DOES ICT USE AFFECT THE SOCIAL WELL-BEING AND ACADEMIC PERFORMANCE IN SWEDEN?

EMPRICAL EVIDENCE FROM PISA 2015?

Bas Senden

Master's thesis:	30credits
Programme/course:	L2EUR (IMER) PDA184
Level:	Second cycle
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Supervisor:	Kajsa Hansen Yang
Examiner:	Susanne Garvis

Abstract

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Aim: This study takes a quantitative approach, using PISA 2015 data in order to investigate the ICT use of Swedish secondary school students and the effects it has on social well-being as well as academic performance. Importantly, the mediating effects of different aspects of social well-being are taken into consideration to investigate the role they play within the relationship between ICT use and learning outcomes.

Theory: The social constructivist perspective is used to provide a rationale for using different aspects of social well-being as mediating variables for learning outcomes. Vygotsky's sociocultural theory and notion of mediation is build upon to create the conceptual framework that proposes a mediation model in which the effect of ICT use on learning outcomes is mediated by the different aspects of social well-being. In addition, the literature review provides a clear point of departure by providing evidence of the relationships under study.

Method: Quantitative data from the PISA 2015 student, teacher and ICT familiarity questionnaire was analysed, using SPSS for data management and MPLUS for Confirmatory factor analysis (CFA) and structural equation modelling (SEM). Path analysis is used to investigate the total, direct and indirect relationships between ICT use, social well-being and academic performance

Results: The results indicate that ICT use has a negative effect on academic performance, whereas the relationship with social well-being is mainly due to the effects of the relationship with peers and the perceived unfairness by which teachers treat students. ICT use leads to better relationship with peers, but a worse relationship with teachers. The social well-being of students influences their academic performance. Similarly, this is also mainly due to engagement with peers and the perceived fairness by which the teacher treats the students. Engaging with peers negatively effects academic performance, whereas students who perceive a fairer treatment perform better. However, no statistically significant mediating effects were found, thus social well-being only mediates the relationship between ICT use and academic performance for a small, non-significant, amount.

Foreword

Writing this thesis was a process of intense learning. It was a process of getting stuck, not understanding and losing all motivation, while at the same time it was a process of epiphanies, understanding and working harder and with more motivation then ever before. It was a process of extremes. During this process, I have been supported in many ways. I would like to reflect briefly on the many people who have supported me, in one way or another, during this period, because their support has contributed to the creation of this document

It would have been an impossible journey without the help of my supervisor, Kajsa Hansen Yang. I would like to thank her for her patience, understanding and never-ending positive attitude as well as her constructive feedback and enthusiastic support.

I would like to express my thankfulness towards family and friends. I can not express enough gratitude towards family and friends at home who have been with me from the start, encouraged me to follow my dreams and supported me over the distance. I would also like to offer my thanks to the friends I have made during the last two years in Gothenburg and who have become like family to me. Especially during the days before the deadline, they have been extremely supportive and encouraging.

Furthermore, I am thankful towards the VSB funds in the Netherlands for supporting me with a scholarship.

With the right motivation, everything is possible.

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1. Background

This section briefly presents a background to the research under study. It contains an explanation of the research problem and why it is important to conduct this study, all according to relevant literature. Finally, the aim of the research is explained, whereas the chapter ends by discussing the limitations.

1.1 Research problem

Information and communications technologies (ICT) are a diverse set of technological tools and resources used to communicate, and to create, disseminate, store, and manage information (Blurton, 1999). Technological tools include desktop computers, laptops and mobile devices. A mobile device, also called a handheld device or handheld computer, is a small computing device that usually comes with a touch screen, wireless network capability and sometimes a mini keyboard (Tingir, Cavlazoglu, Caliskan, Koklu, & Intepe-Tingir, 2017). These ICT tools are revolutionising society in many ways across a great variety of disciplines. Every new generation grows alongside different technological advances and spends more time on ICT devices. With the rise of the internet, the usage of ICT devices has become staggering. The average time per day a 15-year old student spends on the internet outside of school was 187 minutes in 2015 (OECD, 2015). The same trend is visible within education. Educational institutions across the globe have heavily invested in ICT now digital skills have become a necessity to participate in an ever-digitalized society (OECD, 2015). Sweden is a prime example and invested greatly in digital Information and communication technology. Between the years 2000-2010 Sweden was ranked as one of the top countries investing in ICT (OECD, 2018a).

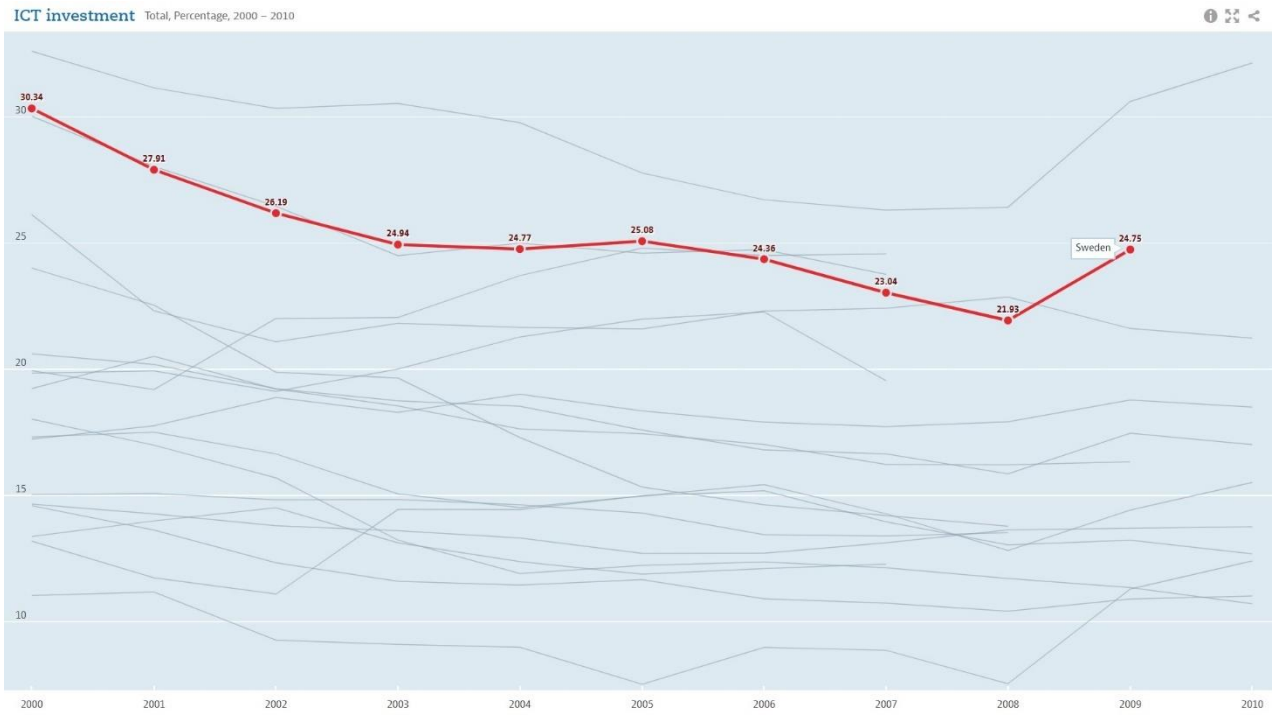

Figure 1 *Total percentage of ICT investment in all OECD countries over the period of 2000-2010. Sweden is highlighted in red (From OECD Data, 2018a)*

However, while ICT devices are becoming more apparent in both classrooms and society, education is still exploring the different ways in which these can be used to assist teaching and learning and how

they affect the students. Most research done in this area focuses on teaching and learning, but the outcomes widely vary. Several studies concluded that technology use within education did little to nothing to improve educational outcomes (Du & Anderson, 2003; Fried, 2008; OECD, 2015). Other studies concluded otherwise, showing the benefits of technology within education (Hu, 2017; Román Carrasco & Murillo Torrecilla, 2012; Skryabin Zhang, Liu & Zhang, 2015) . This indicates a complex relationship between the use of technology and educational outcomes leaving many questions unanswered. Another important aspect of ICT is the connection to our social lives. For example studies have indicated that the use of Social Network Sites can be beneficial for a stronger social capital (Ellison, Steinfield, & Lampe, 2007) whereas excessive use of the internet has been related to lower levels of social well-being and interpersonal and family problems (OECD, 2015; Park, Kang and Kim, 2014). Social well-being is defined by the OECD (2015) as the relationships with family, peers and teachers and students' feelings about their social life and is often seen as an indicator linked to both technology use and educational outcomes. For example, the OECD (2017a) states that students who reported that they feel like an outsider at school score 22 points lower in science on average. While on the other hand, students who feel that they are part of a school community are more likely to have better academic performance and be more motivated (Borgonovi & Pál, 2016; OECD, 2017a). In response to these findings, this study proposes to investigate the relationship between technology, social well-being and academic achievement. The results can shed more light on the role of social relationships with family, peers and teachers and students' feelings about their social life and the influence on technology and academic performance.

1.2 Statement of relevance

Both the use of technology and student's well-being are trending topics within education, gaining more attention in recent years. The use of technology both inside school as outside school is growing in a rapid speed and researchers are still finding out the exact influences on students. Most research on technology in education is focused on learning and teaching. However, well-being in relation to the use of innovative technology is often neglected (Castellacci & Tveito, 2018; Cotten, 2008). Moreover, in the 2015 Programme for International Student Assessment (PISA), multiple questions were included to measure four different dimensions of well-being: 1) psychological, 2) physical, 3) cognitive and 4) social. This data gives the opportunity to connect the use of technology, not only to teaching and learning, but to well-being as well. However, all these dimensions are complex and could be studied separately, there are however strong arguments for the choice of social well-being. Listening to the voices of the public, who has not heard the complains about screen time replacing our face to face time, mobile phones being used during dinners, concerts or other social events and students using their laptops during lectures for everything except study purposes. Alongside, studies are indeed showing us the impacts of technology on the different aspects of our social well-being. Therefore, in this research, the dimension of social well-being is chosen as a mediator between technology and academic performance.

The outcome of the research will give us insight in how we can utilize technology not only to improve teaching and learning but also take into account the social well-being of students. Social well-being is an important aspect of a student's life, spending a considerable amount of time in the classrooms. Moreover, students at this age are in a crucial part of their development and a valuable social support network can ensure that they are protected from loneliness, and physical and mental health problems (Borgonovi & Pál, 2016), thus creating an environment where there is attention for the social well-being of students can prevent social emotional problems and costly interventions. Moreover, the different use of ICT devices and their effects on social well-being and academic performance can provide policy makers with relevant knowledge in how to use ICT devices. It can also improve the knowledge of possible dangers connected to the use of ICT devices.

1.3 Research aim

The aim of the study is to examine the effect of ICT use on academic performance of 15-year old students in Sweden, taking into consideration their social well-being. More specifically, this research aims on investigating the mechanism of Swedish students ICT use, social well-being and academic achievement. ICT use for different purposes both inside and outside of school are included. Researching these relationship can shed light on the complexity of the phenomenon which nature depends on e.g. the initial level of skills, type of the skill and type of ICT use (Jackson, Von Eye, Witt, Zhao, & Fitzgerald, 2011) and can contribute to the ongoing debate about the use of ICT.

This debate has been made apparent when a report from the Organisation For Economic Development (OECD) in 2015, titled: Making the connection, stated that: ‘’no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education and that technology is of little help in bridging the skills divide between advantaged and disadvantaged students’’. This caused a worldwide reaction and disbelief among scholars. As a reaction to this report, Hu (2017) published a report titled: ‘’Students, computers and learning: Where is the connection?’’ in which they are making the connection between the use of ICT and evidence-based learning and practice. They do so, by presenting many evidence-based examples of ICT use in education and the positive impact on learning, showing a broad picture of the elaborate uses of ICT. Their article closes with the statement that ICT has enabled new ways for education to be delivered, created new learning places and improved our ability to deliver more effective pedagogies to improve student results (Hu, 2017). Therefore, it is daring to make concrete statements about the effects of ICT as it is moderated by many variables, changing over time and used in many different ways and contexts. However, including social well-being as a mediator can provide evidence of the interwovenness of ICT, not only with learning outcomes, but with the relationships we have with parents, peers, teachers and how we feel at school.

1.4 Limitations

During the study, not all components in the proposed theoretical framework for social well-being were available in the Swedish PISA 2015 data. This was due to the fact that Sweden did not collect the optional parental data and exclude bullying variables from the dataset because of the reliability issues. This has resulted into the construct relationship with peers only being represented by peer engagement and the construct relationship with parents missing two indicators from the parental questionnaire. However, the construct of relationship with parents did still have enough indicators to build a reliable construct. Two constructs, namely peer engagement and parental engagement only consists of two indicators resulting in high measurement error of the construct and thus a low scale reliability.

The constructs general achievement, plausible values of mathematics, science and reading literacy were used. The dataset contains ten plausible values for each subject, but this study only used one plausible value per subject. However, there are not many differences between the plausible values of each subject, thus the affect on the estimates of the relationship between ICT use, social well-being and academic outcomes in this study are minimal.

Moreover, specific measures of the areas of ICT use are not available in PISA 2015. Rather, the derived variables from the dataset are limited to a very general use of ICT. More data on what and how students use ICT both inside and outside of school could lead to a better understanding of the specific effects of ICT on academic performance. Thus, the available data limits the scope of the research.

2. Theoretical and conceptual framework

This chapter start with a theoretical framework which gives an overarching view of the subject under study and the possible relationships occurring. It also provides a broad conceptual framework that introduces the context in which the subjects under study will be analysed.

