more detail in Section 1.3. In Section 1.4, the perspective adopted and the broader theoretical hypotheses that were applied are outlined.

Table 1. Overview of the main operationalized concepts.

Socio-digital engagement	
Socio-digital participation - Latent orientations of socio-digital participation reflected by various digital activities	Connected learning - Digital learning preference - Wish for digital schoolwork
Academic well-being, motivation, and achievement	
Schoolwork engagement - Energy - Dedication - Absorption	School burnout - Emotional school-related exhaustion - Cynicism towards school - Feelings of inadequacy as a student
Achievement goal orientations - Mastery-intrinsic - Mastery-extrinsic - Performance-approach - Performance-avoidance - Avoidance	Academic achievement - Self-reported grade point average - Registry-based grades

1.2 Beyond screen time: complexity of adolescents' socio-digital engagement

A considerable body of research has focused on studying the effects of “screen time” as a unidimensional concept referring to the total time spent with screens. This concept, however, is inherently flawed as it does not consider the variation in the content of screen time nor the active role of the individual involved. Thus, the core of this thesis lies in acknowledging that the differences in adolescents' practices of engaging with digital media are more important than, for instance, minutes spent around screens. This thesis builds on the assumption that adolescents are not only active participants in their screen-related use of time, but also that adolescents' practices of digital engagement are inherently multifaceted (Eynon & Malmberg, 2011; Kennedy, Judd, Dalgarno & Waycott, 2010; Thompson, 2013; van den Beemt, Akkerman & Simons, 2011). Moreover, offline and online contexts are not separated, but instead intertwined in a dynamic interplay (Baym & boyd, 2012) and should be approached as integrated in adolescents' everyday life and reflective of their overall daily activities, motives, and experiences. Adolescents' engagement with digital media should be approached more as deliberate participation in media flow and cultural practices conceptualized through the different genres and the constantly evolving underlying orientations (Ito et al, 2010). Consequently, adolescents' digital engagement was considered to be reflected in their practices of socio-digital participation and connected learning. These were used as conceptual frameworks.

1.2.1 Socio-digital participation

A crucial part of adolescents' socio-digital engagement was conceptualized to constitute various orientations of socio-digital participation (SDP; Hakkarainen et al., 2015). By socio-digital technologies, we refer to the integrated systems of novel technological tools, social media, and the internet that enable constant and intensive online interaction with information, people, and artifacts. These technologies have transformed adolescents' everyday life, their peer relations, and their interaction with the world around them. Accordingly, the orientations of socio-digital engagement are not conceptualized as “using technologies”, but as practices of participating and, in general, reflecting issues related to adolescents' life and experiences. Moreover, the concept of socio-digital participation also considers that digital activities are social in the sense that they involve direct or artifact-mediated networking interaction and involve participation in culturally mediated activities (Gee & Hayes, 2011; Ito et al., 2010; Jenkins, 2009). However, despite earlier, naïve claims of adolescents' miraculous digital competencies, it is now apparent that both the digital activities and the related competencies of

adolescents are far from uniform and that the claims of a new technologically sophisticated generation are largely ungrounded (Bennett & Maton, 2010; Margaryan & Littlejohn, 2011). The emphasis has slowly shifted towards examining the different ways that young people engage with digital tools and media.

Adolescents' differences in socio-digital engagement can be approached based on two differing but overlapping practices or genres of participation (Ito et al., 2010): friendship-driven, that is, using technologies to keep up and deepen already established social connections, and interest-driven, that is, utilizing modern technologies to learn and engage in activities based on a specific object of interest. Drawing on these dimensions, Ito and colleagues (2010) describe three levels of socio-digital participation: a) "hanging out" including communication with friends and using technology for entertainment, b) "messing around" with technology and media that engage in learning and complex problem solving, and c) "geeking out" for seriously building object-oriented expertise related to digital technologies or creative working with media. While friendship-driven activities are focused on interacting mostly with already known friends, interest-driven activities are centered on a mutual interest and often involve interacting with extended social and knowledge networks (Barron, 2006). Survey studies (Eynon & Malmberg, 2011; Kennedy et al., 2010, van den Beemt et al., 2011) addressing the variation in adolescents' digital activities support the conceptualizations of Ito and colleagues. These share the key finding that, in terms of digital media, the majority of adolescents engage mostly in friendship-driven activities (e.g., interacting with friends, entertainment), and only a relatively small minority participate frequently in more demanding, interest-driven digitally mediated activities (e.g., building semi-professional skills mediated by digital media). Although only a few adolescents appear to be "geeking out", practices of most adolescents are expected to fluctuate across diverse forms of friendship- and interest-driven activities so that their digital engagement involves elements of all of these practices. This thesis focuses on the underlying multiple dimensions of digital activities; of these, previously recognized have been at least social networking/ communicating oriented participation (chatting, communicating), knowledge-oriented participation (knowledge seeking and sharing knowledge), media-oriented participation (creating and sharing media), and different types of digital gaming (Eynon & Malmberg, 2011; Kennedy et al., 2010; Li, Hietajärvi, Palonen, Salmela-Aro, & Hakkarainen, 2016; Thompson, 2013; van den Beemt, Akkerman, & Simons, 2011). Henceforth, the concept of socio-digital engagement is used in this thesis as an umbrella term including both the underlying orientations of socio-digital participation and the activities that students engage in with digital media within their connected learning ecologies.

However, digital engagement and socio-digital engagement are sometimes used interchangeably.

1.2.2 Connected learning

With regard to learning outcomes, digital engagement has been proposed to facilitate learning through social participation and expanding of resources by appropriation of new skills and building competencies (Barron, 2006; Chassiakos, Radesky, Christakis, Moreno, & Cross, 2016; Granic, Lobel, & Engels, 2014; Hakkarainen et al., 2000; Ito et al., 2010; Li et al., 2016; Moisala et al., 2016a). Therefore, socio-digital engagement was also considered to be an expression of connected learning (Ito et al., 2013; Kumpulainen & Sefton-Green, 2012), that is, learning extended across time, space, networks, and tools, situated in the reciprocal interactive processes between the learners and their social ecologies (Nardi & O'Day, 2000). It appears that the more children and adolescents engage with digital media, the more skills they gain (EU Kids Online, 2014). Much of this connected and interest-driven learning (Barron, 2006) has been identified as occurring in informal, out-of-school contexts (Kumpulainen & Sefton-Green, 2012). To conclude, digital engagement provides adolescents with multifaceted opportunities for personal and collaborative creation of knowledge and artifacts by integrating processes of autonomous self- and co-regulated learning, making, and sharing (Bereiter & Scardamalia, 2006; Shirky, 2010) and through participation in digitally mediated cultural practices (Jenkins, 2009) as well as associated locally emerged ecologies of learning and participation (Barron, 2006). We are talking about connected learning when informal and formal contexts of learning are connected so that students can thrive and develop as learners across various contexts (Ito et al., 2013).

1.3 Academic well-being, motivation and achievement

Prior studies indicate that different indicators of academic and emotional functioning develop reciprocally during adolescence (Roeser et al., 1998; 1999) and that, for instance, study motivation is related to both well-being and academic achievement (Tuominen-Soini et al., 2008; 2012). Therefore, academic well-being and motivation were approached from multiple perspectives: achievement goal orientations in Study II, school engagement in Studies III and IV, and school burnout in Studies III and V. Academic achievement was assessed through grades in Studies II and V.

1.3.1 Schoolwork engagement and school burnout

In recent decades, the concept of school engagement has received a lot of attention (Fredricks, Blumenfeld, & Paris, 2004) and what is meant by engagement varies. In this thesis, a more well-being-oriented approach to engagement was adopted. Consequently, in this study school engagement was defined as consisting of emotional, cognitive, and behavioral components: energy, dedication, and absorption (Salmela-Aro & Upadyaya, 2012). Energy in this context refers to a positive and proactive approach to schoolwork, dedication to a positive cognitive attitude or motivation towards schoolwork, and perceiving schoolwork as meaningful, while absorption refers to an experience of concentration on schoolwork and a feeling that time seems to pass quickly. Experiencing a high level of school engagement is beneficial for students' academic achievement and well-being (Salmela-Aro & Upadyaya, 2012; Upadyaya & Salmela-Aro, 2013), and thus, should be one of the main goals promoted in modern pedagogies.

In general, most students in Finland can be considered engaged (Salmela-Aro, Muotka, Alho, Hakkarainen & Lonka, 2016a; Salmela-Aro & Read, 2017; Tuominen-Soini & Salmela-Aro, 2014). However, although on the grand mean level Finnish students show high levels of school engagement, research has identified subgroups struggling with disengagement and cynicism towards school (Salmela-Aro, 2017). Further, in previous studies both personal (self-efficacy) and school-related resources (support) predicted school engagement (Salmela-Aro & upadyaya, 2014), and it is of interest how the practices of digital engagement can potentially contribute to these resources.

As an indicator of negative school-related well-being, this thesis focused on school burnout. Although burnout is generally examined in work contexts, it can also be usefully applied to school context (Salmela-Aro, Kiuru & Nurmi, 2008; Salmela-Aro, Kiuru, Leskinen & Nurmi, 2009; Schaufeli, Martinez, Pinto, Salanova & Bakker, 2002). In schools adolescents are expected to engage in study work and meet requirements. School burnout, similarly as job burnout, is emerging from an imbalance of the psychological and practical demands and the resources available to meet these demands (Salmela-Aro & Upadyaya, 2014). In this thesis, school burnout was conceptualized as consisting of three dimensions: emotional exhaustion due to study demands, a cynical orientation towards school, and feelings of inadequacy as a student (Salmela-Aro et al., 2009). Exhaustion refers to experiencing tiredness, ruminating about school-related issues, and subsequent sleep problems and can be conceptualized as also an indicator of stress. Cynicism towards school is defined as an indifferent attitude towards studying in general or a loss of interest in and meaning of studying. Sense of inadequacy as a student refers to a diminished feeling of competence, achievement, and accomplishment as a student. A recent study using the demands-resources model in the school context revealed that school burnout predicted a decrease in school engagement later on and that study-related demands, such as

demanding education goals and workload, predicted school burnout (Salmela-Aro & upadyaya, 2014),

With regard to previous studies regarding schoolwork engagement and burnout combined, Tuominen-Soini and Salmela-Aro (2014) identified four groups of Finnish high school students: engaged, engaged-exhausted, burned-out, and cynical. Both engaged (44%) and engaged-exhausted (28%) students were engaged and doing well in school, although engaged-exhausted students were more stressed and more worried of possible failures. Cynical (14%) and burned-out (14%) students were less engaged, showed lower school values, and had worse academic achievement. Cynical students, however, showed less stress, exhaustion, and depressive symptoms than their burned-out peers.

To conclude, both schoolwork engagement and school burnout have been widely used across different age samples, educational contexts (Salmela-Aro & Read, 2017; Tuominen-Soini & Salmela-Aro, 2014), and outcomes (Salmela-Aro & Upadyaya, 2012; Salmela-Aro et al., 2009) and when combined have been shown to provide a good overview of students' academic and psychological functioning (Salmela-Aro, 2017; Upadyaya & Salmela-Aro, 2013).

1.3.2 Achievement goal orientations

Achievement goal orientations represent the students' generalized reasoning for engaging in academic tasks, that is, the broader purposes for engaging in academic pursuits. More specifically, achievement goal orientations describe the kinds of goals the students tend to choose and the kinds of outcomes they prefer in relation to studying (Niemivirta, 2002). The central distinction has been between students' strivings towards developing their competence and towards demonstrating their competence, that is, between mastery and performance goals. This distinction has later been expanded and additional goals related to achievement behavior have been described (see Elliot & Harackiewicz, 1996; Elliot & McGregor, 2001; Niemivirta, 2002). For instance, work avoidance has been recognized as one possible goal orientation, which means that the student does not wish to engage in academic activities and is especially pleased when he or she does not have to work hard (Nicholls, Patashnick, & Nolen, 1985).

At present, it is widely accepted that students can pursue multiple goals simultaneously and these are often examined by using a person-oriented approach (Meece & Holt, 1993; Niemivirta, 2002; Pintrich, 2000; for review, see Niemivirta, Pulkka, Tapola, & Tuominen, 2019) and identifying latent profiles as was done in Study II. Such profiles have in previous research been identified as students who display dominantly mastery tendencies, students who emphasize mainly performance tendencies, students who display primarily avoidance tendencies, and students without a dominant tendency towards any specific

achievement goal orientation (Niemivirta et al., 2019; Tuominen-Soini, Salmela-Aro & Niemivirta, 2008; 2011; 2012).

Students with different achievement goal orientation profiles have been shown to differ in, for instance, general socio-emotional functioning, that is, both school-related and general well-being as well as their actual academic achievement in terms of grades (Tuominen-Soini et al., 2008; 2012). In general, mastery and performance-oriented students tend to also perform better than indifferent or avoidance-oriented students (Tuominen-Soini et al., 2008; 2012). To my knowledge, no studies have examined how students' different motivational profiles are reflected in their digital engagement, that is, how students with different achievement goal orientations in relation to school differ in their socio-digital engagement and whether these patterns reflect supportive processes or discrepancies with regard to schoolwork.

1.3.3 Academic achievement

In this thesis, academic achievement was conceptualized directly through academic grades and was taken to reflect general behavioral academic functioning. Indeed, previous research indicates that good academic success is associated with high levels of school engagement (Upadaya & Salmela-Aro, 2013) and adaptive achievement goal orientations (Tuominen-Soini, 2012).

1.4 The perspective adopted

Beyond aiming to conceptualize the multiple dimensions of digital engagement, this thesis specifically focused on examining the relations between students' digital engagement and academic and emotional functioning, which has received less attention from the research community than issues of general well-being as presented in the introduction. Moving beyond screen time and adopting the understanding of digital engagement as driven by different orientations and reflected through varying types of activities allowed me to extend this study towards examining some explanatory perspectives. Previous studies have already identified differing cross-sectional profiles (Eynon & Malmberg, 2011; Kennedy et al., 2010; van den Beemt, Akkerman & Simons, 2011) and longitudinal patterns (Krossbakken et al., 2018; Rosenberg et al., 2018) of engagement with digital media, and it is likely that these differences play a role also in well-being and school-related outcomes, suggesting that diversity in adolescents' experiences with digital media should be taken better into account (Howard, Ma & Yang, 2016).

It seems that the field of digital media engagement and related outcomes, although growing, is still lacking an adequate theoretical foundation (Orben,

2019). In this thesis, the discrepancies between digital and academic engagement were approached by applying concepts and theoretical models used in neighboring contexts to the study of digital media. The relations from digital media to academic well-being, motivation, and achievement were approached, on the one hand, from the viewpoint of continuities and discontinuities between informal and formal learning (Malcolm, Hodgkinson, & Colley, 2003) and, on the other hand, from the viewpoint of the demands-resources model of well-being (Demerouti, Bakker, Nachreiner & Schaufeli, 2001). The theoretical hypotheses/models presented in more detail in the following sections were adopted as conceptual tools to explain the possible varying relations and psychological processes connecting the digital and academic contexts.

1.4.1 Gap hypothesis

Students live, experience, and learn across various contexts, and how learning is framed in academic settings is not the whole picture (Erstad & Sefton-Green, 2013). The recently emerged practices of socio-digital engagement have opened a whole new layer of opportunities for adolescents to participate, network, create, and develop various competencies in the process (Ito et al, 2010; 2013). These types of self-regulated practices are not always congruent with the more traditional ways of learning and participating in schools. Students flourish and fulfill their potential when the informal and formal practices of learning are congruent (Ito et al, 2013), but when this is not the case frictions can emerge (Vermunt & Verloop, 1999). Destructive friction emerges when students' existing ways of self-regulated learning or their competencies are not recognized or utilized in the more teacher-regulated practices of schooling, consequently causing a decrease in academic and emotional well-being (Vermunt & Verloop, 1999). Constructive friction occurs when students' out-of-school practices of working with knowledge are challenged in school, but in a way that supports personal growth and development as a learner (Vermut & Verloop, 1999).

Regarding digital engagement, it has been suggested that the ways that students engage with digital media in their out-of-school activities collides with the presumably more traditional pedagogical practices of school (Halonen, Hietajärvi, Lonka & Salmela-Aro, 2016; Kumpulainen & Sefton-Green, 2012). This is referred to as the gap hypothesis pointing to the gap between adolescents' digital and school-related engagement (Kumpulainen & Sefton-Green, 2012; Prensky, 2001; Salmela-Aro, Muotka, Alho, Hakkarainen, & Lonka, 2016a; Selwyn, 2006). The gap hypothesis suggests that elementary school students who are engaged in learning with digital media out of school are possibly consequently disengaged in traditional school (Halonen et al, 2016), which in this thesis is conceptualized as a manifestation of destructive friction. The tentative gap appears, however, to be

more complex than originally thought. Studies to date suggest that regarding learning the majority of students do not engage with digital media in more sophisticated or critical ways (Thompson, 2013; Wang, Hsu, Campbell, Coster & Longhurst, 2014; Waycott, Bennett, Kennedy, Dalgarno & Gray, 2010) and some students who are digitally engaged outside of schools do not necessarily see it as purposeful in learning in school (Glušac, Makitan, Karuović, Radosav, & Milanov, 2015). Adolescents do not all share the same experiences regarding media (Bennett & Maton, 2010), suggesting that they might experience learning with technologies also differently (Hatlevik, Guðmundsdóttir, & Loi, 2015; Howard, Ma & Yang, 2016; Moos & Azevedo, 2009).

The gap hypothesis is supported by findings indicating that students reporting more cynicism towards school also reported that they would be more engaged in their schoolwork if they were able to use more digital media (Salmela-Aro et al., 2016a). Other studies, in turn, offer both positive and negative relations between out-of-school digital engagement and student engagement depending on the actual activities (Bebell & Kay, 2010; Junco, 2012a; 2012b). With regard to academic achievement, the literature suggests that the use of social media is positively related to literacy grades and negatively to general academic achievement (Kirschner & Karpinski, 2010; Liu, Kirschner & Karpinski, 2017). However, there may be individual differences in this. For instance, for some students the use of social networking services appears to be related to better academic achievement (Ainin, Naqshbandi, Moghavvemi & Jaafar, 2015), depending on, for example, personality traits (Naqshbandi et al., 2017). Gaming, in turn, seems to have a small negative effect on academic achievement (Ferguson, 2015), whereas especially strategic video games predict academic achievement indirectly through higher problem-solving skills (Adachi & Willoughby, 2013). Although gaming has been shown to have benefits in developing various competencies (Granic, Lobel, & Engels, 2014), the motivational pull of gaming might be overriding the motivation for schoolwork (Ryan, Rigby & Przybylski, 2006). In general, however, using digital media in education appears to offer mainly positive results regarding school engagement and achievement (Bebell & Kay, 2010; Junco, Heiberger & Loken, 2011; Sung, Chan & Liu, 2016; Tamim, Bernard, Borokhovski, Abrami, & Schmid, 2011).

The above-mentioned complexity of adolescents' engagement with digital media and learning calls for a more nuanced formulation and theoretical justification of the gap hypothesis. For instance, as an explanatory mechanism, taken from the general field of study on the gap between informal and formal learning (Malcolm, Hodkinson, & Colley, 2003), it is often proposed that students' out-of-school interests and competencies are not recognized (Rajala, Kumpulainen, Hilppö, Paananen, & Lipponen, 2015), or that their out-of-school practices of working with learning and knowledge are so different that this creates

a misfit, or a destructive friction (Vermunt & Verloop, 1999), between the learner and the learning environment (Kumpulainen & Sefton-Green, 2012, McFarlane, 2015), or both. Towards that end, it may be that if students' out-of-school digital practices and experiences of learning with digital media are misaligned with what is actually done in schools, this might lead to increased symptoms of school burnout or vice versa. Accordingly, this approach was adopted in this thesis.

1.4.2 Demands-resources model

The digital Goldilocks hypothesis refers to an understanding that moderate technology use is not harmful, but excessive digital engagement can displace alternate activities that are known to be linked to well-being such as spending time with friends, reading, or exercise (Przybylski & Weinstein, 2017). From a psychological point of view, the digital Goldilocks hypothesis can be approached from the theoretical framework of the demands-resources model (Salmela-Aro & Upadyaya, 2014). In the demands-resources model, the possible negative outcomes are seen as resulting from an imbalance of the psychological demands (e.g. interruptions, cognitive load, emotional dissonance) and the resources (e.g. knowledge building and utilization, peer support) available to overcome these demands (Demerouti et al., 2001). The outcomes can be conceptualized over two processes, the energy-depleting process and the motivational process, also in relation to school context (Salmela-Aro & Upadyaya, 2014).

On one hand, some specifically frequent or intensive practices of digital engagement (i.e. keeping up with multiple social media feeds, posting frequently, intensive gaming) mediated by, for instance, fear of missing out (Alt, 2015; 2018; Dhir, Yossatorn, Kaur & Chen, 2018; Oberst, Wegmann, Stodt, Brand, & Chamarro, 2017; Przybylski, Murayama, DeHaan & Gladwell 2013) or lack of regulation, may lead to increases in the daily cognitive demands, which consequently lead to lower academic (and general) well-being. With regard to academic well-being, the relation between excessive digital participation and general well-being has already been extended to school burnout (Salmela-Aro, Upadyaya, Hakkarainen, Lonka & Alho, 2016b), indicating that excessive internet use predicts later school burnout and vice versa. The potential negative effects of digital engagement on academic well-being can indicate an imbalance between study demands and individual psychological resources. This might be a result of motivational interference and regularly choosing to engage in digital activity over academic activities (Chen, Teo & Zhou, 2016) or multitasking while studying (Adler & Benbunan-Fich, 2012; Chen & Yan, 2016, van Der Schuur, Baumgartner, Sumter, & Valkenburg, 2015), causing less progress, more mistakes, and a build-up of academic work, leading to lower academic well-being through the energy-depletion process (Salmela-Aro & Upadyaya, 2014). On the

other hand, socio-digital engagement and consequent connected learning can also be providing novel resources for students (Waycott et al., 2010) that support study activities and lead to higher study engagement and motivation in line with the motivational process; increased resources may spill over to higher motivation (Salmela-Aro & Upadyaya, 2014). For instance, the cognitive benefits derived from gaming (Moisala et al., 2016a) can function as resources if students are able to utilize them in schoolwork. Some students engage in digital participation to develop their interests (Barron, 2006), skills, and competencies by intensive and deep engagement (i.e., geeking out; Ito et al, 2010). It can be deduced that this type of engagement would be likely to provide students with expanded resources for also learning in academic settings (Barron, 2006; Ito et al, 2013). Resources, as mentioned, have been shown to predict higher school engagement (Salmela-Aro & Upadyaya, 2014). This gives reason to suspect that in some students more sophisticated digital participation might well promote school engagement, in contrast to what is implied by the initial gap hypothesis.

To conclude, the theoretical backdrop of this thesis was in combining the multiple perspectives on digital engagement with the processes of academic motivation, well-being, and achievement using the gap hypothesis and demands-resources models as analytical frameworks in conceptualizing the complex interplay between the digital and academic contexts.

2 Aims and methods of the study

2.1 Main aims

The overall aim of this thesis was to move beyond the concept of “screen time” and examine how and why adolescents engage in digital participation and, further, to investigate if and how digital participation is related to academic and emotional outcomes. Towards that end, a core aim was to develop the conceptual discourse in terms of the related social and psychological processes that could be used in interpreting the causes for these relations, their directions, and their educational implications. Thus, in a broader sense the three main aims were to broaden empirically the conceptualization of adolescents’ digital engagement and examine the gap hypothesis as well as the demands-resources model combining digital engagement with academic and emotional functioning. The main empirical research questions of this thesis can be summarized into three research questions:

- What kinds of multidimensional structures of socio-digital participation orientations do students’ different digital activities reflect (Studies I and III)?
- How are the orientations of socio-digital participation related to academic well-being, motivation, and achievement cross-sectionally (Study II) and at different educational levels (Study III)?
- What kinds of supportive or destructive longitudinal processes of academic well-being and achievement across upper comprehensive school can be identified in relation to socio-digital engagement, wish for using digital media in schoolwork (Study IV), and at the within-person level (Study V)?

The thesis consisted of five original studies (see also Table 3). The first research question was addressed in Studies I and III and was related to moving beyond the concept of screen time and uncovering young peoples’ multiple approaches to using digital media both qualitatively and quantitatively. That is, the aim was to examine the multidimensional structure of orientations underlying socio-digital engagement. The second research question was addressed in Studies II and III and was directed towards moving further and examining if, and how, these different orientations were related to academic well-being or motivation. The third research question was addressed using longitudinal data in Studies IV and V and was empirically directed towards examining the longitudinal processes of academic and emotional functioning in relation to digital engagement. More precisely, the aims were to examine how the interplay of personal digital learning preference and contextual possibilities to learn with digital tools is related to school engagement over time (Study IV) and to determine the direction of effects between social media networking, action gaming, school burnout, and academic achievement at the within-person level (Study V).