2.1 Theoretical framework

In this research, we adopt the stance that learning is mediated by social processes, thus the effects of ICT on learning are possibly influenced by the social well-being of students. The idea that learning is influenced by social processes is not new but has been studied extensively by social-constructivist who consider the construction of intellect to be an interdependent process between the individual and the social. Therefore, social-constructivist perspectives reject the point of view that the locus of knowledge is in the individual and hence regard learning and knowledge as inherently social (Palinscar, 1998). The role of social processes as a mechanism for knowledge and learning is usually identified with Vygotsky, who offered a classic learning theory which helps us to understand and think about the relationship between the social environment and learning by suggesting how and why change in learning happens. His theory of cognition considers higher mental functioning appearing on two planes. First between people on the social plane and then with the individual learner on the psychological plane (Vygotsky, 1978). Hence, social constructivism places a great emphasis on the importance of social interactions on human learning and cognition (Bell, 2011; Garzotto, 2007). According to this perspective on learning, the accustomed internal development processes only occurs when a person is interacting with people in his environment, including peers. This interaction is not only face-to-face interaction, a recent study, using the social-constructivist theory has been applied to internet game experiences, measuring the benefits of playing together or playing alone. The results confirmed Vygotsky's theory, providing empirical evidence that internet game experiences, involving social interaction are more conductive to learning than playing alone (Garzotto, 2007).

Sociocultural theory of Vygotsky

One of the most influential social constructivist theories in educational research is the sociocultural theory, which suggest that learning and development takes place in a constantly changing socially and culturally shaped context, or as Palincsar (1998) stated:

> *''as learners participate in a broad range of joint activities and internalize the effects of working together, they acquire new strategies and knowledge of the world and culture''.*

An important aspect within this theory is Vygotsky's notion of the role of mediation by tools and sign. This is explained by human behavior being mediated by external artefects, both physical and psychological, which give the prompt to action. His mediation triangle, as seen in figure 2, explains how human behavior is not simply the reaction to a stimuli but is affected by artefacts and tools mediating between the subject and the object. The primary stimulus is depicted as S, mediation by the X and together both stimulus secure a response which is seen in the diagram as R. (Marginson & Dang, 2017).

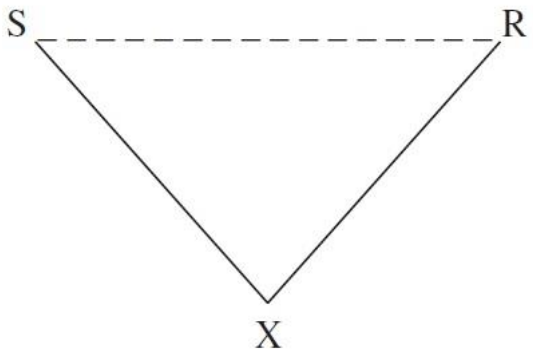

Figure 2 *Stimulus-repsonse-mediation triangle. Adapted from Vygotsky (1978, p.40)*

2.2 The conceptual Model

In order to empirically test the theoretical model, one need to translate it into a testable hypothetical model. The thesis aims to examine the mechanism among students' ICT uses, social well-being and academi achievement. A mediation model of a three-variable system thus is the most suitable, in which two variables impact the outcome variable. The basis mediation model is depicted in figure 3. In this model there are three paths; the path from the independent variable to the mediator (path a), the path from the mediator to the outcome variable (path b) and the path from the independent variable to the dependent variable (path c). The independent variable has a direct effect on the outcome variable (path c) and the mediator variable also has an impact on the outcome variable (path b). However, a variable meets the condition to function as a mediator when (a) variations in levels of the independent variable significantly affect the mediator variable, (b) variations in the mediator significantly affect the dependent variable and (c) when path *a* and *b* are controlled, a previously significant relationship between the independent and dependent variable is no longer significant (Baron & Kenny, 1986).

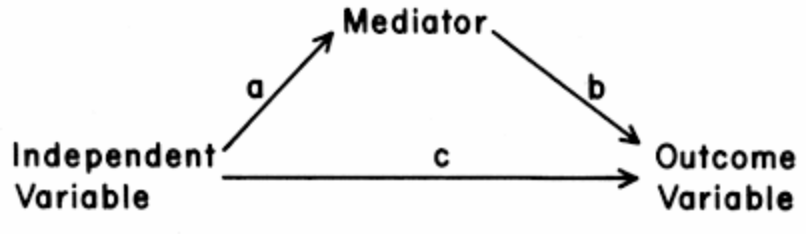

Figure 3 *the mediation model*

In this study the independent variable is the use of ICT of 15-year old Swedish students. The mediator is their social well-being and the outcome variable is academic performance. This is depicted in figure 4. Hence, this model states that the ICT use must influence social well-being and academic performance and lastly, social well-being must affect academic performance. However, the effect of ICT use on academic performance must be less when social well-being is taken into account as a mediator.

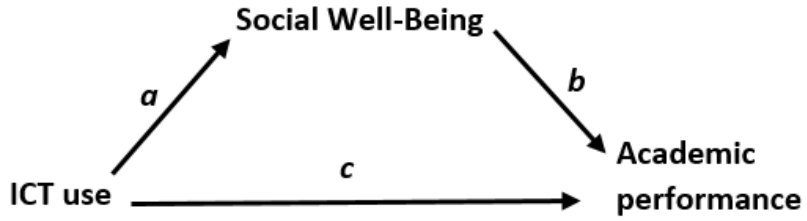

Figure 4 *the hypothesized mediation model*

3. Literature review

This section contains a more in-depth overview of the literature. It is structured in a way which reviews the literature, divided into subjects, from a general viewpoint working towards a more detailed perspective which is relevant for the research.

3.1 Theoretical perspectives on ICT

3.1.1 ICT in education

Technological tools have become not only more apparent in education over the last decade, from 2006 to 2011, the number of computers per student have doubled, laptops became widely available in classrooms and almost all school had broadband (Wastiau et al., 2013), the digital competence that is necessary to use them has become an essential skill. It is therefore no surprise that the European commission has adopted a digital action plan in the start of 2018 that aims at supporting technology use and digital competence development in education. In line with this plan the Swedish government has decided to strengthen the national curriculum with regards to digital skills. In order to further improve the digital knowledge of Swedish students, digital competence will become an essential part of the Swedish national curriculum (European commission, 2018). Digital competences are defined by the European Commission (2018) as:

> *"the confident, critical and responsible use of, and engagement with, digital technologies for learning, at work, and for participation in society. It includes information and data literacy, communication and collaboration, digital content creation (including programming), safety (including digital well-being and competences related to cybersecurity), and problem solving"*

The importance of these digital competence becomes even more apparent when we take a look at the availability of digital equipment in Sweden. A survey of schools in Europe measuring use, access and attitudes in 27 countries shows us that more than 90% of the Swedish students is in highly digitally equipped schools, after Norway the most in all the countries measured (Wastiau et al., 2013). These results are confirmed by comparative studies with big databases, presenting that almost all student in Sweden have access to a computer and internet at school (Frailon, Ainley, Schulz, Friedman & Gebhart, 2014; OECD, 2015; OECD, 2019) This paints a picture of unprecedented access to ICT resources at school. At home, the same trends are visible, students in Sweden have, with almost no exceptions, access to a computer and internet (OECD, 2015; OECD, 2017a). Thus, we can safely state that ICT access in Swedish schools and household have become abundant. The accessibility and availability of ICT is a conditional requirement for the use of ICT, however, there was no relationship found between high levels of ICT accessibility and availability at school and students' use in learning and teaching. (Nancy, Willem, & Tjeerd, 2008; Wastiau et al., 2013). The accessibility and availability of ICT is one that has seen a great transformation over the past decades both in school and outside of school. Technological tools are a major part of our daily lives and will continue to do so, thus, digital competence is a skill that students' need to acquire for the future.

3.1.2 The use of ICT

Literature on the use of ICT in education is abundant and it can be a daunting task as it is easy to stop seeing the forest through the trees. This is mainly due to the complexity of the subject and the many factors that influence ICT use. It is a complex subject with multilevel aspects in the domains of policy, resources, curriculum, organization, teaching and learning (OECD, 2010). This part focuses on ICT and learning, which is the use of ICT by the learner or student. If we look solely on the student use of ICT, there are three general indicators provided by the OECD (2010). First, how students actually use ICT (utilization indicators), second what the outcomes are of their use (outcome indicators), and third what the impact is of their use on school learning (learning impact indicators).

The students use of ICT is made clearer by Heo & Kang (2010), who propose three dimensions for the ICT use of students which are made visible in figure 5. The first dimension considers the places where ICT is used and is divided into two categories, in-school and out-of-school use. The second dimension considers the purposes of ICT use and is also divided into two categories, learning and entertainment. The third dimension shows the contexts in which ICT is used and is divided into the social context and the individual context.

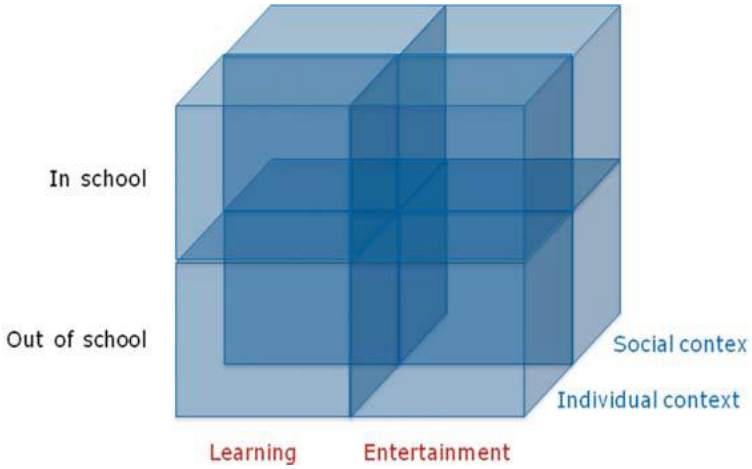

Figure 5 *the dimensions of ICT use for students (p.193, Heo & Kang, 2010)*

Outside of school use

PISA results have shown that almost all students' across OECD countries regularly use a computer at home, while in the northern European countries it almost exceptionally rare to not use a computer at home (OECD, 2015). When we look more closely at what they use their computers for, Hinostroza, Matamala, Labbé, Claro, & Cabello (2014) have found that the use of ICT at home is mostly represented by four categories: socializing, academic, gaming and production. The most common activity at home was using the internet for fun, spending on average more than two hours online per day (OECD, 2015; Ben-David Kolikant, 2012). Thus, we can say that ICT is extensively used by students outside of school and it is of no surprise that the effect of this use and the relationship to student outcomes has been intensely studied over the past decade. The research indicates that when ICT is used outside of school for school-related tasks, a significant positive relationship with academic performance was found (Skryabin et al., 2015). This positive relationship was also found among the different uses of ICT, such as internet and social media use (Chen, Hsiao, Chern, & Chen, 2014; Jackson et al., 2011; Marker, Gnambs, & Appel, 2018; Skryabin et al., 2015). On the contrary, when ICT is used for non-related academic purposes, a significant negative relationship was found (Salomon & Ben-David Kolikant, 2016). While this seems to stand true for the use of social media, (Huang, 2018; Liu, Kirschner, & Karpinski, 2017; Marker et al., 2018) there are multiple studies who found an exception in using computers for internet and video gaming (Jackson et al. 2011; Bowers & Berland, 2013; OECD, 2015).

However, it is important to note that there is no general agreement and many contradictory findings are found when analysing the literature.

Inside of school use

When looking at the inside and outside of school use, we find that the average use of computers and internet at school across is relatively low compared to the use at home (Fraillon et al. 2014; OECD, 2015). Data from the International Computer and information Literacy study (Fraillon et al. 2014) and the OECD (2015) suggests that, on average, just under half of the students were using computers at school for schoolwork, with browsing the internet for schoolwork as the most common activity. These observations are not new, it has been noted in previous studies that, although the access to computers in schools is high, the use in remains disappointing (OECD, 2004; Cuban, 2001). Some students have reported that they find it difficult to use ICT in some of their school subjects, but that this is depending on the subject being taught (Lindberg, Olofsson, & Fransson, 2017).

As for the effects of ICT use in school on student outcomes, there is no agreement between studies varying from ICT having a positive effect on academic performance (Ponzo, 2011; Sung, Chang, & Liu, 2016; Tingir et al., 2017) to having a negative effect (Skryabin et al., 2015). However, most studies agree that classroom computers are beneficial for academic performance when used to look up information and ideas (Comi, Argentin, Gui, Origo, & Pagani, 2017; Falck, Mang, & Woessmann, 2018) but found a significant difference when ICT was used to teach a specific subject (Comi et al., 2017; Skryabin et al., 2015; Tingir et al., 2017).

3.1.3 The effect of ICT uses on student outcomes

Throughout the review we have seen a discrepancy in results of ICT use on student outcomes in school and outside of school. If we look at the general use of ICT and the effect of student outcomes, the results are not much different. Some studies have found positive overall effects of ICT use on academic outcomes (Cheema & Zhang, 2013; Román Carrasco & Murillo Torrecilla, 2012; Skryabin et al., 2015; Sung et al., 2016), whereas other studies have found no effects (Hunter, Leatherdale, & Carson, 2018; Lei, 2010) or even negative effects (Biagi & Loi, 2013; Peiró-Velert et al., 2014). It seems that evaluating the impact of ICT on student outcomes is extremely difficult due to the complex relationship and many factors influencing ICT use. Following the OECD (2010), Biagi & Loi (2013) gave some insight in the complexity of the ICT use of students by showing that the use of students' ICT is affected by micro (such students' economic, social and cutlural status), meso (school's characteristics) and macro (institutional) level factors, as well as their interrelationships.

3.1.4 The effect of ICT uses on Social well-being

Using ICT devices have transformed the way we socialize and everywhere you look, youngsters are intensely engaged with phones which have become a necessity in order to ''stay connected'' tot the world and other people. However, the ease of access and the difficulty in controlling ICT use has caused concern for the safety and privacy of young adolescents. Dangerous relationships with stranger, cyberbullying, overuse, extreme videogaming and compulsive texting are just examples of possible concern parents, educators and policy makers can have. Therefore, it is not surprising that research has found a connection between the extent and ways in which students use technology and their social development (Lloyd, Dean, & Cooper, 2007). Examples found in different studies have related specific type of activities to the social well-being of students. For example, Social Network Sites (SNS) have interwoven ICT with social well-being and previous research has indicated that they can be beneficial for a stronger social capital (Ahn, 2011; Ellison et al., 2007), whereas online gaming is found to have a positive relation to offline social support, especially if games provide opportunities to socialize instead

of focusing on competition and ambitions (Trepte, Reinecke, & Juechems, 2012). Another example is the use of internet, which has been found to increase life satisfaction because it provides entertainment and can widen our social networks (OECD, 2017a). However, excessive use of ICT devices has been related to lower levels of social well-being and interpersonal and family problems. For example, excessive internet use can lead to lower life satisfaction and disengagement with school (Park, Kang and Kim, 2014; OECD, 2015; OECD; 2017a). However, if we look at how young adolescents perceive their own computer gaming and internet use, Rasmussen et al. (2015) found that they perceive it as unproblematic and a large minority perceive problems in their use of computer games and the internet.