Regarding the multidimensionality of digital participation (RQ1), I expected that similar dimensions of socio-digital participation as recognized previously would be identified (Eynon & Malmberg, 2011; Kennedy et al., 2010), that is, orientations related to social media engagement, acquiring and sharing knowledge and media, and gaming. Regarding the relations to academic well-being, motivation, and achievement (RQ2), I expected to uncover some associations between the orientations of socio-digital participation and academic well-being or motivation that would indicate either an imbalance between the psychological demands and the resources or a gap between adolescents' digital practices and their educational environment. These were explored as open and explorative questions. With regard to the longitudinal processes (RQ3), I anticipated identifying both supportive and destructive processes related to academic and digital engagement. More precisely, I expected to observe evidence for multiple processes related to both the gap hypothesis and the demands-resources model (Salmela-Aro & Upadyaya, 2014). For instance, digital learning preferences were anticipated to indicate participation in connected learning, which, consequently, would increase also study resources, thus being related to higher schoolwork engagement. With regard to destructive processes, in line with findings that link excessive engagement with digital media and school burnout (Salmela-Aro et al., 2016b), I expected to uncover a longitudinal relation with social media networking and school burnout, possibly reflecting the increased cognitive demands caused by keeping up with multiple social media, leading to exhaustion reflected also in academic settings.

To conclude, this thesis aimed to provide a richer and more detailed picture of young people's digital engagement, but also work towards understanding the complex psychological processes of academic and emotional functioning of Finnish students in the digital era.

2.2 Context: the Finnish education system

In Finland, compulsory comprehensive education starts in the year that a child turns seven and lasts nine years (see Finnish education in a nutshell, 2014). During comprehensive school all students follow the same general track guided by the Finnish Core Curriculum (OPS), with only a few exceptions.

After completing comprehensive education around the age of 15 years, young Finns can for the first time choose their educational track: whether to opt for general secondary education (high school) or vocational secondary education or to drop out altogether. Student selection to secondary schools is mainly based on students' grades recorded on their comprehensive school certificate; entering high schools, especially in the capital area of Finland, is highly competitive. The transition to secondary education is a key educational step in adolescence, and

school adjustment can be a challenge. At the end of high school, students take the matriculation exam, that is, the only nationwide high-stakes examination that is decisive for future higher education. In general, most students continue their studies after compulsory education; more than 90% start general or vocational secondary studies immediately after basic education. For example, in the year 2017, of completers of comprehensive school, 53% continued to high school and 41% to vocational education (Official Statistics of Finland, 2018).

After upper secondary school, students can continue their academic pathway to higher education in one of two ways: universities or colleges of applied sciences. Universities in Finland are tuition-free, but admission is highly selective and based on either academic achievement in high school or specialized admission exams. For instance, only roughly 20% of applicants are selected to the Master's programs of the University of Helsinki (<https://www.helsinki.fi/en/admissions/how-to-apply/statistics-about-admissions>) each year. Although it is technically possible to enter a university from the vocational track, most students come from high school and changing the track may be challenging. To conclude, upper comprehensive school, followed by transition to secondary education constitute a crucial educational phase, during which adjustment and disengagement issues can have lifelong repercussions. Therefore, the years of upper comprehensive school were also selected as the main context of this study.

2.3 Participants and procedure

2.3.1 Data collection

All datasets used in this study were drawn from the “Mind the Gap Between Digital Natives and Educational Practices” project (Mind the Gap, 2014) funded by the Academy of Finland. I was involved in the project from the very beginning, participating in designing the questionnaire instruments and the questionnaires themselves as well as in data collection. The project was active across the years 2013 to 2016. The study protocol was approved by the University of Helsinki Ethics Review Board in Humanities and Social and Behavioral Sciences.

The data consisted of self-report questionnaires, qualitative interview data, and actual school grades across various subjects drawn from the registry. Regarding the questionnaires, most participants completed the questionnaire in school, but some of the higher education students received an electronic form that they could fill in at any time. Participation in all data collections was voluntary, and informed consent forms were collected from the students and from their parents for participants aged under 18 years.

School teachers who were able to organize data collection administered the questionnaires during school hours, and all students in attendance at the time of data collection and who were willing to take the questionnaire were included as participants. Reasons for attrition may be either the school's or the teacher's inability to incorporate the data collection into their timeframe or the students being absent during the data collection or being unwilling to respond. Despite this, the number of students in longitudinal data collection who participated in at least two of the three waves was satisfactory.

2.3.2 Participants

For an overview of the participants in each individual study, see Table 2. Study I was a pilot study conducted in a multicultural school in south-west Finland in two parts: collecting data through a self-report questionnaire (SRQ), supplemented by semi-structured interviews of a subsample. The SRQ data (N = 284) was collected in spring 2013 from adolescents attending grades 6-9. The response rate was 82.2%. A gender-balanced (M=19, F=16) subsample of 35 students from grade 6 (n=15) and grade 7 (n=20) was selected for semi-structured interviews carried out in fall 2013. The participants were selected according to their SRQ responses to represent different technology users ranging from average users to gamers and creative users.

The data used in Study II (N = 1342) were collected between October 2013 and January 2014 in 18 high schools, of which 16 were public high schools and two were private schools situated in the capital area of Finland. The participants were first-year high school students who filled in a SRQ. The participants completed the questionnaire during regular school hours.

Study III utilized data from three different age groups representing different educational levels: elementary school, high school, and higher education. The elementary school student data (N = 741) were collected in May 2013 from 33 schools in the capital area of Finland. The participants were attending sixth grade. The high school student data (N = 1317) were drawn from the same dataset as in Study II. The higher education student data were collected between December 2013 and October 2014 from three institutions providing higher education in the capital area of Finland (N = 1232). The participants were first-year students from 76 different degree programs. Given that the role of educational context in development from early adolescence to young adulthood is crucial (Roeser et al., 1998) and to be able to re-examine and investigate the validity of the results from Study I, it was necessary to examine the structure of socio-digital participation orientations across various groups of students and educational stages. Besides representing different educational stages, the three cohorts were born and grew up in very different times regarding the prominence

of digital technologies. The younger adolescents had engaged with various forms of digital media from very early on, whereas the young adults had adopted novel digital technologies at a later age.

Studies IV and V utilized a longitudinal dataset that was collected as a follow-up to the elementary school sample from Study III. The data were collected annually in spring from students starting from grade 7 (age ~14 years) and ending with grade 9 (age ~16 years). Grades 7-9 constitute the whole upper comprehensive school period, meaning that at the end of the data collection the students were finalizing their compulsory comprehensive education and transitioning into non-compulsory education (i.e. high school, vocational school) or dropping out altogether the next fall. The dataset included students from 27 schools in the capital area of Finland. Of the participants in the longitudinal dataset, ~30% had data for all three waves over the data collection period, ~31.5% participated twice, and ~38.5% participated only once. Grades were acquired from the registry for 81.7% of participants. The Study IV sample comprised data for 1705 participants, and the Study V sample comprised data for 1726 participants.

Table 2. Number of participants, age, gender distribution, educational context, and data collection procedure in Studies I-V.

Study	N	Age (years)	Gender distribution	Educational context	Data collection
Study I	284	13-15	Male 41.1% Female 58.9%	Upper comprehensive school 6 th to 9 th grade	Cross-sectional SRQ, interviews
Study II	1342	$M_{\text{age}} = 16.04$ $SD = .39$	Male 33 % Female 67%	High school 1 st year	Cross-sectional SRQ
Study III	$n_1 = 741$	$M_{\text{age}} = 13.02$ $SD = 0.18$	Male 43.7% Female 56.3%	Comprehensive school 6 th grade	Cross-sectional SRQ
	$n_2 = 1317$	$M_{\text{age}} = 16.04$ $SD = 0.39$	Male 32.6% Female 67.4%	High school 1 st year	
	$n_3 = 1232$	$M_{\text{age}} = 23.64$ $SD = 5.58$	Male 34.6% Female 65.4%	Higher education	
Study IV	1705	14-16	Male 43.7% Female 56.3%	Upper comprehensive school 7 th to 9 th grade	Repeated SRQ
Study V	1726	14-16	Male 43.7% Female 56.3%	Upper comprehensive school 7 th to 9 th grade	Repeated SRQ, registry-based grades

Note: SRQ: self-report questionnaire, S1-S3: samples 1 to 3. Participants in Study II and Sample 2 in Study III, and in Study IV and Study V overlap.

2.4 Measures

Multiple measures were utilized in data collection to be able to answer the research questions in this thesis. The majority of scales were selected based on previous research and had been previously validated, whereas the development and examination of properties of the socio-digital participation inventory and its subscales can be considered at least partially one of the outcomes of this thesis and is described in more detail in Section 2.4.1. All other measures utilized in the original studies are presented in Sections 2.4.2 – 2.4.9, and the summary of the context, main aims, and key measures used in each of the original studies is presented in Table 3. Descriptive values and internal consistencies for all scales (when available) are presented in the Appendix.

2.4.1 Socio-digital participation

A general inventory assessing multiple types of digital participation ranging from the use of social media to creative practices and gaming was constructed for the purposes of this thesis as well as the surrounding research projects. The inventory was highly influenced by the previous work presented in Hakkarainen et al. (2000) and Barron (2004) in terms of framing the conceptualizations of socio-digital engagement and related competencies. The inventory is referred to as the socio-digital participation inventory (SDPi). Compared with many previous (often single-item) measures of screen time, a benefit of the SDP inventory is that it taps into a wide array of gradually more complex digital activities and includes gaming, which is often studied as a separate phenomenon. In the context of each item, a Likert-type scale from 1 (= never) to 7 (= all the time) was used.

The initial SDP inventory administered in Study I consisted of 35 items aimed at assessing the use of social (media) networking services or “hanging out” in social media (e.g. “How often do you follow profiles, pictures, and activities of your friends?”); composing and sharing media artifacts (e.g. “How often do you share music you have created or mixed?”); knowledge-oriented participation (e.g. “How often do you update your own blog or share your writings?”); academic-oriented participation (e.g. “How often do you discuss school-related issues on the internet?”); and type of games played (e.g. “How often do you play adventure games?”).

The revised SDP inventory used in Studies II and III consisted of 33 items (32 items were used in the elementary school questionnaire). Items measuring technology-mediated communication and maintenance of social relations (“I visit and send messages at social media sites”) were used to assess social networking-oriented participation, while knowledge-oriented participation was assessed with items measuring activities related to acquiring, discussing, creating, and sharing knowledge on different platforms (e.g., “I search for new information about my hobbies or things I am interested in,” with one additional item, which was included

only on the later high school and higher education questionnaires: “I learn new skills related to my hobbies or things I am interested in”). Items measuring creation and sharing of media artifacts (e.g., “I share music that I have created or mixed”) were used to assess media-oriented participation, and an array of questions inquired about the frequency of different types of gaming (e.g., “How often do you play...music, rhythm, or dance games?”; “...sports games?”; “...first-person shooters?”).

In Study IV, the factor for social (media) networking was used as a separate scale. It consisted of four items assessing the self-reported frequency of technology-mediated communication and maintenance of social relations (“I visit and send messages at social media sites”) that had clear and consistent structure in the previous studies. In Study IV the factor for action gaming was also used separately and consisted of six items measuring the self-reported frequency of playing different types of action and sports-related digital games (e.g., “How often do you play...sports games?”; “...first-person shooters?”).

In addition, a scale of gaming seriousness (6 items; e.g., “Gaming is a very important hobby for me”) rated using a 7-point Likert-type scale ranging from 1 (= not at all true) to 5 (= very true) was utilized in Study II.

2.4.2 Digital competence

Subjective skills in using digital technologies were measured with a set of items derived and adapted from earlier research (Barron, 2004; Hakkarainen et al., 2000). Digital competencies were measured with 14 items representing two separate skill sets: 9 items assessing advanced skills (e.g., “How competent do you see yourself in programming?”) and 6 items assessing basic skills (e.g., “How competent do you see yourself in editing text documents?”). These were rated using a 5-point Likert-type scale ranging from 1 (= not at all competent) to 5 (= very competent).

2.4.3 Digital learning preference

Digital learning preference (DLP; Hakkarainen et al., 2000; see also Halonen et al., 2016) was measured with four items that assessed having a preference towards learning and solving problems with digital technologies: “I’m happy to solve challenging problems related to digital technologies”; “It’s fun to learn to use digital technology because it continuously offers new challenges”; “I’m ready to work hard to learn new digital technology-related skills”; “I trust my own skills to learn digital technologies”. These were measured on a scale from 1 (= not at all true) to 5 (= very true), with higher score indicating a stronger preference.

2.4.4 Wish for digital schoolwork

Wish for digital schoolwork (WDS; Hakkarainen et al. 2000; see also Halonen et al., 2016; Salmela-Aro et al, 2016a) was measured with three items that directly tapped into the gap hypothesis by assessing motivation and possibilities for using more digital media in school and its perceived effect on school engagement: “I’m more engaged in my schoolwork when I’m able to use digital technologies”; “I would like to use more digital technologies in my schoolwork”; “I study much harder when I’m able to use digital technologies in schoolwork.” In other words, the scale assessed whether the student favored engaging more with digital media in schoolwork. These were measured on a scale from 1 (= not at all true) to 5 (= very true). Higher scores indicated a stronger wish for using more technologies in schoolwork.