3.1.5 Summary

For those concerned with education it is of importance to understand how learning is affected in this constantly evolving technological context (Bell, 2011). Information and communications technologies (ICT) are a diverse set of technological tools and resources used to communicate, create, disseminate, store, and manage information (Blurton, 1999) and have become part of educational institutions and households around the globe. In turn, digital skills have become a necessity to participate in an ever-digitalized society (OECD, 2015). However, there is no agreement between scholars on the effects of ICT use on learning and academic performance. This might be due to the fact that the use of ICT and its effect on academic performance is a complex phenomenon and the nature of this relationship depends on the initial level of skills, type of the skill and type of ICT use (Jackson et al., 2011). Furthermore, ICT does not exist in isolation but is rather interwoven with the users and tools in the learning environment (Lim, 2002). ICT development will continue in the future and it is of substantial value to put effort into the development of digital skills and confidence.

3.2 Theoretical perspectives on Social well-being

3.2.1 An introduction to children's' well-being

Just after the first world war the first document that recognized the rights of children was adopted by the League of Nations and it has been only forty years ago that leaders around the world made a commitment to adopt the United nations Conventions of the Rights of the Child. Now, forty years later, we do not only recognize children as human beings, we want them to live healthy, happy, fulfilling lives which we intend to measure. The measurement we use is the construct of well-being as high levels of well-being have been associated with positive and fulfilling life-experiences (Pollard & Lee, 2003). In order to find a definition of child well-being, Pollard and Lee (2003) systematically reviewed 175 articles and adapted a definition by Yarcheski, Scoloveno, and Mahon (1994) who described well-being as "a multidimensional construct incorporating mental/psychological, physical, and social dimensions". Child well-being as a construct that is measured in multiple dimension has been recognized throughout the literature. The index of child well-being in Europe found seven domains, health, subjective well-being, personal relationships, material resources, education, behaviours and risk, housing and the environment (Bradshaw & Richardson, 2009) and Pollard and Lee (2003) concluded on five domains, physical, psychological, cognitive, social, and economic. This approach of well-being as a multidimensional construct has been used to measure child well-being in international comparative studies like PISA, measuring not only subject-specific problem-solving competencies but the cognitive, psychological, physical, social and material domains of well-being. By doing so they collected some of the most comprehensive information on student well-being around the world (Borgonovi, 2016).

3.2.2 The social domain

This domain of well-being includes the supportive relationships and sense of trust and belonging with others (nef, 2009). Social connections and the sense of trust and belonging are an important factor in

determining the quality of life and are associated with higher levels of subjective well-being (Helliwell & Putnam, 2004). In order to measure child well-being, there was a need to break it down in measurable constructs and indicators. Some of these conceptual frameworks can gives us more insight in the social well-being of children. For example, Lippman, Moore and McIntosh (2011) used Bronfenbrenner's (1979) ecological model and divided the social well-being of children into five domains: family, peers, school, community and the larger macro system. The domain of family includes relationships with parents, siblings, extended family and the functioning of a family as a whole, whereas the domain of peers include friendships. Within the school domain, relations with teachers and engagement and connection with school are the main constructs, whereas the community domain is supported by relations with nonfamily adults, engagement in community institutions, sense of belonging in a community, civic engagement, constructive and non-taxing employment and digital relationships. The last domain, the macro system, consists of a positive group identity and engagement with ideologies and movements (Lippman, Moore, & McIntosh, 2011). Another example is the conceptual framework from Pollard and Lee (2013) who have presented measures of child well-being as: family relationships, peer relationships, the availability of emotional and practical support, personal resources, socially desirable behaviours, and interpersonal, and communication skills. Finally, PISA 2015 has assessed social well-being by measuring the relationships with family, the relationship with peers, the relationship with teachers, social learning experience and their sense of belonging at school (Borgonovi, 2016).

3.2.3 The importance of the social domain

Social well-being has been indicated as a crucial factor influencing the quality of our experienced life. Most importantly is the quality of our relationships with others, which is not only seen as a fundamental human need but has also been found to contribute significantly to our overall well-being (Fattore, Mason & Watson, 2009; nef, 2009). In different qualitative studies they have asked children about their understanding of well-being and their findings show that the relationships children have with peer and family were central, if not the most important, indicators to their experience of well-being (Fattore et al. 2009; Matthews, Lippman, Guzman, & Hamilton, 2006). The importance of these relationships to teenagers is made even clearer if we look at their developmental stage in life. They are in a period of social exploration and identity development and spend a substantial amount of time in school, interacting with peers, teacher and other staff members (Borgonovi, 2016; Feldman, 2012). Furthermore, at this age they are searching for acceptance and validation of their peers and the creation of a social network (Feldman, 2012; OECD, 2017). Except for being an important indicator of child well-being, the creation of a social network has also shown to be valuable for the future as it can protect them from loneliness, physical and mental health problem (Borgonovi, 2016; Gale, Deary, & Stafford, 2013). Thus, the relationships children form with others and the quality of these relationships are important indicators of their overall well-being and essential for both the quality of their current and future lives.

3.2.4 The social domain and student outcomes

Our social environment and the effects on learning and cognition have been intensively studied in the research community and as a result, different learning theories and philosophical approaches that support the critical role of the social domain and its effects on learning have emerged. One of the most well-known approaches is social constructivism, based on the works of Vygotsky (1978), were emphasis is put on the social and collective in learning. His theory of social cognitive development states that: ''cognition is mediated through social interaction among individual's collaboration and out of learners' unique experiences'' (Vygotsky, 1978; Che Wan Ida Rahinamah & Ibrahim, 2016). Or in other words: Learning is imbedded in our social nature and by interacting with our social environment, we create the right conditions for our mental cognition, language and social development to flourish. Another more recent theory supporting the connection between the social domain and learning is the situated learning theory from Lave and Wenger (1991). In their theory, they treat thinking and learning

as ‘’something that is established in the world as it is experienced in social practice’’ (Arnseth, 2008). The main idea is that humans are socially curious and learn mostly through social interaction with others. Learning therefore does not reside in the mind of the individual, but instead it is situated in a context in which other members of a community of practice participate and play a vital role. Situated learning occurs during doing and participation and occurs when it is not intended or planned (Ataizi, 2012). Furthermore, recent studies have shown the results of the social well-being of children on their student outcomes. For example, results of the PISA 2015 study indicate that the students' interactions with parents influences their academic performance. An important indicator in the student-parent interaction that has shown to effect student outcomes was whether students experienced their parents being interested in their school activities. These students are more likely to perform better then students who experienced a lack of interest. Another aspect that has shown to effect students' outcomes is the feeling that they are part of a school community, their sense of belonging (OECD, 2017a). Another example is found in a study provided by Durlak, Weissberg, Dymnicki, Taylor & Schellinger (2011). After a meta-analysis of 213 studies on the impact of social and emotional learning programs and found a significant positive effect on academic performance.

3.2.5 Summary

Well-being is a multidimensional construct incorporating the cognitive, psychological physical, social and material domain. For this review, we focused on the social domain which consists mainly of the relationships we have with others, our engagement and sense of belonging. The social domain is a crucial factor which has been shown to significantly affect our overall well-being. For example, it has been perceived by children themselves as the most important indicator in their understanding of well-being, it can protect us from loneliness, physical and mental health problems and it is of great importance to the development of children. Furthermore, the effects of the social domain on learning have been of long interest to researcher, resulting in different theories and approaches. These theories and approaches align with recent research indicating that the social well-being of children is an essential predicator of academic outcomes.

3.2.6 Mediating effects of the social domain

Relationships have been found between ICT use and both social well-being and academic performance, however, the literature is inconclusive whether the effects are positive or negative. This has much to do with the complexity of ICT use and the many influential factors, such as the use of technological devices for a substantial amount of different applications, all which can have a different effect on both social well-being and academic performance. Moreover, the time spend and the ways in which these applications are used is affecting these relationships as well, thus ICT use is a complex phenomenon to study. However, it is apparent that these three aspects are interrelated, thus it is safe to assume that there is a possible mediating effect of social well-being.

4. Research Questions

This research utilizes a quantitative analytical approach using data from the PISA 2015 dataset to address the interrelationship among Swedish 15-year-olds ICT uses, their social well-being and school performance. Four research questions will be focused upon:.

Q1. To what extent do the different uses of ICT affect the academic performance of Swedish secondary school students?

Q2. To what extent do the different uses of ICT affect the social well-being of Swedish secondary school students?

Q3. To what extent does the social well-being of students affect the academic performance of Swedish secondary school students?

Q4. To what extent does social well-being mediate the effect between ICT use and the academic performance of Swedish secondary school student?

5. Methodology

This section presents the data and analytical methods chosen to investigate the research questions. It also addresses the reliability and validity of the data as well as research ethics and limitations. The statistical package for the social sciences (SPSS) was used for data management and MPLUS was used for Structural Equitation modelling (SEM). Some important concepts use interchangeable terminology during this chapter, these concepts will first be explained and mentioned together with their synonyms.

1) *Observed variables* are also called measured variables, indicators or manifest variables. These are what is directly measured by the researcher using a measurement instrument and constitutes, in the broadest sense, of an assessment of behaviour. The measured scores are called observed variables and are the indirect measurement of unobserved variables (Byrne, 2011; Ullman, 2006).

2) *Unobserved variables* are also called latent variables, constructs, derived variables or factors. Latent variables are theoretical constructs that cannot be observed directly and thus cannot be measured directly. Latent variables need to be defined by the researcher in terms of what they are thought to represent, linking observed variables with unobserved variables and making measurement possible (Byrne, 2011; Ullman, 2006).

5.1 Sample and data

The Program for International Student Assessment (PISA) is OECD's international survey which was created in 1997 and is administered every three years to assess 15-years old students. Thus, there have been six cycles leading to the 2015 dataset that will be analyzed in this research. The aim is to evaluate education systems across the globe by testing knowledge and skills of these students in science, reading, mathematics, financial literacy and collaborative problem solving. Importantly, PISA considers the students' knowledge not only in isolation; the reproduction of knowledge is not the only goal. Moreover, whether students can reflect on their knowledge and apply the learned knowledge in new real-world situations is of importance to PISA. In addition to testing student performance, PISA collects data on the characteristics of schools, families and students. All these aspects are measured by the mandatory students and school context questionnaires. Furthermore, PISA gives each separate country the opportunity to administer optional questionnaires. Optional questionnaires in PISA 2015 are: the educational career questionnaire, the ICT familiarity questionnaire, the parent questionnaire and the teacher questionnaire. All the questionnaires include numerous trend indicators, which are used to report a trend over time, or single items (such as age). However, many of the indicators were designed to measure a latent construct which the OECD created by using transformation or scaling procedures. (Biagi & Loi, 2012; OECD, 2017b; OECD, 2017c; OECD, 2018).

Worldwide, more than ninety countries have participated in the assessment, surveying students, principals and in some countries, teachers and parents. The dataset in 2015 contains data for 34 OECD countries and 38 partner countries and economies. Creating an extensive database which can be used by statisticians and professional researchers for further analysis. For this research the Swedish PISA dataset will be used. This dataset contains data for 5458 participants, from which 2731 are female and 2727 are male. The survey has been conducted through computer and included the optional questionnaires; collaborative problem solving and the Information and Communication Technology (ICT) questionnaires.

5.2 Reliability and validity

Reliability refers to the replicability or repeatability of results by examining the extent to which results are consistent over time. It also refers to a representative sample of the total population and whether the results can be reproduced. Validity refers to whether a study measures what it is supposed to measure within the given sample or how accurate the interpretations and decision of the study are (Golafshani, 2003; Sullivan, 2009).

PISA is a rigorous and comprehensive student assessment with a high degree of validity and reliability due to strict quality-assurance mechanisms which are applied in translation, sampling and data collection (OECD, 2017c). Leading experts work together with governments in participating countries and decide about the background information to be collected and the scope and nature of the assessment.

Many of the PISA questionnaire items were designed to measure latent constructs and many of these latent constructs or derived variables are used in this study. In order to create these latent constructs, PISA used transformation and scaling procedures. Most of the latent constructs used for this research are constructed by the Item Response Theory (IRT) scaling methodology. An important mechanism used for ensuring reliability of the scales used in this research is construct validation. Construct validity is the extent to which a higher-order construct is represented by a particular measure and is gained by investigating the relationship between the measure of interest and other measures designed to measure similar and different constructs (Sullivan, 2009).

Construct validation is an important issue for PISA as they strive to create comparable measures. Especially cross-country validity is important because the information derived from the questionnaires can potentially influence policy and is used to improve education. To ensure cross-country validity PISA uses two different methodological approaches for validating the context questionnaires. Firstly, the internal consistency of each scaled construct was reported using Cronbach's alpha. Commonly accepted cut-off values are 0.9 to signify excellent, 0.8 for good, and 0.7 for acceptable internal consistency (OECD, 2017c). Table 1 depicts the internal consistency of the scaled constructs that are relevant for this research. Two of the scaled constructs have acceptable internal consistency, four score good and one score is excellent. The scales themselves will be explained in further detail in the next section.

Table 1 *Scale reliability*

Constructs	Cronbach's alpha
ENTUSE	0.805
HOMESCH	0.928
USESCH	0.878
BELONG	0.897
COOPERATE	0.731
CPSVALUE	0.784
EMOSUPS	0.880
ESCS	0.610

Secondly, an analysis on the invariance of items parameters for each item and scale was conducted to ensure cross-country comparability. This was done because it is necessary that the same constructs are

measured in different national and cultural contexts. This proves hard as, for example, cultural differences can cause measurement errors (OECD, 2017c).

Furthermore, the OECD ensured that the students tested come from the same target population and are roughly equal in age. The results will therefore not be affected by potential age effects. The OECD also requires a participating minimum number of students and school to ensure a representative sample which will not be too small. Sampling procedures follow established scientific principles which are specified in the technical report of PISA 2015 (OECD, 2017c).

5.3 Variables and Derived variables

In order to analysis the latent constructs ICT use, Social well-being and Academic performance, it is necessary to determine the observed variables and derived variables in the PISA 2015 dataset that correctly measure this construct. The observed variables and derived variables chosen are related to the relevant literature that focused on determining which indicators were correctly assessing the chosen constructs presented in this research.

5.3.1 ICT use

We determined the different dimensions of ICT use, which occur both inside and outside of school and encompasses different activities and context in which it is used. ICT in education is measured by PISA 2015 with the optional ICT familiarity questionnaire, which PISA introduced in 2003. This questionnaire includes additional questions on the students' usage of electronic and digital devices inside and outside of school for different purposes, the availability at school and at home as well as their attitudes and confidence towards ICT. Thus, it gathered detailed information about the typology and intensity of ICT use among 15-year old students. Thanks to the PISA 2015 ICT familiarity questionnaire, we can now analysis and compare for instance; ICT use, availability, competence and interest. The questionnaire measured nine latent constructs which are depicted in table 2.

Table 2 *derived variables for the ICT Familiarity Questionnaire*

LC Name	Description	Question no.	IRT scaling
ICTHOME	ICT available at home index	IC001	
ENTUSE	ICT use outside of school leisure	IC008	YES
ICTSCH	ICT available at School Index	IC009	
HOMESCH	ICT use outside of school for schoolwork	IC010	YES
USESCH	Use of ICT at school in general	IC011	YES
INTICT	Students' ICT interest	IC013	YES
COMPICT	Students' Perceived ICT Competence	IC014	YES
AUTICT	Students' Perceived Autonomy related to ICT Use	IC015	YES
SOIAICT	Students' ICT as a topic in Social Interaction	IC016	YES

In this study, we investigate the actual use of ICT among 15-yeard old Swedish student in Secondary school. There are three latent constructs that inform us about the usage of digital devices. First, ENTUSE assesses ICT use outside of school for leisure activities and is measure by question IC008.

Second, HOMESCH assesses outside of school use for school work and is measured by question IC010. Third, USESCH assesses ICT use at school in general and is measured by question IC011. All three scales were derived using IRT scaling. The scale reliability as seen in the validity and reliability sections is good for ENTUSE and USESCH and excellent for HOMESCH. ENTUSE is measured by 13 indicators which can be found in table 3 in the appendix, there are N=621 missing cases which is 11.4% of the total. HOMESCH is measured by 12 indicators which can be found in table 4 in the appendix, there are N=829 missing cases which is 15.2% of the total. USESCH is measured by 9 indicators which can be found in table 5 in the appendix, there are N=815 missing cases, which is 14.9% of the total. All the tables contain the mean and standard deviation for each indicator. The indicators of all the three derived variables are measured on a 5-point Likert scale which ranges from 1 ‘’never or hardly ever’’, 2 ‘’once or twice a month’’, 3 ‘’once or twice a week’’, 4 ‘’almost every day’’ to 5 ‘’every day’’.

5.4.2 Social well-being

In the PISA 2015 survey, they included a set of indicators for the well-being of adolescents. Most of these indicators are self-reported and part of the student questionnaire and the optional parent questionnaire. PISA measures five dimensions of well-being, namely; psychological, cognitive, social, physical as well as capabilities that students need to live a happy and fulfilling life (OECD, 2017a). For this research we focus on the social dimension of well-being and take into account the theory presented earlier to determine this construct. The OECD refers to social well-being as the relationships with family, peers and teachers, and students’ feelings about their social life. Based on this definition Borgonovi and Pál (2016) created a working paper authorised by the OECD mapping out the social dimensions of students’ well-being. They have divided the social dimension into five latent constructs. The first construct is belongingness at school which consist of one item measuring sense of belonging. Then social learning experience is measured using the item cooperative learning spirit. Third, the relationship with teachers is measured using the perception of teachers’ attitude: unfair treatment. Fourth, the relationship with peers, which consist of three different items measuring engagement with peers and bullying. Last, the relationship with parents consist of five different items measuring parental support and engagement with parents. It must be noted that this framework provides the basis for determining which indicators and latent constructs are part of the social dimension and some changes within the use of the framework can occur due to unavailable data or data prone to errors in measurement. Figure 6 depicts the latent constructs and their specific indicators and instruments as stated in the conceptual framework of Borgonovi & Pál which will be explained into more detail below.

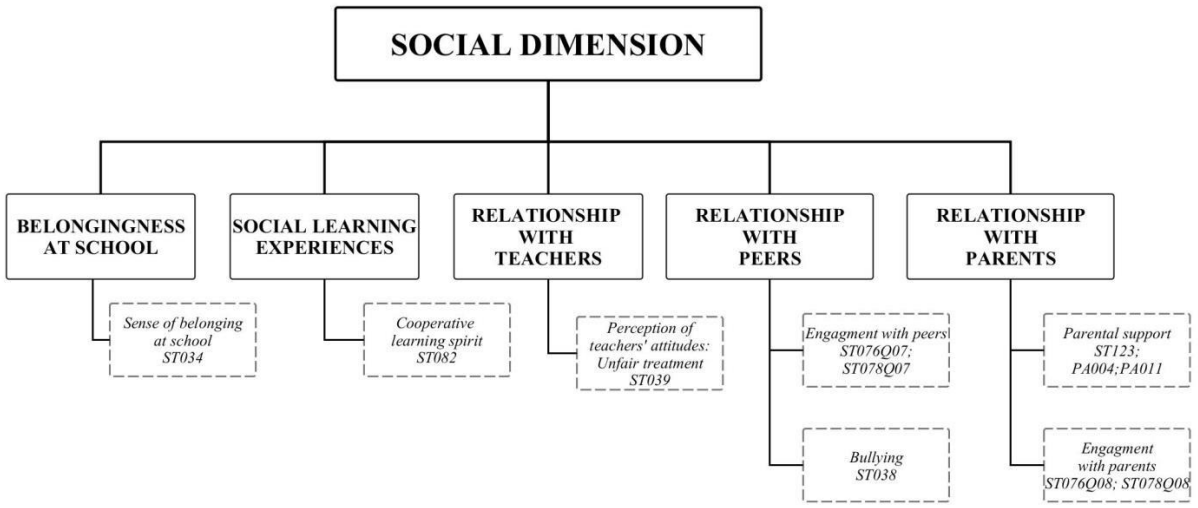

Figure 6 *The social dimensions of students’ well-being*

Belongingness at school: Sense of belonging at school
Whether students feel they belong as if they are part of a school community is important as students in this age look for strong social ties, care, support and acceptance from others. It is also an indicator for improved academic performance and motivation. Furthermore, their sense of belonging effects the perception of the relationship with teachers, resulting in more positive student-teacher relationships when students feel more part of a school community (OECD, 2017a; Borgonivi, 2016). In PISA 2015 question ST034, from the student questionnaire, focused on the students' sense of belonging by asking the students to report feelings about loneliness, belonging, social bonding or isolation.

Table 3 *Indicators for Sense of Beloning (BELONG)*

Construct	Item	Thinking about your school: to what extent do you agree with the following statements?	M	SD
BELONG	ST034Q01TA	I feel like an outsider or left out of things at school.	3.15	.982
	ST034Q02TA	I make friends easily at school.	2.07	.878
	ST034Q03TA	I feel like I belong at school.	2.19	.893
	ST034Q04TA	I feel awkward and out of place in my school.	3.14	.972
	ST034Q05TA	Other students seem to like me.	2.09	.774
	ST034Q06TA	I feel lonely at school.	3.19	.974
Cronbach's Alpha			0.897	

The item consists of six indicators which were reversed coded before using IRT scaling to create the derived variable which was named BELONG. Reliability in Cronbach's alpha for this scale was 0.897 which is almost excellent. Accordingly, the derived variable and the indicators with their mean and standard deviation can be found in table 6. All indicators were measured on a 4-point Likert scale ranging from 1 ''strongly agree'', 2 ''agree'', 3 ''disagree'' and 4 ''strongly disagree'' (OECD, 2017c). The amount of missing cases is N=369 which is 6.8% of the total.

Social learning experience: Cooperative learning spirit
How students interact with each other and how much they value such interaction is an important aspect of their social well-being (Borgonovi, 2016). Working together with peers to build successful teams requires skills and knowledge and the ability to communicate and manage relationships. Therefore, a cooperative learning spirit can affect the relationships with peers and better peer learning can improve academic performance (idem).

In PISA 2015, question ST082, from the student questionnaire, focused on the students' social learning experience by asking the students what kind of learning strategies they use when they study together with peers. The question consists of 8 indicators which measure two derived variables whose scales are build using IRT scaling. COOPERATE is a derived variable that is constructed by four indicators that measure how much students enjoy cooperating with peers. Reliability of this scale is 0.731 which is acceptable, the indicators of this derived variable and their mean and standard deviation can be found in table 4.

Table 4 *Indicators for Enjoy co-operation (COOPERATE)*

Construct	Item	To what extent do you disagree or agree with the following statements about yourself?	M	SD
COOPERATE	ST082Q02NA	I am a good listener.	3.12	.652
	ST082Q03NA	I enjoy seeing my classmates be successful	3.08	.688
	ST082Q08NA	I take into account what others are interested in.	3.11	.629
	ST082Q12NA	I enjoy considering different perspectives.	3.09	.634
Cronbach's Alpha			0.731	

CPSVALUE is the other derived variable and measures how much students value cooperating with peers. The derived variable is constructed using IRT scaling and consists of four indicators. Scale reliability is 0.784 which is acceptable and close to good. The indicators of this derived variable and their mean and standard deviation can be found in table 5. All the indicators are measured by a 4-point Likert scale ranging from 1 ''strongly agree, 2 ''agree'', 3 ''disagree'' and 4 ''strongly disagree'' (OECD, 2017c). In order to create the latent construct which is hypothesized in the framework, namely Social Learning Experience, the derived variables will be combined in the analysis. The total amount of missing cases is N=367 which is 6.7% of the total, while the reliability of the hypothesized SLE scale has a Cronbach's Alpha of .783.

Table 5 *Indicators for Value co-operation (CPSVALUE)*

Construct	Item	To what extent do you disagree or agree with the following statements about yourself?	M	SD
CPSVALUE	ST082Q01N	I prefer working as part of a team to working alone.	2.64	.876
	ST082Q09N	I find that teams make better decisions than	2.71	.791
	ST082Q13N	I find that teamwork raises my own efficiency.	2.77	.821
	ST082Q14N	I enjoy cooperating with peers.	3.05	.754
Cronbach's Alpha			0.784	

Relationship with teachers: students' perception of their teachers' attitudes

Teacher-student relationships (TSRs) contain not only academic support, but also social-emotional support. Emotional support was significantly linked to school problems, internalizing problems, inattention/hyperactivity and overall emotional symptoms (Tennant et al., 2015). TSRs are positively linked to both student engagement and academic performance, with engagement seen as the central factor in explaining the relationship between quality TSRs and academic performance (Roorda, Jak, Zee, Oort, & Koomen, 2017). How students perceive the support gained from teachers creates better engagement which in turn causes better academic performance (Klem & Connell, 2004). These findings shed light on the importance of TSRs and their relation to academic performance.

Table 6 *Indicators for Teacher Fairness (unfairteacher)*

	Item	During the past 12 months, how often did you have the following experiences at school?	M	SD
unfairteacher	ST039Q01NA	Teachers called on me less often than they called on other students.	1.75	.966
	ST039Q02NA	Teachers graded me harder than they graded other students	1.69	.898
	ST039Q03NA	Teachers gave me the impression that I am less smart than I really am.	1.66	.924
	ST039Q04NA	Teacher's disciplined me more harshly than other students.	1.41	.809
	ST039Q05NA	Teachers ridiculed me in front of others.	1.45	.800
	ST039Q06NA	Teachers said something insulting to me in front of others.	1.31	.703
Cronbach's Alpha			.833	

In PISA 2015 question ST039, from the student questionnaire, is a new question that focuses on the students' perception of their teachers' attitudes by asking them whether they had experienced unfair treatment of teachers in the past 12 months. The question consists of 6 indicators which were reverse coded, but no scale was constructed using IRT scaling procedures. Instead, a sum of the indicator scores was used for the scale unfairteacher. Scale reliability is .833 and is computed with a scale reliability test in SPSS. All six indicators and their mean score and standard deviation can be found in table 6. The items are measured by a 4-point Likert scale ranging from 1 ''never or almost never'', 2 ''a few times a year'', 3 ''a few times a month'' and 4 ''once a week or more'' (OECD, 2017c). The amount of missing cases is N=469 which is 8.6% of the total.

Relationship with peers: engagement with peers

Relationships with peers is closely related to the sense of belonging at school and peer support and acceptance can lead to higher self-esteem and better academic performance (Uslu & Gizir, 2017). However, it can both be supportive for academic performance by motivating each other to learn as well as hindering by encouraging destructive behavior (Borgonovi, 2016). The framework proposed by Borgonovi (2016) uses items ST076Q07NA and ST078Q07NA, from the student questionnaire, to measure students' engagement with peers, which is part of the latent construct relationship with peers.