2.4.5 School engagement

School engagement was assessed using the schoolwork engagement inventory (i.e., EDA abbreviated from energy, dedication, and absorption; Salmela-Aro & Upadyaya, 2012) measuring a trait-like, long-term, study-related positive state of mind. The inventory consists of three subscales, each including three items, measuring energy (e.g., “When I study, I feel I’m bursting with energy”), dedication (e.g., “I am enthusiastic about my studies”), and absorption (e.g., “Time flies when I’m studying”). However, schoolwork engagement is often specified as a unidimensional measurement model representing a generally positive study-related frame of mind (Salmela-Aro & Upadyaya, 2012). The items were rated on a scale ranging from 1 (= never) to 7 (= every day).

2.4.6 School burnout

School burnout was assessed using the school burnout inventory (SBI; Salmela-Aro et al., 2009), based on the Bergen Burnout Inventory (BBI-15; Näätänen, Aro, Matthiesen & Salmela-Aro, 2003), by changing the work context to the school context. The inventory consists of three subscales: emotional exhaustion at school (3 items, e.g., “I feel overwhelmed by my schoolwork”), cynicism towards the meaningfulness of school (3 items, e.g., “I feel that I’m losing interest in my schoolwork”), and sense of inadequacy as a student (2 items, e.g., “I often have feelings of inadequacy in my schoolwork”). The items were rated on a scale ranging from 1 (= completely disagree) to 6 (= completely agree).

2.4.7 Achievement goal orientations

Achievement goal orientations were assessed using an instrument developed by Niemivirta (2002), tapping into five types of achievement goal orientations:

mastery-intrinsic, mastery-extrinsic, performance-approach, performance-avoidance, and avoidance. The scale for mastery-intrinsic orientation included three items assessing students' focus on learning, understanding, and gaining competence (e.g., "To acquire new knowledge is an important goal for me in school"). The scale for mastery-extrinsic orientation included three items assessing students' aspirations for academic success (e.g., "It is important for me to get good grades"). The scale for performance-approach orientation included three items assessing students' focus on relative ability (e.g., "An important goal for me in school is to do better than the other students"). The scale for performance-avoidance orientation included three items assessing the avoidance of demonstrating normative incompetence (e.g., "I try to avoid situations in which I may fail or make mistakes"). The scale for avoidance orientation included three items reflecting students' desire to minimize the effort and time spent on studying (e.g., "I try to get away with as little effort as possible in my school work"). Students rated all items using a 7-point Likert-type scale ranging from 1 (= not true at all) to 7 (= very true).

2.4.8 School value, fear of failure, academic withdrawal

Included in Study II were also other motivational scales used to examine the validity of the latent profile solution. The scale for lack of school value (Niemi-virta, 2004) comprised three items assessing students' perceived importance and utility of and interest in going to school and studying (e.g., "I think going to school is a waste of time"). The scale for fear of failure (Niemi-virta, 2002) comprised three items assessing students' preoccupation with possible failures in school (e.g., "I always worry about failing in tests and exams"). The scale for academic withdrawal (Niemi-virta, 2002) comprised three items reflecting students' generalized tendency to withdraw from demanding school tasks or to give up easily (e.g., "I have realized that I give up easily if school tasks are difficult"). All items were rated using a 7-point Likert-type scale ranging from 1 (= not true at all) to 7 (= very true).

2.4.9 Academic achievement

Academic achievement was assessed in Study II based on self-reported grade point average and in Study V using register-based yearly grade point averages across course grades in Mathematics, Finnish, Biology, and Physics. The grades were drawn from the registry maintained by the Education Division of the City of Helsinki.

Table 3. Summary of the context, main aims, and measures in each of the original studies.

Study	Context	Main aims	Main measures
Study I	Comprehensive school	Explore the dimensions of socio-digital participation	Socio-digital participation inventory (SDPi), qualitative interviews
Study II	High school	Examine how students' achievement goals are related to orientations of socio-digital participation and how students with different motivational profiles differ in their socio-digital participation practices	Achievement goal orientations (Niemi-virta, 2002); SDPi; digital competence
Study III	Comprehensive school, High school and higher education.	Re-explore the dimensions of socio-digital participation across three educational levels and investigate their relations to schoolwork engagement and school burnout	SDPi; schoolwork engagement inventory (EDA; Salmela-Aro & Upadyaya, 2012); School burnout inventory (SBI; Salmela-Aro, Kiuru, Leskinen & Nurmi, 2009)
Study IV	Upper comprehensive school	Examine how digital engagement is related to traditional school engagement first cross-sectionally at three time points and second, longitudinally across three years	Digital learning preference, Wish for digital schoolwork (Hakkarainen et al, 2000); schoolwork engagement inventory (EDA; Salmela-Aro & Upadyaya, 2012)
Study V	Upper comprehensive school	To evaluate the direction of relations between social media engagement, action gaming, school burnout, and academic achievement over time at the within-person level	Social media engagement (SDPi), action gaming (SDPi); School burnout inventory (SBI; Salmela-Aro, Kiuru, Leskinen & Nurmi, 2009); registry based grades

2.5 Data analyses

IBM Statistical Package for Social Sciences (SPSS) was used as the main analysis software in Study I and to conduct some of the analyses in Study II. In all other studies, SPSS was also utilized as a data management and preliminary analysis tool. In Studies II-V, the primary analyses were conducted using Mplus (Study II version 6, Studies III-V version 8; Muthén & Muthén, 2018), and starting from Study III the analyses were run in conjunction with R and RStudio (R Core Team, 2018) with the package MplusAutomation (Hallquist & Wiley, 2018). See Table

4 for an overview of the statistical data analyses utilized in each of the original studies.

Table 4. Overview of the statistical data analyses utilized in each of the original studies.

Study	Approach	Missing data	Estimation	Modeling
Study I	Cross-sectional	Listwise deletion	Generalized least squares	Exploratory factor analysis
Study II	Cross-sectional, person-oriented	Expectation Maximization - imputation, pairwise deletion	Maximum likelihood (with robust standard errors)	Latent profile analysis, general linear model
Study III	Cross-sectional	Multiple imputation	Weighted Least Squared (robust)	Exploratory structural equation modeling
Study IV	Longitudinal	Full-information maximum likelihood	Maximum likelihood (with robust standard errors)	Multiple indicator cross-lagged panel model (with latent interaction)
Study V	Longitudinal, within-person	Full-information maximum likelihood	Maximum likelihood (with robust standard errors)	Multiple indicator random-intercept cross-lagged panel model

2.5.1 General analytical strategies

Outliers, missing data, and attrition

In all studies, the data were first screened for multivariate outliers and missing values (Bennett, 2001). Multivariate outliers were all examined individually and deleted when deemed necessary if, for instance, a participant showed an implausible answer pattern such as all values in extremes. Missing data were examined based on the overall percentage of missing data and the percentage of missing responses for each individual item. The randomness of the missing data was evaluated with Little's MCAR test.

In Study I, the handling of missing data was listwise deletion. In Study II, missing data were treated so that all cases with more than one missing value in the clustering variable items were eliminated. Thereafter, the remaining missing values in the clustering variables were imputed using the Expectation

Maximization algorithm in SPSS. Pairwise deletion was used in subsequent analysis in Study II. In Study III, missing data were multiply imputed following a stepwise method in Mplus 8.0 (Muthén & Muthén, 2018) by, first, creating a set of five two-level H1 imputed datasets using the default variance-covariance method and, second, running the subsequent models on these datasets and evaluating the pooled results. Five datasets have been shown to provide sufficiently accurate estimates (Asparouhov & Muthén, 2010). In Studies IV and V, all missing data were handled with full-information maximum likelihood during estimation.

In Study V, to assess attrition effect, I carried out a multivariate analysis of variance on the mean scores of social networking, action gaming, overall school burnout, and academic achievement averaged over time and compared participants who participated once, twice, or at all three time points.

Complex data

In Studies III and IV, the complex survey-data option (Muthén & Muthén, 2018; see also Asparouhov & Muthén, 2006; Muthén & Satorra, 1995) was used in all analyses to correct for non-independence due to the nested structure of the data at the class level in elementary, upper comprehensive, and high school, and at the degree program level in higher education. These were the lowest clustering levels.

Estimation and model selection

In all model selection, a priori strategy to avoid post-hoc modifications and overfitting with an emphasis on parsimony and interpretability was adopted. In Study III, as the items were ordinal and many of them displayed non-symmetric distributions, the models were estimated with robust weighted least squares (WLSMV) estimation in Mplus 8.0 (Muthén & Muthén, 2018). In Studies IV and V, maximum likelihood with standard errors robust for non-normality (MLR) was used as the estimator.

When using WLSMV and exploratory structural equation models, the fit was evaluated using Chi-square, root mean square error of approximation (RMSEA) with an approximate cut-off value for a good fit of less than .05, comparative fit index (CFI) with a cut-off value of greater than .96, and the Tucker-Lewis index (TLI) with a cut-off value of greater than .95 (Yu, 2002) as well as SRMR with a cut-off value of less than .08. With MLR and traditional SEM, model fits were evaluated based on the Chi-square value and the root mean square error of approximation (RMSEA) with an approximate acceptable cut-off value of less than .08, standardized root mean residual (SRMR) with an approximate cut-off or less than .08, and, incremental indices, such as comparative fit index (CFI) and Tucker-Lewis index (TLI), with approximate acceptable cut-off values of greater than .9 (Hu & Bentler, 1998).

In the longitudinal structural equation models, configural (factor structure), metric (factor loadings), and scalar (factor loading and intercept) measurement invariance was tested across gender (Study IV) and time (Studies IV and V). The nested Chi-square difference test of zero difference between models is both implausible (there is never zero difference between nested models) and biased against invariance with larger samples (MacCallum, Browne, & Cai, 2005). Due to this, in evaluating measurement invariance, I relied also on the conventional criteria of evaluating change in other, parsimony-adjusted, fit indices between compared measurement models. More precisely, an increase of .15 in RMSEA and/or a decrease of .10 in CFI would lead to the rejection of the hypothesis of sufficient measurement invariance (Chen, 2007; see also Putnick & Bornstein, 2016).

When comparing competing nested structural models (in addition to the same strategies as in evaluating measurement invariance), I evaluated the cost of parsimony and interpretability due to increased misfit by Bayesian information criterion (BIC) that penalizes complexity. The difference in BIC was evaluated with a cut-off of a difference of less than 2, indicating no preference between models, and a difference of more than 10, indicating strong preference over the model with the smaller BIC values (Raftery, 1995).

Internal consistencies

In Studies I, II and, IV the internal consistencies of the measures were examined using Cronbach's alphas (see Appendix). In Study V, the internal consistencies of the measures were examined in more detail by computing bootstrapped confidence intervals and point estimates of Cronbach's alpha and MacDonald's omega coefficient using the R-package MBESS (Kelley, 2018).

2.5.2 Exploratory factor analysis and exploratory structural equation modeling

In Study I, a series of exploratory factor analyses were conducted for the SDPi items using Unweighted Least Squares extraction with Promax rotation. The accepted minimum loading per factor for each item was greater than .32 (Tabachnick, Fidell & Osterling, 2001), and items with secondary loadings greater than .32 were eliminated.

In Study III, to ensure the structural validity for our measurement models, we adopted an exploratory structural equation modeling (ESEM) framework, as it is most suited for examining multidimensional phenomena (see e.g., Asparouhov & Muthén, 2009; Marsh, Liem, Martin, Morin, & Nagengast, 2011). In contrast to a more traditional confirmatory factor analysis approach (CFA), the use of ESEM allowed us to specify a less restrictive exploratory factor analysis measurement model with rotations for the SDPi items, as we expected that many of the items

reflect more than one underlying orientation. A CFA-based model would have been too restrictive and might have resulted in distorted factors and inflated factor correlations, subsequently leading to distorted structural relations (Asparouhov & Muthén, 2009). Geomin rotation was used with a rotation criterion of .01 which has been shown to provide satisfactory rotated loadings in most cases (Hattori, Zhang & Preacher, 2017).

2.5.3 Person-oriented modeling

In Study II, we adopted a person-oriented approach (see Bergman, Magnusson, & El-Khoury, 2003) and utilized latent profile analysis. A benefit of latent profile analysis is that it is a model-based method that provides a set of fit indices useful in determining the optimal number of profiles. The main fit indices used were sample size adjusted Bayesian Information Criterion (BIC) and Vuong-Lo-Mendell-Rubin (VLMR) nested model comparison, which is used to test the difference in log-likelihood values between models k and $k-1$ (Lo, Mendell, & Rubin, 2001). A lower BIC value suggests a better fit and a p -value of VLMR of less than .05 indicates that $k-1$ should be rejected in favor of the estimated model k . We also considered classification quality (i.e., entropy value), and placed emphasis on the interpretability of the latent classes, and the reasonableness of the solutions with respect to theory and prior research.

2.5.4 Longitudinal confirmatory factor analyses

In Studies IV and V, the measurement models were specified using a longitudinal confirmatory factor analysis approach (CFA), in which all items were allowed to load on their corresponding factor only. Residuals of the same items were allowed to be correlated over time, whereas no residual covariance between different items was permitted. The use of multiple indicator measurement models allowed us to specify the structural models without measurement error.