Table 7 *Indicators for Engagement with friends (PEERENG)*

Construct	Item	On the most recent day you attended school; did you do any of the following before going to school/after leaving school?	M	SD
PEERENG	ST076Q07NA	Meet friends or talk to friends on the phone before going to school.	1.51	.500
	ST078Q07NA	Meet friends or talk to friends on the phone after leaving school.	1.20	.400
Cronbach's Alpha			.518	

The items measuring the engagement with peers are focused on the communication with friends. They were asked whether they talked to friends on the phone before leaving school and after leaving school. The relationship with peers does not exist as a derived variable within the PISA 2015 dataset, thus no scale reliability was reported. Instead scale reliability is computed with a scale reliability test in SPSS and gives a scale reliability of .518. However, the scale reliability of this construct is difficult to measure correctly because the scale consists of only two items. The mean of the two items will be constructed to create a latent construct measuring peer engagement (PEERENG). These two items are dichotomous and measured by answering 1 ''Yes'' or 2 ''No'', thus before constructing the scale the items were recoded into dummy variables. Both items measuring this construct, together with their mean and standard deviation, are found in table 7. The amount of missing cases is N=790 which is 14.5% of the total.

Relationship with peers: bullying

The Swedish dataset does not contain either question ST038 or the derived variable being bullied. The OECD (2017c) indicated that the question had a strongly skewed distribution, which could be a possible explanation. The, the relationship with peers will only consist of the scale that measures peer engagement (PEERENG).

Relationship with parents: Parental support

Several studies have shown that involvement of parents in their children's education has a positive impact on academic performance (Jeynes, 2007; Topor, Keane, Shelton, & Calkins, 2010). This result holds across populations and cultures; however, it is more apparent in primary then secondary school. Specific components of parental involvement such as parental style and expectations seem to have a greater impact then household rules and parental attendance and participation at school functions (Jeynes, 2017; OECD, 2017a). PISA results even show a negative impact on student performance when parents are directly involved with their child's education. This includes activities such as helping with homework or obtaining homework related materials. However, this could be related to parents being more involved because their child is already performing poorly (OECD, 2017a).

Table 8 *Indicators for Parents emotional support (EMOSUPS)*

Construct	**Item**	**Thinking about the <this academic year>: to what extent do you agree or disagree with the following statements**	**M**	**SD**
EMOSUPS	ST0123Q01NA	My parents are interested in my school	3.40	.700
	ST0123Q02NA	My parents support my educational efforts	3.53	.665
	ST0123Q03NA	My parents support me when I am facing	3.49	.712
	ST0123Q04NA	My parents encourage me to be confident.	3.49	.724
Cronbach's Alpha			0.880	

In PISA 2015 four indicators are used to construct the derived variable of parents' emotional support (EMOSUPS) using IRT scaling procedures. Scale reliability in Cronbach's alpha for this item is 0.888, which is almost excellent. All indicators and their mean and standard deviation can be found in table 8. The indicators are measured using a 4-point Likert scale ranging from 1 ''strongly agree'', 2 ''agree'', 3 ''disagree'' and 4 ''strongly disagree''. The amount of missing cases is N=185 which is 3.4% of the total.

Relationship with parents: parental engagement

PISA 2015 results have shown that a students' attitude towards education is affected by their perception of how interested parents are their school life. On the other hand, increased academic performance and life satisfaction was seen among students whose parents reported that: ''they spend time talking to their child'', ''eating a meal together with their child around the table'' or ''discussing how well their child is doing at school'' (OECD, 2017a). Moreover, the communication between parents and their children is also important for helping them to deal with stressful situation and protect them from mental and health problems (Borgonovi, 2016). Thus, parental engagement can be an effective tool which positively influence a students' well-being. The framework for analysis of student well-being by Borgonovi (2016) proposes two items to measure parental engagement: ST076Q08NA and ST078Q08NA from the student questionnaire.

Table 10 *Indicators for parental engagement (PARENG)*

Construct	Item	On the most recent day you attended school; did you do any of the following before going to school/after leaving school?	M	SD
PARENG	ST076Q08NA	Talk to your parents before going to school.	1.13	.331
	ST078Q08NA	Talk to your parents after leaving school.	1.05	.221
Cronbach's Alpha			.428	

PISA asks the students whether they were talking to their parents before going to school and after leaving school. Parental engagement does not exist as a derived variable within the PISA 2015 dataset, thus no scale reliability was reported. Instead scale reliability is computed with a scale reliability test in SPSS and gives a scale reliability of .428. However, the scale reliability of this construct is difficult to measure correctly because the scale consists of only two items. The mean of the two items will be constructed to create a latent construct measuring parental engagement (PARENG). These two items are dichotomous and measured by answering 1 ''Yes'' or 2 ''No'', thus before constructing the scale the items were recoded into dummy variables. Both items measuring this construct, together with their mean and standard deviation, are found in table 13 in the appendix. The amount of missing cases is N=775 which is 14.2% of the total.

5.3.3 Student outcomes

Student performance is measured in three different subjects, namely Science, Reading and Mathematics. To increase the accuracy of the measurement, PISA uses plausible values which are: ''multiple imputations – drawn from a posteriori distribution by combining the IRT scaling of the test items with a latent regression model using information from the student context questionnaire in a population model (OECD, 2017c)''. For each student, 10 plausible values are computed for each test domain, however, for this study, the first plausible value of each test domain is used, which are indicated in the dataset as PV1SCIE, PV1READ and PV1MATH and can be found in table 11. These three indicators of student performance are used to create the latent construct general achievement (GACH). Scale reliability testing in SPSS gives a scale reliability of .935. This latent construct is not defined by PISA but is hypothesized and validated by using (CFA) Confirmatory Factor Analysis.

Table 11 *Indicators for General Achievement (GACH)*

Construct	Item	Variable labels	M	SD
GACH	PV1SCIE	Plausible Value 1 in Science	492.54	102.11
	PV1READ	Plausible Value 1 in Reading	499.76	101.91
	PV1MATH	Plausible value 1 in Mathematics	492.54	102.11
Cronbach's Alpha			.935	

5.3.4 The index of economic, social and cultural status (ESCS)

The index for economic, Social and cultural Status (ESCS) is used as a control variable to assess or clarify the observed relationships between the independent, dependent and mediator variables. ESCS is a composite score built by several indicators and questions from the student questionnaire. It includes the highest education of parents in years (PARED), which is measured by question ST005, ST006, ST007, ST008, the highest parental occupational status (HISEI), which is measured by question ST014, ST015 and home possessions (HOMEPOS), which is measured by question ST011, ST012, ST013. Thus, ESCS is based on education, occupational status and home possessions, whereas home possessions functions as an indicator of family wealth as PISA does not directly measure income. The factor loadings on ESCS for each indicator are found in table 12. An estimated value was assigned to students who were missing data on one of the three indicators, ESCS was not computed if more data was missing and a missing value was assigned which resulted in N=145 missing cases which is 2.7% of the total (OECD, 2017c). ESCS is used in the current study as the overall control for the proposed mediation model in figure 4 (see also figure 10 below).

Table 12 *Indicators, questions and factor loadings of ESCS in Sweden*

	Indicators	Questions	Factor loadings	M	SD
ESCS	HISEI	ST014, ST015	0.82	57.74	20.333
	PARED	ST005, ST006, ST007, ST008	0.77	14.306	2.298
	HOMEPOS	ST011, ST012, ST013	0.66	.422	.898
Cronbach's Alpha				.610	

5.4 Analytical approach

5.4.1 Analytical techniques

Structural Equation Modelling (SEM)

Structural Equation modeling (SEM) is used to analyze the Swedish PISA 2015 data and answer the research questions under study. SEM has been described as a combination of statistical techniques which models the complex relationship between one or more independent variables (IV) and one or more dependent variables (DV). Both can be observed variables or unobserved variables, the definition of both is found in the introduction of this chapter. (Schreiber, Nora, Stage, Barlow, & King, 2006; Stein, Morris, Hall, & Nock, 2017; Ullman, 2006). SEM takes a confirmatory approach to data analysis and is suitable for hypothesis testing. The first task in testing the hypothesized model is to determine the goodness-of-fit with the chosen sample data and then how well the observed data fits into the chosen model (Schreiber et al., 2006; Ullman, 2006). The goodness-of-fit indicators are used to assess the model fit and the indicators that are used to assess the model fit in this research are the Comparative Fit Index (CFI), root mean square error of approximation (RMSEA), the standardized root mean square

residual (SRMR) and the Chi-square. These indicators have certain cut-off values to assess whether they fit the model, when working with continuous data, these cut-off values are respectively: CFI should also be higher than .95 with 1 as a perfect fit, RMSEA preferably lower than .06 but is still acceptable between .07-.08, SRMR should be lower than .08 and for Chi-square ($\chi 2$) a ratio of $\chi 2$ to *df* (degrees of freedom) < 2 or 3 (Gustafsson, Yang Hansen, & Rosén, 2013; Schreiber et al., 2006). However, Chi-square is known to be sensitive to large sample sizes, which is the case in this study. Therefore, it should be interpreted with caution and in combination with other goodness-of-fit indicators when assessing model fit.

SEM encompasses two components: (a) the measurement model is consists of a statistical technique named Confirmatory Factor Analysis (CFA). This is a theory driven technique used to confirm a hypothesized theoretical model, thus it is assumed that the researcher has some knowledge of the underlying latent constructs based on theory, previous research, or both. Latent factors are not directly measurable, but can be assessed by a pattern of observed variables which represent the latent variables as mentioned in the hypothesized model. Instead of simply combining items into a scale by using the sum or the mean of the items, CFA creates a composite which takes into account measurement error. Therefore, it enhances the validity in determining underlying factors. In conclusions we could say that CFA determines the relationship between directly observed and indirectly observed (latent) variables as specified in the hypothesized model and thus reduces the number of observed variables into a smaller number of latent variables (Karadag, 2012; Schreiber et al., 2006; Ullman, 2006). An example of a confirmatory factor analysis model can be found in figure 7.

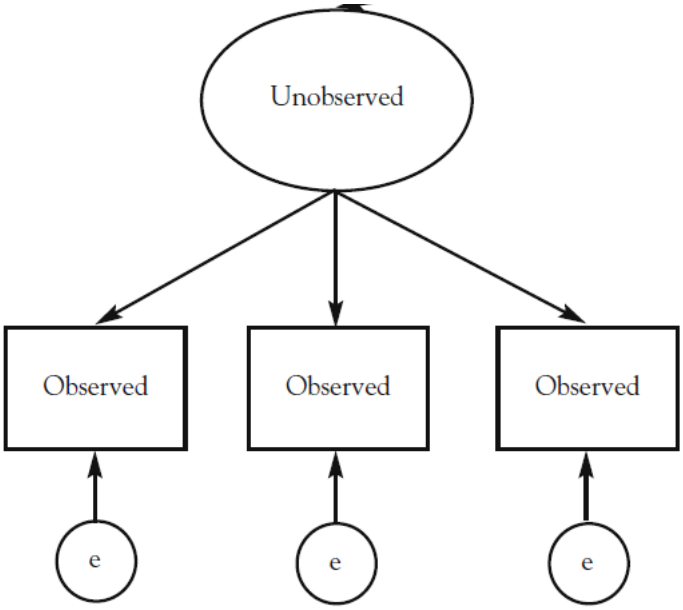

Figure 7 *model for confirmatory factor analysis, e = measurement error*

(b) a structural model which displays the interrelationship between the independent and dependent variables. In other words, the hypothesized relationship among unobserved and observed variables are considered the structural model, an example can be found in figure 8.

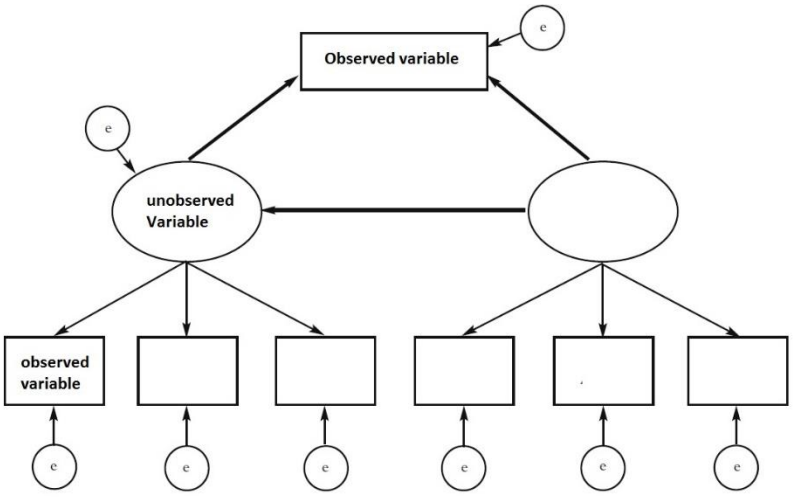

Figure 8 *structural model, e = measurement error*

Path Analysis

Path analysis is an important aspect of SEM and is used to provide casual links between the variables. The basic purpose is to determine whether the hypothesized model that has been designed can be verified through the findings of the study. Path analysis determines both indirect and direct effects of variables and takes into account the causal effects the variables in the model have with one another (Karadag, 2012). In addition, path diagrams are fundamental to SEM as they allow researchers to diagram the hypothesized set of relations. In the path diagram, latent variables are represented as circles, observed variables are represented as rectangles. The path diagram clarifies the possible connections among variables and is drawn according to the following rules presented by Karadag (2012): (a) The presumed causal relationship between variables is depicted by unidirectional arrows drawn from each defined variable to every endogenous variable; (b) The predicted non-causal relationships presumed to exist between exogenous variables are depicted with bidirectional arrows; (c) the residual is depicted with a unidirectional arrow drawn from the residual to the endogenous variable; (d) the numbers on the different arrows are the values of the path and correlation coefficients.

5.4.2 Analytical process

The mediation model in the conceptual framework gave a basic structure and can now be further extended after concluding on the observed and unobserved variables that represent the independent and dependent variables in the hypothesized model. This study has three independent variables: (1) ENTUSE, for ICT use outside of school for leisure activities, (2) HOMESCH, for ICT use outside of school for school work and (3) USESCH for general ICT use in school, three observed variables: (1) PV1SCIE, plausible value for science, (2) PV1READ, plausible value for reading, (3) PV1MATH, plausible value for mathematics and six latent variables: (1) BELONG, students' sense of belonging at school, (2) SLE, students social learning experience, (3) unfairteacher, perceived fairness by which the teachers threat the students, (4) PEERENG, engagement with peers, (5) RELPAR, the relationship with parents measured by parents' emotional support and parental engagement and (6) GACH, general achievement. The relationship between these latent variables will be measured according to a mediational model. In order to clarify how the relationship between these independent and latent variables will be analyzed, we could hypothesize a possible scenario. In this scenario we observe a positive relationship between ICT use outside of school for homework (HOMESCH) and general achievement (GACH). However, one reason for this relationship is that more use of ICT outside of school for homework makes students feel like they belong more at school (BELONG), whereas student who do not use a lot of ICT for homework have a lower sense of belonging at school. In turn, students who have a greater sense of belonging at school perform better. In other words, spending more time on ICT outside of school for homework influences the engagement with peers, which in turn influences

the general achievement. The implications of these direct and indirect relationships can be explained with the help of figure 9.

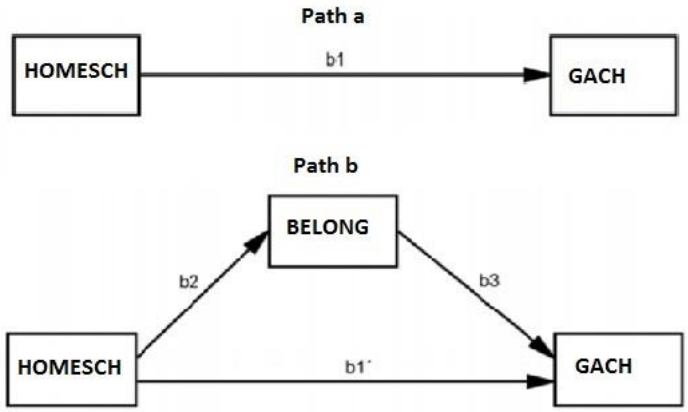

Figure 9 *path models*

Path a shows the direct effect of HOMESCH on GACH, this effect is presented by the regression coefficient, b1. As there is only one effect visible, the direct effect is equal to the total effect. In path b b we find the earlier hypothesized scenario, where there is still a direct effect between ENTUSE and GACH, again presented by b1, however this is not the total effect. To elucidate, now there a path between ENTUSE and BELONG, presented by b2 and a path between BELONG and GACH, presented by b3. These two effects produce an indirect on ENTUSE on GACH, which can be measured if we multiply b2 with b3. This indirect effect has to be added to the direct effect in order to create the total effect. This can be done with the formula: b1 = b1 + b2b3, or in other terms: the total effect is the direct effect plus the indirect effect. Thus, if both b2 and b3 are positive, the total effect in path a will be smaller than the total effect in path b. If we go back to our hypothesized scenario, this indicates that, because HOMESCH positively affects BELONG and BELONG positively affects GACH, the total effects of HOMESCH on GACH are bigger when we take the latent construct BELONG into the model. BELONG in this case is the mediating variable and may explain a part of the relationship between the independent and the dependent variable. Other mediating variables might be looked after to explain more of the indirect effects. However, it is possible that the indirect effect is equal to the total effect in which case there is no direct effect. This is referred to as ''complete mediation'' (Gustafsson et al., 2013). This analytical process will be applied on the statistical model to interpret the indirect, direct and total effects of the different uses of ICT on general achievement through the indicators of social well-being.

5.4.3 The hypothesized model

The hypothesized final model can be found in figure 10. First, it consists of a measurement model for general achievement, which will be computed using CFA on the three plausible value which are the observed variables for the latent variable general achievement. Second, a structural model, which is presented as the relationships between all the variables. According to this model, it is hypothesized that the three independent variables for ICT use could have a possible influence on the latent variable for general achievement. The same three independent variables could have a possible influence on the five latent variables presenting aspects of the social dimension. In turn, these five latent variables have a possible effect on general achievement. A mediational triangle is created if, for example, ICT use for leisure is shown to have an effect on both general achievement and the relationship with parents and in turn the relationship with parents has an effect on general achievement. Thus, the effects of ICT use for leisure on general achievement are, either partly or fully, mediated by the relationship with parents.

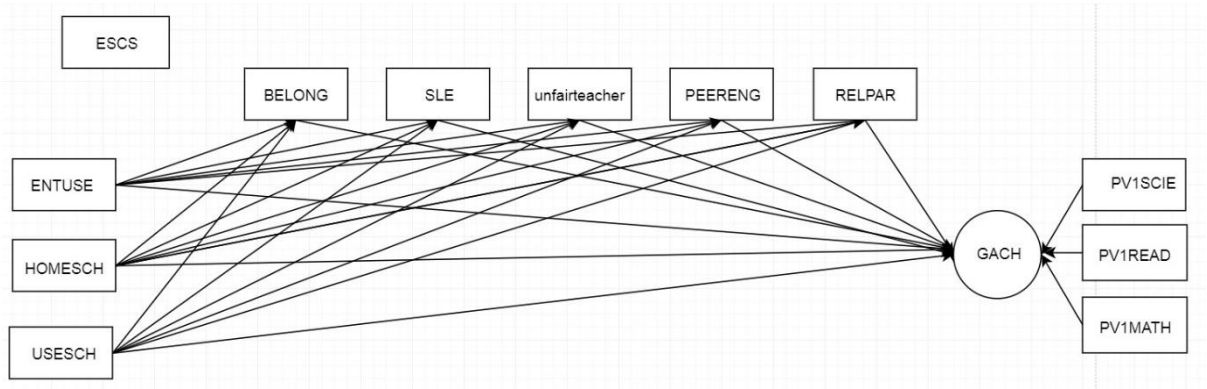

Figure 10 *Final model*

Another important latent variable in the model is economic, social and cultural status (ESCS) as seen in the left upper corner. This latent variable also acts as an independent variable and is used as control variable, thus having a relationship with both the three independent variables and the six latent variables. These relationships are unidirectional and not drawn in the model to ensure the clarity of the model.

5.5 Ethics

The PISA standard provides the opportunity for participating countries to adapt certain questions or procedures to suit local circumstances or add components specific to a particular context (OECD, 2017). Besides that, each country is responsible for adding additional confidentiality measures before delivering the database. National project managers are installed within their own country and are responsible for the confidentiality of the material during all phases of the assessment implementation.

Furthermore, the OECD has secure materials, such as test materials, data and draft materials which they keep confidential. They approve no-one other than staff and participating students to access and view the test material. Moreover, only approved staff has access to secure PISA materials and have to sign a formal confidentiality agreement. Participating schools, students or teachers all have anonymised ID codes and cannot be recognized or traced and consent has been given before collecting the data.

6. Results

This section presents the findings from the confirmatory factor analysis (CFA) and the structural equation modelling (SEM). During the methodology chapter we have discussed the cut-off values of the fit indexes when using these analytical tools. For clarity, an overview of the fit indexes and there cut-off values are presented here in a table 13.

Table 13 *Fit indexes and cut-off values*

Indexes	Shorthand	General rule for acceptable fit if data are continuous
Chi-Square	$\chi 2$	Ratio of $\chi 2$ to df < 2 or 3, significant P value of > 0.05
Root mean square error of approximation	RMSEA	<.06 to .08 with confidence interval
Comparative fit index	CFI	>.95 for acceptance
Standardized Root Mean Square residual	SRMR	<.08

6.1 Confirmatory factor analysis

Before starting on the final model, a Confirmatory factor analysis for general achievement is conducted. This CFA is done in order to integrate the observed variables together and confirm the latent variable general achievement. Three observed variables, pv1scie, pv1math and pv1read define the latent variable general achievement

The Chi-square ($\chi 2$) shows a significant p-value of 0.000, which is highly significant. Strictly interpreted this would indicate that the model would not fit as Chi-square significants has to be higher than 0.05, meaning that the model achievement variance covariance matrix does not significantly differ from the observed variance covariance matrix. This confirms that the model has properly reproduced the data structure. A non-significant Chi-square thus indicates a good model fit. However, chi-square test statistic are highly sensitive to big samples and increases as a function of sample size. Given the large sample in this study, the Chi-square estimate will always be significant, and it does not necessarily indicate that the model does not fit the data. Therefore, one needs to consult other goodness-of-fit indicators to judge whether a model fits the data or not. According to the other model fit indexes the model has a perfect fit. RMSEA and SRMR are 0, CFI shows a perfect fit of 1.

On the far end at the right-hand side of figure 12 (in the green circle) is the measurement model, which shows the standardized factor loading from the plausible values on general achievement. For all three plausible values, the factor loadings are very high: pv1scie; .977, pv1math; .904, pv1read; .853, indicating that the observed variables are strong indicators for the unobserved variable general achievement (GACH).

6.2 Final model

The structural model is shown in figure 12 and shows the parameter estimates between the variables under study, thus it will be used to investigates the research questions in this study. ESCS is used as a control variable which has pathways to every variable except the three observed variables. To make sure the path diagram can be presented clearly, the pathways are taken out of the diagram. To clarify the model further, it shows the different uses of ICT on the left side, from top to bottom: HOMESCH (ICT use at home for schoolwork), USESCH (ICT use at school in general) and ENTUSE (ICT use outside of school for leisure). On the right there is GACH (general achievement) and the observed variables for plausible achievement: PV1SCIE (plausible value for science), PV1MATH (plausible value for math) and PV1READ (plausible value for reading). In between are the aspects of social well-being, from the left to right: SLE (social learning experience), PEERENG, (engagement with peers), unfairteacher (perceived fairness by which the teacher treats the students), BELONG (sense of belonging at school), and RELPAR (relationship with parents). The numbers on the unidirectional arrows are the standardised regression coefficients for this model.

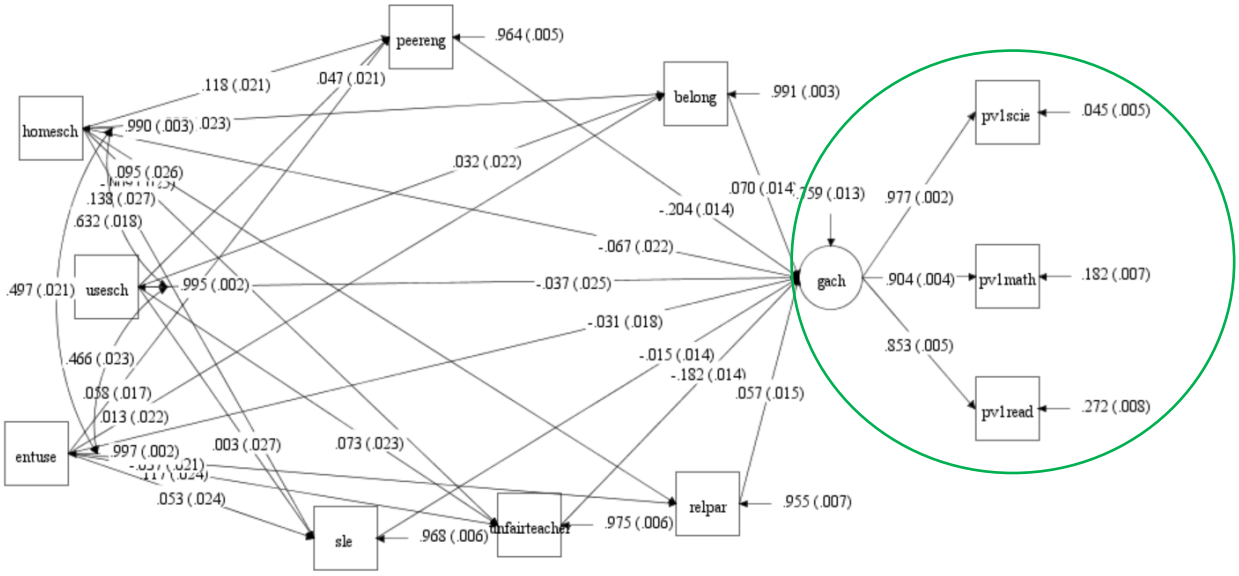

Figure 12 *path diagram of the structural model*

The model fit can be assessed with the goodness-of-fit indicators presented in table 15. Chi-square is significant, the RMSEA is 0.071 which is not very good, however the confidence interval is 0.066-0.075, which is below .08, thus it is acceptable. The CFI is 0.956 which indicates a good fit, whereas the SRMR is 0.041 which indicates an excellent fit. Based on all the goodness-of-fit indicators the models shows a good fit. Thus, the parameter estimates can be considered. In order to clarify the model, we will now discuss the total, direct and indirect effects of the variables.

Table 15 *model fit indexes for the final model*

Parameters	$\chi 2$	P-value of $\chi 2$	DF	RMSEA	CFI	SRMR
	771.742	0.000	28	0.071	0.956	0.041

6.3 Total, direct and indirect effects

Table 16 to 19 present all the standardized direct, indirect and total effects estimated by the final mediation model shown in figure 12. The direct effect is the difference between the total effect and the indirect effects. The indirect and total effects have to be computed from data in the model. Therefore, the parameter estimates will be explained in relation to the estimated total and indirect effects.

6.3.1 ICT on GACH

The total effects of HOMESCH on GACH are -0.086 with a p-value of 0.000 and thus statistically significant. The biggest part of this effect is through the direct effect of HOMESCH on GACH which is also statistically significant with an estimate of -.067 and a p-value of 0.002. HOMESCH is the only type of ICT use that has a direct statistically significant effect on GACH. The total indirect effects of HOMESCH through SWB on GACH are -0.019 with a p-value of 0.014 and most of these indirect effects can be accounted to the indirect effect of HOMESCH on GACH through PEERENG, which has an estimate of -0.024 with a p-value of 0.000. It is the only indirect effect worth mentioning between HOMESCH and GACH but is not statistically significant as it is not above -0.05. However, it does tell us that the effects of HOMESCH on GACH are partly mediated by PEERENG.

The total effects of USESCH on GACH are statistically significant with an estimate of -0.058 and a p-value of 0.029. The total direct effects of USESCH on GACH are not significant with an estimate of -0.037 and a p-value of 0.138 which is too high. The total indirect effects of USESCH through SWB on GACH are -0.021 with a p-value of 0.004. Almost all of these indirect effects are accumulated through PEERENG and unfairteacher. The indirect effects of USESCH through PEERENG on GACH are -0.010 with a p-value of 0.027, whereas the indirect effects of USESCH through unfairteacher on GACH are -0.013 with a p-value of 0.003. Although not statistically significant, they show that the effect of USESCH on GACH is mostly mediated through PEERENG and unfairteacher.