2.5.5 Longitudinal panel models

In Study IV, to test the longitudinal hypotheses, that is, to evaluate the longitudinal relations between digital engagement and school engagement, I specified a multiple indicator longitudinal panel model (L-CLPM; see Figure 1; Little, Preacher, Selig & Card, 2007). Mean differences across genders were controlled by regressing each latent variable on gender. The model was fitted in a stepwise manner with an emphasis on parsimony and interpretability. First, we estimated the L-CPLM with directional structural paths specified between successive time points $T+1$ and $T+2$ and stationarity assumed with a lag of one. That is, the paths from Time 1 to Time 2 were constrained to be equal to paths from Time 2 to Time

3 to achieve better parsimony and interpretability. This model was compared with the final measurement model with an unconstrained covariance structure.

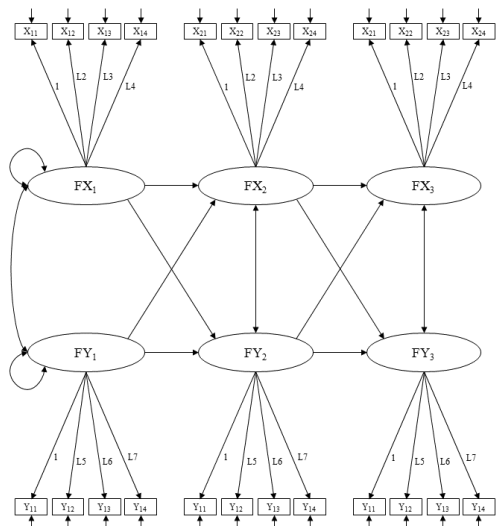


Figure 1. A multiple indicator cross-lagged panel model.

In Study V, the structural models were specified as multivariate multiple indicator random intercept cross-lagged panel models (RI-CLPM; see Figure 2; Hamaker, Kuiper & Grasman, 2015). In contrast to traditional cross-lagged panel models, the RI-CLPM decomposes observed variables into two parts: (1) time-invariant “between-person” factors and (2) time-varying “within person” factors used to estimate autoregressive and cross-lagged effects (Hamaker et al., 2015).

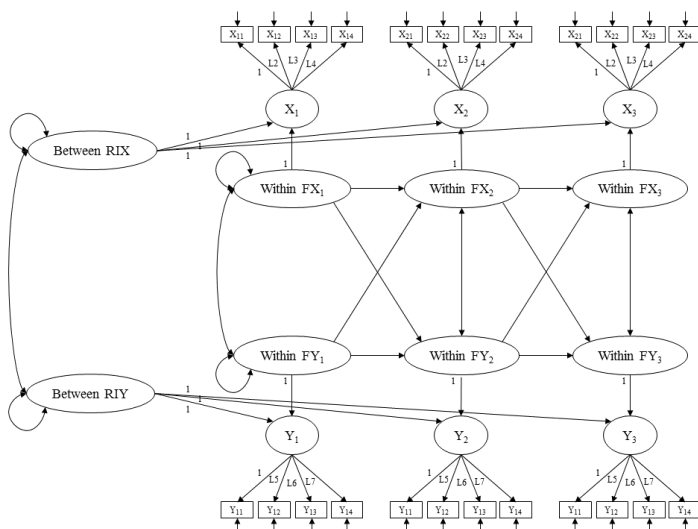


Figure 2. A multiple indicator random intercept cross-lagged panel model.

Regarding all models, we first fit a multiple indicator RI-CLPM model with no additional restrictions and evaluated model fit and possible modifications. Then, we specified the structural paths constrained to be equal across the intervals, and again evaluated model fit in comparison to the model with unconstrained lagged parameters. The scale of the factors was standardized beforehand by first setting the mean and variance of all factors at the first time point to 0 and 1, respectively, and freeing all factor loadings. In the second step, the first factor loadings were fixed to their estimated values, and all factor variances were set to be freely estimated.

2.5.6 Visualizing correlations

In Study III, to test the cross-sectional parts of hypotheses 1 and 2, gender-controlled cross-sectional relations between the latent constructs were also visualized as a partial correlation network. This type of modeling allows for a powerful measurement error-corrected modeling of undirected structural relations between latent variables (Guyon, Falissard & Kop, 2017). In practice, this was done by exporting the latent variable correlation matrix of the gender-controlled measurement model from Mplus to R (using R package MplusAutomation; Hallquist & Wiley, 2018) and visualizing the cross-sectional partial correlations by plotting the latent variables as nodes in a EBICglasso -regularized partial correlation network (Epskamp & Fried, 2018) using R package qgraph (Epskamp, Cramer, Waldorp, Schmittmann, & Borsboom, 2012), thus creating a type of latent variable network model (Epskamp, Rhemtulla, & Borsboom, 2017). The edges in the latent partial correlation network can be interpreted similarly as regression path coefficients, as they are controlled for each other, but without assuming any direction of effects.

2.5.7 Latent interactions

The latent interactions in Study IV were estimated using the latent moderated structural equations (LMS) approach (Klein & Moosbrugger, 2000) implemented in Mplus (Muthén & Muthén, 2018) as a maximum likelihood-based approach, which, in general, is recommended (Marsh, Wen & Hau, 2004).

2.5.8 Semi-structured interviews

Study I also contained qualitative data. Selected participants were interviewed face-to-face in Finnish by the research team. The interviews addressed the participants' friendship-driven practices of hanging out with their peers, their possible interest-driven practices and competencies regarding digital media, and their various ways of utilizing these to support school learning. The interview tool was designed as a joint effort by the research team.

Table 5. Analytic categories, their descriptions, and typical examples in Study I interview data.

Category	Description	Typical examples	n ₁	f ₂
Social networking	Communicating with friends, using social media	<i>"I mostly use Kik with my smartphone" (M17)</i>	35	46
Knowledge-oriented participation	Seeking, creating, and sharing knowledge on a topic	<i>"...like from the internet I can find instructions on how to act and behave in dog (conformation) shows." (F01)</i>	23	26
Creative participation	Creating and sharing media artifacts such as drawings, videos, and music	<i>"I draw with it (smartphone) too, for like 2, 3, 4 hours a day". (F02)</i> <i>"I've made three football videos (and shared online)". (M09)</i>	10	17
Academic-oriented participation	Using digital technologies in support of schoolwork	<i>"Usually, when I do schoolwork at home, I have the computer next to me, and if there's something I don't know, I don't use books, I look it up online as it's faster" (M17)</i>	34	44
Gaming-oriented participation	Playing games or participating in gaming-related activities	<i>"...Sims, we play it together, she has an avatar and I have an avatar there, so we talk. And she helps me and I help her with tasks there sometimes." (F02)</i>	23	31

Note: 1 = number of participants mentioning the activity, 2 = frequency of total different mentions for activities in this category.

The interviews were audio recorded and took approximately 20-30 minutes. Qualitative content analysis (Krippendorff, 2004) was performed on interview data using the dimensions of socio-digital participation identified in the questionnaire data as an analytic framework for categorization. The interview data were first partitioned to text segments using the smallest comprehensive main ideas as the unit of analysis. Then, the second author in Study I categorized the identified ideas according to the socio-digital participation orientation that they reflected the most. All independent ideas were categorized separately, and the categories were mutually exclusive. All of the dimensions identified via the quantitative data analysis were also represented in the participants' interview responses, and all of their descriptions fit the analytic categories, so no new categories emerged in the interview analysis. The analytic categories, their descriptions, and typical examples are presented in Table 5.

3 Overview of the original studies

3.1 Study I

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

The aim of Study I was to conceptualize the dimensions of socio-digital participation (SDP) by drawing on data collected using a novel SPD inventory and a semi-structured interview. The study was conducted in a multicultural school in Finland in two parts: collecting data through a self-report questionnaire (SRQ), supplemented by semi-structured interviews of a subsample. The SRQ data were collected in spring 2013 from 284 adolescents from grades 6-9 complemented by a subsample of 35 students selected for semi-structured interviews carried out in fall 2013. The participants were selected according to their SRQ responses to represent different technology users, ranging from average users to gamers and creative users, and were attending grade 6 or 7.

A series of exploratory factor analyses (EFA) were conducted for the SDPi items using Unweighted Least Squares extraction with Promax rotation. Pearson correlations and descriptive statistics were examined. The interviews addressed the participants' practices of socio-digital participation and their relations to formal learning.

Relying on both previous research as well as our own empirical data, we were able to identify dimensions of friendship-driven and interest-driven activities that consisted of six orientations that were clearly identified in both the quantitative and qualitative analyses. In line with previous research (Ito et al, 2010), social networking was conceptualized to be more likely to be friendship-driven, and knowledge- and media-oriented networking to be interest-driven. Regarding gaming, we identified two separate dimensions of gaming: recreational games and action and sports games. Finally, academic participation was conceptualized as a separate boundary-crossing dimension between autonomous and controlled study activities.

Most of the students participated in friendship-driven socio-digital engagement rather intensively. Content-wise these friendship-driven activities were mostly centered on communication with friends. However, some adolescents, even at that age, had developed also more sophisticated practices of digital engagement, such as sharing their art or providing a game server to facilitate other people's gaming activities, building an extended network of developing expertise in the process. The results also supported the understanding that the creative socio-digital engagement of some of these students requires advanced technical expertise,

creative thinking, social networking, and teamwork. This study, however, was done with a rather small sample, as a result of which in Study III the dimensions of socio-digital participation were examined across three bigger samples representing three different educational phases.

3.2 Study II

Hietajärvi, L., Tuominen-Soini, H., Hakkarainen, K., Salmela-Aro, K., & Lonka, K. (2015). Is student motivation related to socio-digital participation? A person-oriented approach. *Procedia-Social and Behavioral Sciences*, 171, 1156–1167.

In Study II, the hypothesized gap between self-regulated technology-mediated practices of adolescents and their academic achievement goals and academic achievement was examined. More precisely, how students' achievement goals are associated with socio-digital participation and related competencies was examined. It was especially of interest whether students with different achievement goal orientation profiles would differ in terms of their practices of socio-digital participation. The data used in Study II were collected between October 2013 and January 2014 from 16 high schools in Helsinki, Finland. The participants (N = 1342; Male = 398, Female = 835, 79 not reported) were first-year high school students.

We examined the structural validity of the measurement model by confirmatory factor analyses, examined correlational results, and classified the students by latent profile analyses and examined group and gender differences using general linear models. Correlational results indicated mastery tendencies and schoolwork engagement were moderately positively correlated with academic-oriented participation, but that GPA was negatively associated with most of the dimensions of socio-digital participation; most notably with hanging out, creative participation, gaming, and advanced technological skills. Further, avoidance tendencies were positively associated with serious gaming and action games.

Four achievement goal orientation groups were identified. Over one-third of students belonged to the indifferent group, which can be seen as representing a “typical” student who does acknowledge the goals of learning and doing well in school, but is reluctant to invest effort in attainment of these goals. Up to 32% of students were identified as success-oriented, emphasizing performance tendencies and endorsing multiple goals simultaneously. Mastery-oriented students (23%) were mostly concerned about their own learning and understanding, and, accordingly, they displayed a very adaptive motivational profile. In addition, there was a rather small group of avoidance-oriented students (9%) actively avoiding all school-related work, and, therefore, showing the most negative motivational profile.

The groups differed in their generalized motivational beliefs and there were meaningful differences in terms of their orientations to socio-digital participation: e.g. indifferent students were more likely to engage in hanging out and gaming, avoidance-oriented students were the least engaged in academic-oriented digital activities. Whilst there was a negative sample level correlation between self-reported grade point average and gaming, both indifferent and success-oriented boys were likely to be active gamers. Moreover, it was interesting that creative participation and advanced skills were negatively associated with grades. In total, adaptive goal orientations and engagement towards school were associated with higher digital competencies and use of digital tools for academic purposes. On the other hand, more maladaptive orientations were associated with being more likely to use social media intensively (especially so for girls) and with more intense and complex gaming (especially for boys). The results indicated that there appeared to be evidence of both continuities and discontinuities between today's schools and their students. However, the cross-sectional setting did not allow inferences to be made regarding the direction of the effects. In Study IV, the “gap hypothesis” was explicitly tested with longitudinal data.

3.3 Study III

Hietajärvi, L., Salmela-Aro, K., Tuominen, H., Hakkarainen, K., & Lonka, K. (2019). Beyond screen time: Multidimensionality of socio-digital participation and relations to academic well-being in three educational phases. *Computers in Human Behavior*, *93*, 13–24.