The total effects of ENTUSE on GACH are statistically significant with an estimate of -.066 and a p-value of 0.000. The total direct effects of USESCH on GACH are not significant with an estimate of -0.031 and a p-value of 0.089 which is also to high. The total indirect effects of ENTUSE through SWB on GACH are -0.035 with a p-value of 0.004. Almost all of these indirect effects are accumulated through PEERENG and unfairteacher. The indirect effects of ENTUSE through PEERENG on GACH are -0.012 with a p-value of 0.001, whereas the indirect effects of ENTUSE through unfairteacher on GACH are -0.021 with a p-value of 0.000. Although not statistically significant, they show that the effect of USESCH on GACH is mostly mediated through PEERENG and unfairteacher. All the effects and their two-tailed value are presented in table 16.

Table 16 *total, direct, indirect and total indirect effects of ICT use on GACH*

ICT use on GACH		**Est.**	**p**
Total effects	HOMESCH on GACH	-0.086	0.000
	USESCH on GACH	-0.058	0.029
	ENTUSE on GACH	-0.066	0.000

Direct effect	HOMESCH on GACH	-0.067	0.002
	USESCH on GACH	-0.037	*0.138*
	ENTUSE on GACH	-0.031	*0.089*
Indirect effects of HOMESCH	through BELONG on GACH	0.001	*0.753*
	through unfairteacher on GACH	0.002	*0.722*
	through PEERENG on GACH	-0.024	0.000
	through RELPAR on GACH	0.005	0.011
	through SLE on GACH	-0.002	0.002
Indirect effects of USESCH	through BELONG on GACH	0.002	*0.158*
	through unfairteacher on GACH	-0.013	0.003
	through PEERENG on GACH	-0.010	0.027
	through RELPAR on GACH	0.000	*0.982*
	through SLE on GACH	0.000	*0.902*
Indirect effects of ENTUSE	through BELONG on GACH	0.001	*0.537*
	through unfairteacher on GACH	-0.021	0.000
	through PEERENG on GACH	-0.012	0.001
	through RELPAR on GACH	-0.002	*0.124*
	through SLE on GACH	-0.001	*0.339*
Total indirect effects	HOMESCH through SWB on GACH	-0.019	0.014
	USESCH through SWB on GACH	-0.021	0.004
	ENTUSE through SWB on GACH	-0.035	0.000

***non-significant p-values are in italic*

6.3.2 ICT on SWB

HOMESCH has a statistically significant direct effect on PEERENG, RELPAR and SLE. The effects of HOMESCH on PEERENG are 0.118 with a p-value of 0.000, whereas the effects of HOMESCH on RELPAR are 0.095 with a p-value of 0.000 and the effects of HOMESCH on SLE 0.138 with a p-value of 0.000. Thus, ICT use outside of school for schoolwork positively effects different aspects of the social well-being of students.

USESCH has a statistically significant direct effect on PEERENG and unfairteacher. The effects of USESCH on PEERENG are 0.047 with a p-value of 0.027, whereas the effects of USESCH on unfairteacher are 0.073 with a p-value of 0.002. Thus, ICT use in school in general has a positive effect on the engagement with peers and on how much students' perceive the treatment of teachers as unfair.

ENTUSE has a statistically significant direct effect on PEERENG, unfairteacher and SLE. The effects of USESCH on PEERENG are 0.58 with a p-value of 0.001, whereas the effects of USESCH on unfairteacher are 0.117 with a p-value of 0.000 and the effects of USESCH on SLE 0.053 with a p-value of 0.028. Thus, the use of ICT outside of school for leisure has a positive effect on the engagement with peers, how much students' perceive the treatment of teachers as unfair and the social learning experience of students. All the effects and their two-tailed p-value are presented in table 17.

***Table 17** effects of ICT use on SWB*

ICT use on SWB		**Est.**	**p**
	BELONG	0.007	*0.750*
	PEERENG	0.118	0.000

Direct effects HOMESCH on	RELPAR	0.095	0.000
	SLE	0.138	0.000
	Unfairteacher	-0.009	*0.722*
Direct effects USESCH on	BELONG	0.032	*0.142*
	PEERENG	0.047	0.027
	RELPAR	-0.001	*0.982*
	SLE	0.003	*0.901*
	Unfairteacher	0.073	0.002
Direct effects ENTUSE on	BELONG	0.013	*0.544*
	PEERENG	0.058	0.001
	RELPAR	-0.037	*0.079*
	SLE	0.053	0.028
	Unfairteacher	0.117	0.000

non-significant p-values are in italic

6.3.3 SWB on GACH

All but one aspect, namely SLE which has a non-significant p-value, of the social dimension have a statistically significant direct effect on GACH. BELONG has a positive effect on GACH with an estimate of 0.070 with a p-value of 0.000. The effects of PEERENG on GACH are negative and the highest with an estimate of -0.204 and a p-value of 0.000. However, the effects of unfairteacher on GACH are following closely behind with a negative effect of -0.182 and a p-value of 0.000. The least significance is found on the effects of RELPAR on GACH, with a positive estimate of 0.057 and a p-value of 0.000. Thus, it seems that SWB is directly connected to the general achievement of students.

Table 18 *effects of SWB on GACH*

SWB on GACH		**Est.**	**p**
Direct effects	BELONG on GACH	0.070	0.000
	PEERENG on GACH	-0.204	0.000
	RELPAR on GACH	0.057	0.000
	SLE on GACH	-0.015	*0.274*
	Unfairteacher on GACH	-0.182	0.000

non-significant p-values are in italic

6.3.4 ESCS effects

The index for economic, Social and cultural Status (ESCS) has a statistically significant and strong direct effect on GACH with an estimate of 0.430 and a p-value of 0.000. It also has a statistically significant direct effect on all the different uses of ICT, mostly effecting HOMESCH with an estimate of 0.122 and a p-value of 0.000, followed by the USESCH with an estimate of 0.083 and a p-value of 0.000, and finally ENTUSE with an estimate of 0.067 and a p-value of 0.000 . In addition, the effects of ESCS on the different aspects of social well-being have more divergence. There is a strong statistically significant direct effect on RELPAR with an estimate of 0.231 and a p-value of 0.000. while the only other statistically significant direct effects are found on BELONG with an estimate of 0.098 and a p-value of 0.000.

None of the indirect effects are significant, moreover, the p-value of most of the indirect effects, as well as the total indirect effects are significant. Thus, the effect of ESCS on academic performance through using ICT at home for schoolwork show no significant mediating effects.

Table 19 *effects of ESCS*

		Est.	p
Direct effects ESCS on	GACH	0.430	0.000
	BELONG	0.098	0.000
	PEERENG	-0.038	0.045
	RELPAR	0.231	0.000
	SLE	0.041	0.029
	Unfairteacher	-0.018	*0.362*
	HOMESCH	0.122	0.000
	ENTUSE	0.067	0.000
	USESCH	0.083	0.000
Indirect effect ESCS on	GACH THROUGH HOMESCH	-0.008	0.006
	GACH THROUGH ENTUSE	-0.002	*0.110*
	GACH THROUGH USESCH	-0.003	*0.126*
	GACH THROUGH BELONG	0.007	0.000
	GACH THROUGH unfairteacher	0.003	*0.356*
	GACH THROUGH PEERENG	0.008	0.048
	GACH THROUGH RELPAR	0.013	0.000
	GACH THROUGH SLE	-0.001	*0.333*
Total effects	ESCS to GACH	0.440	0.000
Total indirect effects	ESCS to GACH	0.011	0.163

*******non-significant p-values are in italic*

7. Discussion

The first research question asked to what extent the different uses of ICT effects the academic performance of Swedish secondary school students. In accordance to the statement of the OECD (2015) that:''no appreciable improvements in student achievement in reading, mathematics or science in the countries that had invested heavily in ICT for education and that technology is of little help in bridging the skills divide between advantaged and disadvantaged students'', this study found that the use of ICT in Swedish schools negatively effects the learning outcomes. This is quite a significant and important finding, which raises some thought about the way we use ICT inside schools, especially considering the fact that technological tools have become widespread available in school and this trend is not likely to stagnate (Wastiau et al. 2013; Frailon, Ainley, Schulz, Friedman & Gebhart, 2014; OECD, 2015; OECD, 2019). Swedish school have a great amount of access to and availability of ICT tool, thus, the main goal now should be to ensure that ICT is used in such a way that both the students' digital competences and learning outcomes are positively influenced. We have heavily invested in ICT tools, now it is of importance to invest in areas such as teacher competence with ICT, software and computer setups that create the right conditions for learning and the increase of digital competence which promotes safe and responsible use of ICT tools.

Surprisingly, this study found that using ICT outside of school for schoolwork is the most negative indicator for academic performance. This is not in line with earlier longitudinal research which indicates that using ICT outside of school, for school related tasks, positively effects academic performance (Skryabin et al., 2015). However, they targeted specific types of ICT use in relation to specific subjects, whereas this study focused on the general use for schoolwork and did not specify the subjects it affected. This shows that this a rather complex issue in which specific types of uses can influence specific subject. Taking the opinion that doing schoolwork would normally lead to better results, the results of this study could also indicate that when students' use ICT for schoolwork they get more easily distracted and thus there might be a discrepancy between the actual time spend studying and the reported time spend studying. This sends an important signal to parents' and teachers', who should carefully consider the amount of schoolwork students should do on ICT devices.

The second research question asked to what extent the different uses of ICT affect the social well-being of Swedish secondary school students. While the different uses of ICT might have a negative effect on academic performance, it seems that their main influence on the social well-being of students is rather positive. This is in line with earlier findings in the literature (Ahn, 2011; Lloyd et al., 2007; OECD, 2017; Trepte et al., 2012) who have concluded that different types of ICT use are connected to different aspects of social well-being. In this study we can see similar results, with the most important one being that students who use more ICT are also more engaged with one another, have better relationships with parents and value cooperation with peers more. This could indicate that students' use ICT mainly to communicate and be in touch, thus to stay connected to the world and other people. Therefore, social network sites, online gaming and the use of internet would be an important part of the ICT use of students'. However, if we look at the results, the strongest tie to these aspects of social well-being is when ICT is used outside of school for schoolwork. This is a surprising result, but can be explained due to the fact that students who use ICT for schoolwork are also the students who have a high economic, social and cultural status, thus already have supporting relationship with parents and value and enjoy cooperating in the first place. It does not, however, explain the engagement with peers which is strongely linked to all the different uses of ICT and negatively to the economic, social and cultural status. Therefore, we can conclude that with all the different types of ICT use, the main use is to engage with peers, thus the use for communication is most apparent for Swedish secondary school students.

There is also an aspect of the social domain that is not influenced by any use of ICT, which is the students' sense of belonging at school. We would expect that being more engaged with peers and value cooperation more would also contribute to the students' sense of beloning at school. However, the ICT use seems to have more effect on the first two domains of the ecological model of bronnfenbrenner,

namely the family and peer level, and not on the school level. In relation to the previous section, these results are not surprising if ICT is mainly used for communication with peers. However, this also tells us that ICT, although helping to engage with peers does not make students feel much less lonely and out of place at school.

Another finding that stood out was the effect of perceived unfair treatment by the teacher. Students who use ICT, even outside of school, are more likely to perceive an unfair treatment of teachers, except when they use ICT for schoolwork. This could possibly be an effect of students being more engaged with ICT devices and therefore being less engaged in classrooms. It also tells us that teachers possibly have a negative attitude towards ICT use and puts emphasis on the importance of digital skills for teacheres.

The third research question asked to what extent the social well-being of students affect the academic performance of Swedish secondary school students. All but one aspect of social well-being has a statistically significant effect on academic performance. Thus, the social well-being of students does affect their academic performance, but the different aspects show both negative and positive effects. In accordance with previous research (Durlak et al., 2011; OECD, 2017), the sense of belonging, the relationship with parents and a fair treatment of teachers has a positive effect on academic performance. Thus, students who feel like they belong and school and who have engaged parents whom emotionally support them as well as teacher who treat them fair perform better academically. This is not surprising as these are also the students with a high economic, social and cultural status and it is generally accepted that good relationships with teachers, parents and a sense of belonging at school lead to better results. Thus, this research emphasizes the importance of these relationship once again and especially for students with a low economic, social and cultural status to increase equality in education. In order to increase these students' academic performance, teachers should be aware of the impact their behavior can have on students'.

There was one aspect of the social well-being that stood out because it negatively affected the academic performance, which is peer engagement. The most logical conclusion would be that spending more time with friends leaves less time for schoolwork. However, engaging with friends is an important aspect of the lives of young teenagers and research has shown that they perceive their relationship with others as the most important indicators for their overall well-being (Fattore et al. 2009; Matthews, Lippman, Guzman, & Hamilton, 2006; Borgonovi, 2016; Feldman, 2012). This is an issue that raises some questions and concerns because we want students to engage with each other but we also want them to perform well academically. The question is whether it is possible to combine these two, whereas the concern might be that it is not. However, as we have seen in the previous section, we can focus on the relationship with parents, teachers and the sense of belonging at school.

The fourth research question asked to what extent social well-being mediates the effect between the different uses of ICT and the academic performance of Swedish secondary school student. This question focuses on the hypothesized mediational model. In the previous section we have discussed the relationships between the different factors, which are necessary to achieve possible mediation. We have found the relationships between the independent variable and the mediating and outcome variable, as well as the relationship between the mediating variable and the outcome variable. Moreover, the previously significant relationship between different uses of ICT has become non-significant for two of the uses when we introduce social well-being. Thus all the conditions for possible mediating have been met and if we look at these relationships, we could have expected a possible mediating effect of peer engagement and unfair treatment of teachers from ICT use through social well-being on academic performance. However, the indirect effects as terminated in the model are all non-significant indicating that social well-being only has a small mediating effect on the relationship between ICT use and academic performance of Swedish secondary school students. Although the mediating effects are not

statistically significant, they do inform about the relationship between ICT use, social well-being and academic performance.