Study III extended research on differences in young peoples' approaches to socio-digital participation. First, the structure of underlying orientations of SDP was examined across three samples of Finnish students (elementary school 6th grade, $n = 741$; high school 1st year, $n = 1317$; higher education 1st year, $n = 1232$). Second, how these different orientations are associated with academic well-being was analyzed. The first aim of the study was to examine how the frequencies of different digital activities are distributed in elementary school, high school, and higher education samples. This was done to provide an explorative overview of students' digital activities. The second aim was to determine what kinds of underlying multidimensional structures of SDP orientations are reflected by the different digital activities and whether the three groups show similar structures. The third aim of the paper was to examine how the dimensions of SDP are related to academic well-being in terms of study engagement and burnout.

Despite some differences between the three student cohorts regarding the structure of socio-digital participation, the same five dimensions were identified in all of them: social networking-oriented participation, knowledge-oriented participation, media-oriented participation, action gaming, and social gaming. In

the high school sample, also a sixth factor, blogging-oriented participation, differentiated from the knowledge-oriented dimension. With regard to associations with academic well-being, the results indicated that engaging with digital media in order to communicate and maintain social networks (social networking) was consistently related to either lower study engagement or higher study burnout. Playing of action and sports games (action gaming) was related in all samples to either lower study engagement or higher cynicism. Using digital tools to gain and share knowledge (knowledge-oriented) was, in contrast, related to higher study engagement.

The results were in line with Study I in that similar orientations were identified. The results also added confirmation to the understanding that despite rapid changes in the digital tools available the underlying orientations are more stable and consistent in different age groups. Importantly, the results of Study III also demonstrated that the underlying orientations of students' digital activities reflect multiple dimensions that are differently related to academic well-being, and that relying on a unidimensional concept of screen time is inherently biased. However, the cross-sectional setting did not allow inferences to be made regarding the direction of the effects, and thus, Study V was conducted to extend the discussion towards examining some of these effects over time and at the within-person level.

3.4 Study IV

Hietajärvi, L., Lonka, K., Hakkarainen, K., Alho, K., & Salmela-Aro, K. (submitted). Are Schools Alienating Digitally Engaged Students? Longitudinal Relations between Digital Engagement and Schoolwork Engagement.

In Study IV, the aim was to examine congruence and friction (Vermunt & Verloop, 1999) between digital and academic engagement. Specifically, the gap hypothesis was tested with longitudinal data. The gap hypothesis suggests that students who prefer self-regulated learning with digital media outside of school are less engaged in traditional, more teacher-regulated school. This was analyzed both cross-sectionally at three time points (T1, T2, and T3) and longitudinally across three years. The participants of this study comprised 1705 (43.7% female) 7th–9th graders from 27 schools in Helsinki. Of these, 1090 participated in the study in at least two waves and 530 participated in all three waves.

As preliminary analyses, we first tested for measurement invariance across gender and time using a longitudinal confirmatory factor analysis approach. Then, the gender-controlled cross-sectional partial correlations between the latent constructs were explored. Finally, the longitudinal relations between digital engagement and school engagement were analyzed using a latent cross-lagged panel model (CLPM). First, the CPLM was estimated with structural paths

specified between successive time points T+1 and T+2. Second, latent interactions between digital learning preference and wish for digital schoolwork at time point T were included as predictors of school engagement at T+1.

Regarding the cross-sectional findings, the digital learning preference was positively related to both wish for digital schoolwork and schoolwork engagement. Wish for digital schoolwork was, in turn, negatively related to schoolwork engagement. The longitudinal model indicated that digital learning preference predicted higher schoolwork engagement over time. Wish for digital schoolwork had only a weak and statistically insignificant negative direct effect on schoolwork engagement. However, their interaction predicted later schoolwork engagement negatively. A closer inspection of the interaction indicated that wish for digital schoolwork predicted lower future schoolwork engagement only for students reporting a higher digital learning preference orientation. For students reporting lower digital learning preference, there appeared to be no relationship between wish for digital schoolwork and schoolwork engagement.

Overall, the results suggest that the effect of digital learning preference on school engagement is moderated by the wish for digital schoolwork. In other words, how the digital learning preference is related to school engagement depends on whether or not the student's personal practices of digital engagement are congruent with the practices of the school. When this is not the case, friction occurs in the form of the hypothesized gap. To conclude, both cross-sectional and longitudinal results showed support for the gap hypothesis; students who preferred digital learning but did not have the chance to digitally engage at school experienced a decrease in school engagement over time.

3.5 Study V

Hietajärvi, L., Lonka, K., Maksniemi, E., Hakkarainen, K., Alho, K., & Salmela-Aro, K. (submitted). A Random-Intercept Cross-lagged Panel Model Approach to Examine the Direction of relations between two types of Social Media participation and School Burnout.

The goal of Study V was to expand our knowledge about how adolescents' socio-digital participation is related to school burnout and academic achievement. More specifically, the study focused on the directions of within-person effects among these constructs. This study utilized the same three-wave longitudinal dataset as in Study IV, supplemented with grades acquired from the registry. Participants in the investigation comprised 1726 (43.7% female) students from upper elementary school (T1 = 7th grade, T2 = 8th grade, and T3 = 9th grade). A multiple indicator random intercept cross-lagged panel model (RI-CLPM) was used to evaluate the direction of relations between digital social networking/social media use, action gaming, school burnout, and academic achievement. In addition to a primary

model investigating the effects in relation to overall school burnout, we specified separate follow-up models for each component of school burnout: exhaustion, cynicism towards school, and inadequacy as a student.

The results for the primary model indicated a positive reciprocal effect between digital social networking and school burnout and a positive effect of school burnout on gaming and a negative effect of academic achievement on gaming. Regarding the follow up analyses, the models indicated that the reciprocal influence between social networking and school burnout was driven only by exhaustion. Cynicism and inadequacy showed only a one-directional positive relation to both social networking and action gaming.

Overall, the results revealed that social networking and exhaustion are reciprocally linked, whereas disengagement and lower academic achievement appear to increase the intensity of students' digital participation instead of the other way around. The findings here add to previous research demonstrating reciprocal relations between digital media use and school burnout and shed new light on the direction of effects, suggesting that digital participation practices need to be considered also as a behavioral outcome (i.e. escapism or search for meaning outside of school) regarding issues of school well-being.

4 Discussion

4.1 Main findings

The main research questions of this thesis were summarized into three broad research questions: 1) examining the multidimensionality of socio-digital engagement (Studies I and III), 2) investigating how these dimensions are related to academic motivation, well-being, and achievement cross-sectionally (Studies II and III), and 3) analyzing these relations longitudinally over a period of three years (Studies IV and V). Moving beyond the empirical research questions, in this section the main findings are summarized in relation to the three broader aims of this thesis. First, the conceptualization of adolescents' digital engagement is presented in Section 4.1.1. Then, the cross-sectional and longitudinal findings are summarized and presented following the two working hypotheses (presented in Section 1.4) combining, developmentally, digital engagement and academic and emotional functioning: the gap-hypothesis in Section 4.1.2 and the demands-resources model in Section 4.1.3, followed by a theoretical synthesis aiming to conceptually combine these two hypotheses in Section 4.1.4.

4.1.1 Complex structure of socio-digital engagement

In line with previous research on the topic, young peoples' socio-digital engagement and related experiences were confirmed to be fundamentally multidimensional and complex (Eynon & Malmberg, 2011; Howard, Ma & Yang, 2016; Kennedy et al., 2010; Rosenberg et al, 2018; Thompson, 2013; van den Beemt, Akkerman & Simons, 2011). Despite this, the first main finding in this study and a cornerstone for the subsequent findings was that the variation in digital activities can be explained with a structure of socio-digital participation orientations. These appeared consistent across different age groups. The structure of the orientations of socio-digital participation was explored in Studies I and III (the orientations were also utilized in Study II and two of the orientations were further utilized in Study V). In general, despite some variation in the factor structure, the same five orientations were consistently identified: social networking-oriented participation, knowledge-oriented participation, media-oriented participation, action gaming, and social gaming. Interestingly, in the high school sample also a distinct sixth factor, blogging-oriented participation, was identified as separate from knowledge-oriented participation. In Study I, a factor for academic-oriented participation was also included that was extended as (academic) digital engagement in Study V. The structure of the orientations of socio-digital participation were similar to those identified in previous studies (Eynon & Malmberg, 2011; van den Beemt et al., 2011) and reflected the genres

of participation identified by Ito et al. (2010). Furthermore, these orientations can be loosely conceptualized as reflecting higher order practices such as maintaining social relations (friendship-driven) or serving one's interest (interest-driven) (Ito et al, 2010).

Of all forms of digital participation, the youth appeared to spend the majority of their screen time engaging in friendship-driven digital social networking. This was clearly in line with previous research on the topic and appears to be a global phenomenon (Anderson & Jiang, 2018; EU Kids Online, 2014; Eynon & Malmberg, 2013). Social networking-oriented participation was interpreted as mainly friendship-driven. Beyond this, some adolescents were engaged in more complex ways of interacting with various social media that might gradually deepen to an enhanced work with some special interest. In the elementary school sample in Study II, social networking was also reflected in some production-oriented social media-related activities. Consequently, it can be deduced that social networking using digital media appears also to be a possible way of broadening networks, thus functioning as a pathway towards developing different interest-driven practices (Ito et al, 2010).

Knowledge, blogging, and media-oriented participation were taken to resemble more interest-driven practices. In the interview data, the participants explicated varying degrees of engagement from seeking to sharing knowledge. Thus, knowledge-oriented participation was conceptualized as a continuum from a shallower knowledge-seeking to a gradually deepening process of creating and building knowledge across various contexts within their learning ecologies (Barron, 2006; Ito et al., 2013). Some adolescents reported socio-digital engagement extending to a wider audience. This included, for example, sharing their art or providing a game server to facilitate other people's gaming activities, building an extended network of developing expertise in the process and highlighting the possibilities for connected learning (Barron, 2006; Ito et al., 2013; Kumpulainen & Sefton-Green, 2012). The qualitative data also provided examples of the altruistic culture of participating in sharing knowledge and artifacts with previously unknown people (Jenkins, 2009; Shirky, 2010). The power of creative socio-digital practices in adolescents' learning was explicated by, for instance, supporting the development of various competencies and widening of networks, leading to a gradually deepening interest-driven learning process alongside knowledge-oriented participation (Barron, 2006). Indeed, the creative socio-digital activities that some of these students are engaged in require advanced technical expertise, creative thinking, social networking, teamwork, and an open mind towards a culture of sharing, all of which can be recognized as 21st century skills (Binkley et al., 2012).

Social gaming, in turn, was conceptualized as "killing time" or "hanging out", with the activity motivated by hanging out with friends, whereas action and sports gaming resembles "recreational gaming", which, although also social, has

gameplay as the main focus of the activities (Ito et al., 2010). Gaming-related activities seem to constitute an essential aspect of concurrent socio-digital engagement alongside other forms of digital participation, even though it can be also addressed as a separate construct and culture (Gee, 2007; Gee & Hayes, 2011; Granic, Lobel & Engels, 2014).

Table 6. Dimensions of socio-digital participation.

Orientation	Description
Social networking-oriented participation (social media engagement)	Primarily reflected by activities that are centered on communication with friends using social media services but also reflected through activities related to posting, i.e. pictures and updates.
Knowledge-oriented participation	Reflected mainly by using social media to gain and share information related, for example, to one's interests. Knowledge acquisition practices appear to be the core activities, whereas sharing of information on various online platforms or following and posting updates also reflects the orientation.
Blogging-oriented participation	Identified only in Study II high school sample. Reflected by activities related explicitly to blogging – the primary activities captured reading and writing tweets – whereas the secondary activities captured other blogging-related activities such as reading or maintaining a blog and media consumption.
Media-oriented participation	Reflected by more long-term and complex activities related to creating and sharing media (video, picture, music, etc.) artifacts, in contrast to the day-to-day sharing of short-term content (e.g. mobile pictures) in social media related to social networking.
Action gaming	Reflected by playing first-person shooter (FPS) games, role-playing games (RPG), and adventure games. Also driving and sports games reflected the orientation to some extent. A more “serious” and object-oriented type of gaming.
Social gaming (recreational gaming)	Consistently reflected by playing of games with social motives such as exercise, fun, puzzle, and music games. Also driving and sports games reflected the orientation to some extent.
Learning-oriented participation	Reflected in digital activities that include personally or jointly initiated self-organized study activities as well as a preference for digital learning in and out of school. These include, for example, using digital tools for problem-solving or to support social learning by interacting with other students, artifacts, and knowledge distributed across the internet.

Academic digital engagement was considered a boundary-crossing orientation since it is likely to be driven both by school-related performance and learning

motives, as evidenced in Study II, and by maintenance of peer group relations. Using digital media to co-regulate self-directed learning activities in an informal setting with friends was explicated in the interviews. Academic-oriented socio-digital participation cannot straightforwardly be defined as either friendship- or interest-driven. It can be partially interest-driven depending on the motivational factors driving one's academic efforts, and as such it is a reassuring finding from the educational point of view. As the data show, creating a semi-formal platform for students' academic-oriented participation appears to support the co-regulation of learning activities that might otherwise be facilitated only through the students' informal personal networks. Further, the data revealed that learning-oriented digital participation was related to and predicted higher school engagement. Therefore, as learning-oriented participation appears to be an activity-crossing bridge between students' informal socio-digital engagement and institutional schoolwork, it also provides educators with a means to support the appropriation of new knowledge practices with novel digital tools.

Although adolescents' socio-digital engagement is a complex and multidimensional phenomenon, some more or less stable elements can be identified. It appears crucial to approach further examinations on the topic with the understanding that different orientations of digital engagement exist and contribute to both the actual activities that adolescents engage in and the outcomes that this behavior entails. In Table 5, the empirically identified orientations of socio-digital participation are presented.

4.1.2 Gap between digital and academic engagement

The second main finding of this thesis was that there truly appeared to be a gap between adolescents' digital and academic engagement. The gap worked not only from informal settings to school but also vice versa. This was initially explored in Studies II and III, but explicitly tested in Study IV. The results revealed that the motivationally indifferent students identified in Study II were more likely to engage in social media and gaming. Further, the correlational findings from Studies II and III indicated that there were various relationships, for instance, from social networking and action gaming orientation to lower self-reported GPA, lower study engagement, and higher cynicism towards school, all of which represent disengagement that might be an indication of the gap. Moving forward from these preliminary findings, in Study IV, we first observed cross-sectionally that digital learning preference was positively related to a wish to use digital tools more in school. Further, wishing for more digital schoolwork was negatively related to schoolwork engagement. Longitudinally, digital learning preference predicted higher schoolwork engagement across time, whereas the interaction between digital learning preference and wish for digital schoolwork predicted later schoolwork engagement negatively. In Study V, it was concluded that better

academic achievement predicts less action gaming over time and that disengagement, i.e. cynicism towards school, and feelings of inadequacy predict increased social networking and action gaming over time, but not the other way around.

To conclude, the gap exists and works both ways. Schoolwork influences and is influenced by digital engagement, supporting the previous findings indicating a complex interplay (Howard, Ma & Yan, 2016). To some students, when the practices of out-of-school digital engagement are misaligned with the educational practices of school, there actually appears to be such a gap. Indeed, both the cross-sectional and longitudinal results of this thesis showed support for a more nuanced understanding of the gap hypothesis; students who, on the one hand, have a disposition for learning with/of digital tools, but on the other hand, are not capable of deploying this competence in school, experience a decline in their school engagement. In turn, experiencing motivational indifference or disengagement in school leads to increased engagement with digital media, highlighting the continued importance of school for adjustment outcomes in adolescent development (Roeser et al., 1998) even in relation to digital media. Given that there is at least assumed to be considerable differences between schools and teachers in how digital tools are implemented in teaching and learning, the gap is likely to be more observable in some schools and students than in others. Yet, taking novel digital tools and practices into account appears to be related to higher school engagement. This, however, is likely to put students into unequal positions and create a digital competence or digital participation gap (Jenkins, 2006). To counter this, all students should be provided with tools for cultivating their digital practices to capitalize on the connected learning possibilities. From the schools' viewpoint, the problem to be solved is how the pedagogical solutions around digital tools are implemented so that the students' out-of-school practices are taken into account to best support students' personal and collaborative learning and development. Some further thoughts on this are presented in Section 4.2.

4.1.3 Digital demands and digital resources

The third finding of this thesis was that digital participation yields both demands and resources and that these are tied together via multiple processes. First, the data in Study III show that among elementary and high school students' social networking-oriented digital participation was consistently related to lower study engagement and/or more symptoms of burnout, especially exhaustion. The specific and reciprocal signal detected in Study V with social media networking in relation to emotional exhaustion indicates that some forms of digital participation are in a dynamic relation with school burnout through the energy-depletion process. For some, this process creates an imbalance between subjects' daily resources and the demands of schoolwork, leading to subsequent issues with

well-being (Salmela-Aro & Upadyaya, 2014). The increase in demands through disruptions to and multitasking in daily activities (Carrier, Rosen, Cheever, & Lim 2015; Moisala et al., 2016b, van Der Schuur 2015) is likely to deplete psychological resources, eventually causing exhaustion. Increasing demands might also be an indication of excessive digital participation, which has been found in previous studies to have a reciprocal effect with school burnout (Salmela-Aro et al., 2016). In line with the Goldilocks hypothesis, excessive use of social media or other technologies can lead to issues with well-being (Przybylski & Weinstein, 2017).

Second, another process related to digital participation and well-being is the motivational process. In Study II, we observed that mastery tendencies and school engagement were positively associated with digital skills and using digital media for academic purposes. In Study III, we discovered that knowledge-oriented digital participation was related to higher study engagement across all educational levels. Similarly, in Study IV digital learning preference predicted higher schoolwork engagement over time. These findings suggest a positive motivational effect sparked by the resources provided by knowledge-oriented activities. These findings together provide larger scale statistical support for the view of digital engagement as an avenue for interest-driven and connected learning (Barron, 2006; Ito et al, 2013), which, when connected with the more formal learning ecologies of schooling can increase psychological resources that support also formal academic engagement and achievement (Ito et al, 2013).

4.1.4 Theoretical synthesis

To conclude, combining the gap hypothesis with the demands-resources framework of academic well-being, the findings of this thesis reveal multiple dynamic processes connecting students' socio-digital engagement with academic well-being and motivation: 1) students' engagement with digital media is fundamentally multidimensional, 2) misalignment between students' digital engagement and wish for more digital schoolwork predicts declining school engagement, 3) disengagement, i.e. lower achievement and cynicism towards schoolwork, increases the time students spend with digital media, 4) time-consuming and frequent types of digital activities, such as frequent use of social media services, increases daily psychological demands, possibly interfering with schoolwork and leading to emotional exhaustion, and 5) knowledge-building types of digital activities increase the psychological resources in terms of available tools and competencies (intellectual prostheses) supporting schoolwork and school engagement.

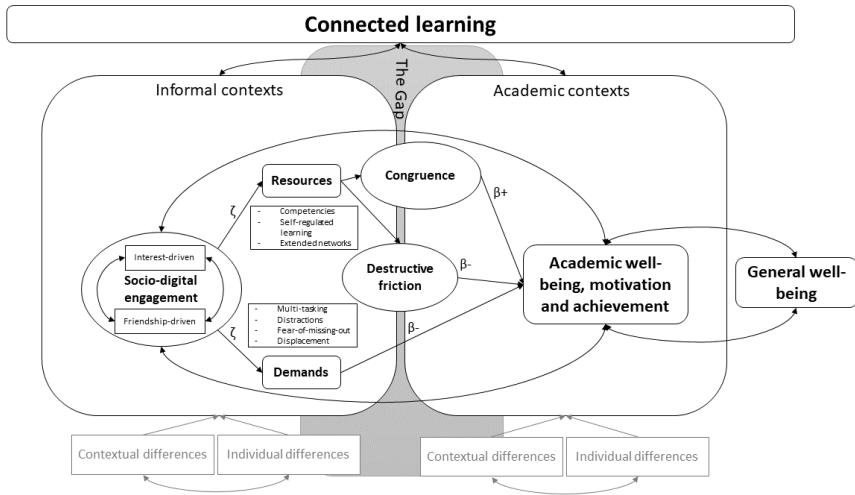


Figure 3. Theoretical synthesis of congruence and friction between socio-digital engagement and academic well-being, motivation, and achievement.

Figure 3 shows the hypothesized theoretical synthesis connecting informal learning through socio-digital engagement with academic learning and well-being. The paths in the theoretical figure labeled with the Greek letter zeta indicate paths that are random, with various effects possible due to moderators, many of which are still unknown. However, the findings of this thesis suggest that at least the qualitative differences as well as the intensity of digital engagement play a major role. For instance, more interest-driven or knowledge-oriented practices of socio-digital engagement appear to be more congruent with academic practices than friendship-driven practices such as social networking.

The Greek letter beta is used to indicate paths for which we can predict the direction. My model suggests that given the right conditions intensive digital engagement increases students' psychological resources, which, in the case of congruence with academic practices, increases both school engagement and subsequent academic achievement. In turn, given a destructive friction the gap emerges, leading to lower school engagement and academic achievement. Intensive digital participation, especially if it develops into excessive habits of digital engagement, increases the daily psychological demands, interfering with academic activities and leading to higher school burnout and lower academic achievement. Furthermore, the findings of this thesis strongly suggest that negative experiences of academic and emotional functioning lead to increased digital participation, possibly as an escape or a search for meaning outside of academic purposes, causing the gap to emerge also because of academic disengagement. Regarding both informal and academic learning, it is also acknowledged in the model that contextual and individual differences matter and should be studied further.

We are talking about connected learning only when congruence is achieved, that is, when students can connect their informal learning contexts with their academic learning (Ito et al, 2013). The gap between informal practices and educational practices outlined in this thesis is an obstacle on the road towards unlocking the learning potential that digital media and novel technologies have made possible.

4.2 Pedagogical considerations

Successful learning with digital media tools calls for transformations in the social practices of schooling, which appear to be happening very slowly (Hakkarainen, 2009). Such transformations are crucial, however, as the schooling system should prepare students for the current knowledge-intensive society with skills for solving complex problems individually and collaboratively, and with novel tools and methods (European Parliament, 2015; European Commission, 2017). The pedagogical considerations that can be derived from the findings of this study are two-fold. The multiple processes relating well-being, achievement, and digital engagement require different types of solutions. In the following, I present my considerations for 1) bridging the gap and 2) supporting adolescents' digital agency.

4.2.1 Bridging the gap

The “gap” stems from the discrepancy between adolescents' life in school and out of school. The findings of this thesis indicate that it works both ways. Aiming to solve the discrepancies between in-school and out-of-school learning is not new (see e.g. Rajala et al., 2016), but given the ubiquity of digital engagement in adolescents' lives it is perhaps now more important than ever. Especially as it appears that digitally competent students appear to benefit from educational settings in which they do not wish for more digital schoolwork but show signs of disengagement when this is not the case. The aim of the educational system should be in cultivating interest and motivation to learn for all students. To this end, the key pedagogical solution would be to act to increase engaging learning practices in school, and to ensure that no student feels disengaged, alienated, or left out. This is not a new idea, and it is of course easier said than done, but it needs to be done. But how?

Simply increasing the amount and time spent using digital tools in education appears not to be the best way forward (Tamim et al., 2011). Integrating digital tools and practices in education needs to be done in a meaningful way. Although many students are fluent in using technologies outside of school, the education benefits are dependent on the pedagogical practices and support that they receive (Wang et al, 2014). The learning practices, strategies, and gains across the out-of-

school learning contexts are varied, and while more intensive digital engagement may enhance certain skills, such as problem-solving, more metacognitive strategies in learning are not necessarily developed (Chiu, Liang & Tsai, 2016). The pedagogical practices in school make all the difference, and development work on the topic has already over a decade ago switched focus on meaningful pedagogical use of digital technologies (Järvelä, Näykki, Laru, & Luokkanen, 2007) and their interpretation as cognitive tools that can reorganize how learners think and engage in productive group interactions (Laru, 2012). A considerable body of research has already been formed, highlighting good practices of, for instance, computer-supported collaborative learning (CSCL, e.g. Orvis, 2008) that should be utilized.

Teachers are in a key position to do this (Halonen et al, 2016) and teachers' attitudes towards integrating digital tools in education make all the difference. Having a positive attitude towards using digital tools in education appears to be affected, for instance, by the perceived usefulness and ease-of-use of the technologies (Teo, Milutinović & Zhou, 2016; Teo, 2018). In turn, behavioral intention to use digital technologies appears to be driven by the perceived usefulness of the digital technologies (Teo, 2009; 2018). However, in Finland, the teachers' competencies in terms of transforming education practices are not necessarily optimal (Valtonen et al, 2017). This should be considered in teacher education regarding both pre- and in-service teachers, and, more importantly, adequate pedagogical support should be provided to schools and individual teachers. Nevertheless, it appears that failing to transform teacher-centered knowledge acquisition and performance-oriented educational practices may lead to an increasing gap between adolescents' informal socio-digitally enriched practices and the conventional practices of schooling.

Promisingly, prior studies reveal that even very young adolescents, supported by socio-digital tools and teachers, can pursue engaging and collaborative projects that require sustained creation and building of knowledge (Bereiter, 2002; Bereiter & Scardamalia, 2006). Integrating specific digital solutions with, for instance, collaborative, inquiry-based, and design-centered pedagogies (Hakkarainen, 2009) has already shown good results over traditional lectures (Sung et al., 2016). Moreover, it appears possible to bring elements of maker culture in school in terms of engaging students in using socio-digital media for designing complex artifacts under teachers' and experts' guidance (Blikstein, 2013). Although in many cases more traditional pedagogies also still have their place in school, I argue that to solve issues related to students' lack of motivation and sense of meaning, novel pedagogies should be pursued.

In the end, the integration of digital media and digital learning tools into schoolwork is not so much about the technologies themselves, but about the novel social and pedagogical practices they make possible (Hakkarainen, 2009). Technologies themselves are of little use and are not likely to contribute to better

academic well-being, motivation, or achievement without good pedagogical practices built around them. To sum up, I continue to argue that schools should be pursuing agency-centered pedagogy (Rajala, 2016) in terms of building the pedagogical solutions on the foundation of students' personal sense, experiences, and agency as well as connecting in-school learning to out-of-school digital and physical environments. This would benefit all students and provide material to bridge the gap.

4.2.2 Digital agency

It is crucial to acknowledge adolescents as active agents in their own practices of digital engagement, but at the same time it should be recognized that development-wise adolescents are facing a variety of social, emotional, and physiological developmental challenges (e.g., Burnett, Sebastian, Kadosh, & Blakemore, 2011; Steinberg & Morris, 2001). While striving to overcome these challenges, adolescents are likely to benefit from support in equipping them to use digital media in a resource-yielding way rather than viewing digital media as a handicap to becoming a fully functioning adult (Hur & Gupta, 2013). Multi-tasking and being exposed to multiple distractions during the day are detrimental in terms of cognitive ergonomics (Firth et al., 2019), and these appear to pose challenges for at least some students (Moisala et al, 2016b) and can lead to stress spilling over to schoolwork. This is especially so, as various aspects of digital media have been purposefully designed and have also evolved to capture and keep attention (Firth et al, 2019). However, other students are able to harvest the benefits of digital engagement without experiencing any major challenges in daily life. The education system is in a key position to balance this in terms of being able to promote practices and skills of self-regulation while using digital media as well as teaching ways to use digital tools to one's benefit instead of them being mere distractions (Hur & Gupta, 2013; Lonka, 2018). Finnish schools have long supported students in building healthy lifestyles with regard to food and exercise. Balancing students' digital engagement should be added to the equation, especially so as The Finnish National Core Curriculum states as a core competence "self-care and managing everyday life" (Finnish National Core Curriculum, 2014). Accordingly, based on the results of this thesis, I argue that it appears evident that promoting supportive practices of digital engagement should be a key focus also in schools (Lonka, 2018). This is not achieved by banning digital technologies at schools, which would merely be sweeping the problem under a rug. Instead, promoting an agency-supportive environment and educating students, practicing regulation and agency, and collaboratively negotiating shared practices of digital engagement would in the long run be the most beneficial way forward.

4.3 Limitations and future directions

Piloting the SDPi instrument can also be considered an aim in this study because as adolescents' digital engagement has evolved so rapidly we needed to develop new measures that were utilized across all studies. In Study I, regarding the interview analysis, the second author, who at that point had not been involved in designing the SDPi or in the statistical analyses, carried out the content analysis. The interviews were consistent with the structural model. In Study III, we identified similar structures of socio-digital participation across three different samples, indicating that the conceptualization of the orientations of socio-digital participation appears robust. Moreover, in Study III, we used exploratory structural equation modeling that allowed us to model the complex multidimensionality of SDP and to examine the factor cross-loadings that might be masked using a confirmatory approach. Using an ESEM-CFA approach enabled us to construct a structurally valid measurement model free of measurement error. While this type of modeling allowed us to examine the complexity of the orientations of socio-digital participation, it is not the whole picture. To gain a better picture, future studies should not only focus on individuals but also their social networking relations combined with other types of data. Further, person-oriented studies aiming to identify latent subgroups' socio-digital engagement based on the complex measurement model should be conducted. However, it must be noted that in working with issues related to digital participation we are aiming at a moving target. It is likely that some relevant aspects were not captured here, which is a limitation, and the inventory should be developed further and continuously validated with new samples in the future.

With regards to the findings from the cross-sectional studies (I-III), we cannot infer causal relations. Thus, it should be noted that all effects that I found in these studies could very well be the other way around or bidirectional. Future studies should also aim to examine methodologically the non-linear effects and the possible observed or unobserved subgroups within which the effects may differ. Studies IV and V utilized a longitudinal sample of adolescents, which strengthens the inferences that can be drawn from the analyses. However, the sample was not representative, and thus, the results may not be fully generalizable. A replication study with a representative sample and possibly with students of different ages and from different academic contexts is warranted.

In Studies III-V, the models were specified using only latent variables, which allowed us to model the relations with measurement error separated (Little et al., 2007). In Study IV, we did not distinguish between-participant and within-participant variances, which affects the inferences that can be drawn, especially limiting any causal speculations (Hamaker, Kuiper & Grasman, 2015). In study V, however, I separated the between and within-person variances and the inferences are made at the within-person level, which strengthens the causal speculations. In Study IV, the inclusion of the latent interaction allowed us to

model the gap conditional between individual and perceived contextual factors, but without a multi-level setting and actually observing and recording the school-level practices it cannot be distinguished whether a gap truly exists between students' digital practices and schools' pedagogical practices.

A critical limitation in this and many other studies on digital engagement is the use of almost solely self-reported data. Self-reports on digital behavior are inherently biased (Ellis, Davidson, Shaw, & Geyer, 2018). Acquiring multiple sources of data, also observational, and going beyond self-report questionnaires appear to be a crucial development point for future research. In addition, this thesis, similarly to the majority of research on the topic, was restricted to examining only cross-sectional or long-term longitudinal relations. It would be useful to also focus on digital engagement on a shorter timeframe employing experience sampling and ecological momentary assessment methods.

4.4 Conclusions

In the tradition of sociocultural psychology, learning is distinguished from the processes of institutional education. Students live, experience, and learn across various contexts, and how learning is framed in academic settings is not the whole picture (Erstad & Sefton-Green, 2013). The recently emerged practices of socio-digital engagement have opened a whole new layer of opportunities for adolescents to participate, network, create, and develop various competencies in the process (Ito et al, 2010; 2013). These types of self-regulated practices are not always congruent with the more traditional ways of learning and participating in schools. Students flourish and fulfill their potential when the informal and formal practices of learning are aligned (Ito et al, 2013), but when this is not the case frictions can emerge (Vermunt & Verloop, 1999). These frictions as well as, for instance, multi-tasking may further contribute to excessive or unbalanced engagement with digital media, reflected in adjustment and well-being issues (Brunborg et al., 2013; Carrier et al., 2015; Etchells et al., 2016; Holmgren & Coyne, 2017; Krossbakken et al., 2018; Moisala et al., 2016b; Przybylski & Weinstein, 2017), indicating a reciprocal, vicious loop.

This thesis contributed theoretically to the discussion of screen time and the different well-being outcomes that emerge as a function of different types of digital participation. Thus, the core of the thesis lies in acknowledging that the differences in adolescents' practices of engaging with digital media are more important than the minutes spent around screens. Adolescents' engagement with digital media should be approached more as deliberate participation in media flow and cultural practices conceptualized through the different genres and constantly evolving underlying orientations (Ito et al, 2010), and understanding why some digitally-mediated practices emerge is as important as how much time it takes. It appears that academic well-being, motivation, and achievement are tied to digital

engagement via both destructive and constructive processes depending on the congruence, or frictions, between the adolescents' practices of socio-digital engagement and the practices of the school. The results showed support for the gap hypothesis, but the results also suggest that the manifestation of this gap is dependent on multiple factors, both individual and contextual. Whilst the gap might emerge because of out-of-school digital engagement that is not recognized in school, it might also emerge due to problems in school that lead to increased engagement with digital media. Overall, it can be stated that the continuity and discontinuity between different contexts of academic and emotional functioning in and out of school appear to be a product of multiple complex interactions (Rajala, 2016) to which new forms of digital engagement have added yet another layer (Ito et al, 2013). Further, to understand the full complexity of student learning and well-being, the overall ecologies need to be acknowledged (Barron, 2006; Erstad & Sefton-Green, 2013).

That said, intensive social media engagement may also increase the daily psychological demands to such an extent that it hinders schoolwork, leading to symptoms of school burnout, which in turn can affect academic success in various ways later. In terms of adolescent socio-emotional development and well-being, the results highlight the complexity of making predictions and general recommendations. Increasing digital engagement can function as both the cause and the effect. It is acknowledged that digital engagement cannot be separated from other layers of adolescent life, but that much of life has become digitally mediated (Baym & boyd, 2012). Towards that end, I argue that everyone concerned with the well-being of youth should be more adept in understanding the content and qualitative differences in digital engagement and their complex and dynamic interplay with individual differences in varying contexts.

To conclude, current research, this thesis included, has thus far uncovered small cross-sectional and long-term (reciprocal) longitudinal effects between digital media and adolescent academic and emotional functioning, but the big picture is rather vague and based on fragmented data and measures of varying specificity. The qualitative differences in socio-digital engagement are crucial in determining the outcomes. However, previous studies have also indicated that there are various possible moderators affecting the relations of digital engagement and well-being, which should be explored and tested. Therefore, in future studies more detailed theoretical hypotheses should be tested with adequate data to enable more accurate inferences to be made of the relation between digital media and adolescent well-being. Moreover, acknowledging that digital and non-digital lives are not separate and that adolescents' digital engagement practices reflect complex structures should be taken as a starting point in all future research efforts. The use of methodologies and data that can take into account these complex structures should be applied on a larger scale alongside methodologies that can capture the more nuanced qualitative differences on a smaller scale.

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Appendix

Appendix A. Summary of means, standard deviations, and internal consistencies of the scales used in the original studies.

Study I	Mean	SD	Cronbach's alpha
Social networking	4.22	1.31	.83
Knowledge-oriented	2.12	1.29	.76
Media-oriented	1.78	1.11	.76
Academic-oriented	2.82	1.37	.83
Social / Recreational gaming	2.14	1.18	.75
Action & sports gaming	2.35	1.30	.83

Study II	Mean	SD	Cronbach's alpha
Achievement goals			
Mastery-intrinsic	5.19	1.13	.85
Mastery-extrinsic	5.68	1.00	.84
Performance-approach	4.03	1.39	.73
Performance-avoidance	4.06	1.58	.86
Avoidance	4.35	1.25	.69
Motivation and academic performance			
Schoolwork engagement	4.68	1.21	.92
Lack of school value	2.45	1.00	.71
Fear of failure	4.14	1.45	.76
Academic withdrawal	3.78	1.35	.73
Self-reported grade point average	8.87	0.71	–
Socio-digital participation			
Hanging out (social networking)	4.01	0.86	.83
Creative participation	1.50	0.60	.79
Information-oriented (knowledge-oriented) participation	2.70	0.88	.73
Academic participation	2.68	0.85	.79
Gaming seriousness	1.92	1.23	.87
Action gaming	1.95	1.10	.83
Social / Recreational gaming	2.01	0.73	.64
Sports gaming	1.89	1.01	.63
Advanced skills	1.96	0.71	.80
Basic skills	4.28	0.57	.80

Study III	Mean			SD			Cronbach's alpha		
	S1	S2	S3	S1	S2	S3	S1	S2	S3
School engagement	4.47	4.66	5.36	1.42	1.23	1.04	.93	.92	.92
School burnout:									
Emotional exhaustion	2.57	3.13	2.81	1.10	1.17	1.10	.72	.79	.77
Cynicism towards school	2.27	2.30	1.79	1.24	1.19	1.00	.78	.81	.84
Inadequacy as a student	2.5	2.87	2.48	1.22	1.20	1.14	.78	.77	.73

Appendix A. Continued from previous page.

Study IV	Mean			SD			Cronbach's alpha		
	7 th	8 th	9 th	7 th	8 th	9 th	7 th	8 th	9 th
Digital learning preference	2.95	2.83	2.77	1.05	1.13	1.08	.89	.90	.90
Wish for digital schoolwork	3.34	3.08	2.84	1.21	1.24	1.18	.91	.92	.92
School engagement	4.25	4.33	4.34	1.48	1.52	1.48	.94	.95	.94

Study V	Mean			SD			Cronbach's alpha			Macdonald's omega		
	7 th	8 th	9 th	7 th	8 th	9 th	7 th	8 th	9 th	7 th	8 th	9 th
Social (media) networking	4.01	4.03	4.20	1.14	1.10	1.08	.85	.81	.79	.86	.83	.82
Action gaming	2.24	2.16	2.18	1.12	1.12	1.19	.83	.84	.87	.84	.85	.88
Overall school burnout	2.62	2.79	2.79	1.10	1.23	1.14	.90	.93	.92	.90	.93	.92
Emotional exhaustion	2.43	2.57	2.55	1.33	1.43	1.32	.84	.89	.85	.84	.89	.85
Cynicism towards school	2.78	2.99	3.06	1.17	1.26	1.21	.79	.84	.82	.79	.85	.83
Inadequacy as a student	2.61	2.74	2.69	1.28	1.36	1.28	.79	.85	.83	.79	.86	.83
Academic achievement	8.15	8.12	8.17	0.98	1.06	1.12	.89	.91	.92	.89	.91	.92