There were two aspects of social well-being that had a small mediating effect, the most important one being peer engagement. Thus, students who use more ICT are more likely to drop in academic performance because they also engage more with peers. ICT creates the right conditions to easily engage with peers, which can lead to distractions and spending less time on schoolwork. In addition, students who use more ICT at school for general purposes or outside of school for leisure are more likely to perform worse academically because teacher treat them more unfair. Thus, their engagement with ICT devices may not be appreciated by teachers, which could possibly show a negative attitude that teacher have towards using ICT. However, these effects are small, and we can conclude that there must be other, stronger mediators at work between ICT and academic performance worth examining in future research. It has become apparent that ICT has an effect on the academic performance of students and it is important to understand this relationship through mediating and moderating factors as this will help us to acquire an understanding of what we need to take into account when we let students' work with ICT devices. A greater understanding of this topic is important not only for teachers and parents, but also for schools and policy makers. The use of ICT is growing in a rapid paste and this trend is not likely to reverse, leaving the previous mentioned parties with the task to create responsible, safe and suitable technological environments in which students can flourish both academically and socially.

Lastly, economic, social and cultural status showed to be an important control variable and strongly effects the academic performance of students' and significantly effects the ICT use. We could therefore think that ESCS might indirectly effect the academic performance through the use of ICT, however, no significant indirect are found. Thus, this could indicate that students' with a higher economic, social and cultural status use ICT differently then students with a low econmic, social and cultural status. This could be an intesting starting point for further research. ESCS also strongly effected the relationship with parents and significantly effected the sense of beloning at school, however, the same conclusion can be drawn when taking into account the non-significant indirect effects on academic achievement through these aspects of social well-being. No significant indirect effects were found, thus the social aspects of well-being do not mediate the effects of ESCS on academic achievement.

8. Conclusion

Students' in Swedish secondary school seem not to benefit academically from using ICT either outside or inside of school, instead the findings indicate they might even perform worse. This could raise questions for parents and educators on why we use ICT and invest so much in it. However, there is some good news, especially for those who do not only look at the numbers. ICT connects: using ICT is beneficial for the social life of students and creates the right conditions to engage more with one another and enjoy and value cooperating with peers. This shows how interwoven ICT is with our social life and could also indicate that ICT is mainly used to communicate with peers. However, ICT is used more inside and outside of school by students' who have a high economic, social and cultural status, but they dont seem to perform worse because they use ICT more. This would be interesting for further research, studying the effects of ICT use on students' with a high or low economic, social and cultural status. Furthermore, while ICT use strengthens the relationship with peers, it is not beneficial for the student-teacher relationship. This could indicate a negative attitude of teachers towards ICT use of students but would need further research.

Interestingly, engaging with others and the perceived unfair treatment of teachers are also the main aspect of social well-being which makes students perform worse academically. This could indicate two things, first, that students who spend more time with friends have less time to spend on their acedemic carreer. Secondly, the student-teacher relationship is an important factor for students to perform academically. Looking at these results we might think that ICT use is making students perform worse academically because they engage more with peers and perceive a more unfair treatment by teachers, or in other words: engaging with peers and perceived unfair treatment mediates the effect of ICT use on academic performance. However, the findings of this study show that this only for a small, non-significant, amount true. This indicates that these effects are standing on their own, thus ICT influences the academic performance and the social well-being of students, whereas the social well-being influences the academic performance, however, there are no significant mediating effects. This means that the study has to reject the hypothesized mediational model between ICT use, social well-being and academic performance, but does not mean no valuable conclusions can be taken from the results.

Probably the most valuable conclusion regarding ICT use is found when we raise the same questions asked earlier: ''why we use ICT and invest so much in it?''. The answer would be that during this age, relationships with peers are of great importance for leading a happy and fulfilling life and ICT might just help to create these conditions. This point of view could be an interesting starting point for further research, which could explore these findings further in order to be conclusive. Moreover, researching ICT use in relation to well-being could contribute to a more holistic understanding of the students ICT use and the possible effects it has, not only on their academic carreer but also on their ability to lead happy, fullfilling lives.

References

Ahn, J. (2011). The Effect of Social Network Sites on Adolescents' Social and Academic Development: Current Theories and Controversies. *Journal of the American Society for Information Science and Technology, 62*(8), 1435-1445. doi:10.1002/asi.21540

Arnseth, H. C. (2008). Activity theory and situated learning theory: contrasting views of educational practice. *Pedagogy, Culture & Society, 16*(3), 289-302. doi:10.1080/14681360802346663

Ataizi, M. (2012). Situated Learning. In N. M. Seel (Ed.), *Encyclopedia of the Sciences of Learning* (pp. 3084-3086). Boston, MA: Springer US.

Baron, R. M., & Kenny, D. A. (1986). The Moderator-Mediator Variable Distinction in Social Psychological Research: Conceptual, Strategic, and Statistical Considerations. *Journal of Personality and Social Psychology, 51*(6), 1173-1182. doi:10.1037/0022-3514.51.6.1173

Bell, F. (2011). Connectivism: Its Place in Theory-Informed Research and Innovation in Technology-Enabled Learning. *International Review of Research in Open & Distance Learning, 12*(3), 98-118. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=59832456&site=ehost-live. doi:10.19173/irrodl.v12i3.902

Ben-David Kolikant, Y. (2012). Using ICT for school purposes: Is there a student-school disconnect? *Computers & Education, 59*(3), 907-914. doi:10.1016/j.compedu.2012.04.012

Biagi, F., & Loi, M. (2013). Measuring ICT Use and Learning Outcomes: evidence from recent econometric studies. *European Journal of Education, 48*(1), 28-42. doi:10.1111/ejed.12016

Bingham, A. (2017). Personalized learning in high technology charter schools. *Journal of Educational Change, 18*(4), 521-549. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=125693232&site=ehost-live. doi:10.1007/s10833-017-9305-0

Blurton, C. (1999). New directions of ICT-use in education. http://www.unesco.org/education/educprog/lwf/dl/edict.pdf

Borgonovi, F. (2016). *A Framework for the Analysis of Student Well-Being in the PISA 2015 Study: Being 15 In 2015*: Paris: OECD Publishing.

Bowers, A., & Berland, M. (2013). Does recreational computer use affect high school achievement? *Educational Technology Research and Development, 61*(1), 51-69. doi:10.1007/s11423-012-9274-1

Bradshaw, J., & Richardson, D. (2009). An Index of Child Well-Being in Europe (Book review). In (Vol. 2, pp. 319-351).

Bronfenbrenner, U. (1979). *The ecology of human development : experiments by nature and design*. Cambridge, Mass.: Cambridge, Mass. : Harvard Univ. Press.

Byrne, B. M. (2011). *Structural Equation Modeling with Mplus : Basic Concepts, Applications, and Programming* (Vol. 14). New York: New York: Routledge.

Castellacci, F., & Tveito, V. (2018). Internet Use and Well-being: A Survey and a Theoretical Framework. *Research Policy*. *47*(1), 308-25

Che Wan Ida Rahimah, B. T., & Ibrahim, C. W. (2016). An overview of educational theories: Social networking and learning. *Social Sciences (Pakistan), 11*(18), 4435-4439.

Cheema, J., & Zhang, B. (2013). Quantity and quality of computer use and academic achievement: Evidence from a large-scale international test program. *International Journal of Education and Development using Information and Communication Technology, 9*(2), 95-106.

Chen, L.-Y., Hsiao, B., Chern, C.-C., & Chen, H.-G. (2014). Affective mechanisms linking Internet use to learning performance in high school students: A moderated mediation study. *Computers in Human Behavior, 35*(C), 431-443. doi:10.1016/j.chb.2014.03.025

Comi, S. L., Argentin, G., Gui, M., Origo, F., & Pagani, L. (2017). Is it the way they use it? Teachers, ICT and student achievement. *Economics of Education Review, 56*(C), 24-39. doi:10.1016/j.econedurev.2016.11.007

Cotten, S. R. (2008). Students' technology use and the impacts on well-being. *New Directions for Student Services, 2008*(124), 55-70. doi:10.1002/ss.295

Cuban, L. (2001). Oversold and underused: Computers in the classroom. Cambridge, MA: Harvard University Press

Du, J., & Anderson, J. D. (2003). Technology and quality of education: does technology help low-income and minority students in their academic achievements. *University of Illinois Journal of Law, Technology & Policy, 2003*(1), 1-34.

Durlak, J. A., Weissberg, R. P., Dymnicki, A. B., Taylor, R. D., & Schellinger, K. B. (2011). The impact of enhancing students' social and emotional learning: a meta-analysis of school-based universal interventions. *Child development, 82*(1), 405. doi:10.1111/j.1467-8624.2010.01564.x

Ellison, N. B., Steinfield, C., & Lampe, C. (2007). The Benefits of Facebook “Friends:” Social Capital and College Students’ Use of Online Social Network Sites. *Journal of Computer-Mediated Communication, 12*(4), 1143-1168. doi:10.1111/j.1083-6101.2007.00367.x

Engeström, Y. (1987). Learning by expanding: An activity-theoretical approach to developmental research. Helsinki: Orienta-Konsultit.

European Commission, 2018. Digital skills enter into Sweden schools. Retrieved on 21 May from https://eacea.ec.europa.eu/national-policies/eurydice/content/digital-skills-enter-sweden-schools_en

Falck, O., Mang, C., & Woessmann, L. (2018). Virtually No Effect? Different Uses of Classroom Computers and their Effect on Student Achievement. *Oxford Bulletin of Economics and Statistics*, *80*(1), 1-38. doi:10.1111/obes.12192

Fattore, T., Mason, J., & Watson, E. (2009). When Children are Asked About Their Well-being: Towards a Framework for Guiding Policy. *Child Indicators Research*, *2*(1), 57-77. doi:10.1007/s12187-008-9025-3

Feldman, R. S. (2012). Ontwikkelingspsychologie. Amsterdam: Pearson Benelux.

Fraillon, J., Ainley, J., Schulz, W., Friedman, T., & Gebhardt, E. (2014). *Preparing for Life in a Digital Age: The IEA International Computer and Information Literacy Study International Report*. Cham: Cham: Springer International Publishing.

Fried, C. B. (2008). In-class laptop use and its effects on student learning. *Computers and Education*, *50*(3), 906-914. doi:10.1016/j.compedu.2006.09.006

Gale, C. R., Deary, I. J., & Stafford, M. (2013). *A life course approach to psychological and social wellbeing*: Oxford University Press.

Garzotto, F. (2007). Was vygotsky right? Evaluating learning effects of social interaction in children internet games. In (Vol. 4663, pp. 376-389).

Golafshani, N. (2003). Understanding Reliability and Validity in Qualitative Research. Th Qualitative Report, 8(4), 597-606. Retrieved from https://nsuworks.nova.edu/tqr/vol8/iss4/6

Gustafsson, J.-E., Yang Hansen, K., & Rosén, M. (2013). Effects of Home Background on Student Achievement in Reading, Mathematics, and Science at the Fourth Grade. In (pp. 183-289): Chestnut Hill, MA: TIMSS & PIRLS International Study Center, Boston College. Boston College, USA.

Helliwell, J. F., & Putnam, R. D. (2004). The Social Context of Well-Being. *Philosophical Transactions: Biological Sciences*, *359*(1449), 1435-1446. doi:10.1098/rstb.2004.1522

Heo, H., & Kang, M. (2010). *Impacts of ICT use on school learning outcome* (Vol. 9789264079786).

Hinostroza, J. E., Matamala, C., Labbé, C., Claro, M., & Cabello, T. (2014). Factors (not) affecting what students do with computers and internet at home. *Learning, Media and Technology*, *40*(1), 1-21. doi:10.1080/17439884.2014.883407

Holen, J. B., Hung, W., & Gourneau, B. (2017). Does One-to-One Technology Really Work: An Evaluation Through the Lens of Activity Theory. *Computers in the Schools*, *34*(1/2), 24-44. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=123074776&site=ehost-live. doi:10.1080/07380569.2017.1281698

Hu, C. (2017). Students, computers and learning: Where is the connection? *Education and Information Technologies, 22*(6), 2665-2670. doi:10.1007/s10639-017-9670-6

Huang, C. (2018). Social network site use and academic achievement: A meta-analysis. *Computers & Education, 119*, 76-83. doi:10.1016/j.compedu.2017.12.010

Hunter, S., Leatherdale, S. T., & Carson, V. (2018). The 3-Year Longitudinal Impact of Sedentary Behavior on the Academic Achievement of Secondary School Students. *Journal of School Health, 88*(9), 660-668. doi:10.1111/josh.12672

Jackson, L. A., Von Eye, A., Witt, E. A., Zhao, Y., & Fitzgerald, H. E. (2011). A longitudinal study of the effects of Internet use and videogame playing on academic performance and the roles of gender, race and income in these relationships. *Computers in Human Behavior, 27*(1), 228-239. doi:10.1016/j.chb.2010.08.001

Jeynes, W. H. (2007). The Relationship Between Parental Involvement and Urban Secondary School Student Academic Achievement: A Meta-Analysis. *Urban Education, 42*(1), 82-110. doi:10.1177/0042085906293818

Karadag, E. (2012). Basic features of structural equation modelling and path analysis with its place and importance in educational research methodology. *Bulgarian Journal of Science and Education Policy*, *6*(1), 194-212.

Kim, M. (2012). Cultural–historical activity theory perspectives on constructing ICT-mediated metaphors of teaching and learning. *European Journal of Teacher Education, 35*(4), 435-448. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=82301564&site=ehost-live. doi:10.1080/02619768.2011.643393

Klem, A. M., & Connell, J. P. (2004). Relationships Matter: Linking Teacher Support to Student Engagement and Achievement. *Journal of School Health, 74*(7), 262-273. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=14692170&site=ehost-live. doi:10.1111/j.1746-1561.2004.tb08283.x

Lave, J. and Wenger, E. (1991) Situated learning. Legitimate peripheral participation. Cambridge: Cambridge University Press.

Lei, J. (2010). Quantity versus quality: A new approach to examine the relationship between technology use and student outcomes. *British Journal of Educational Technology, 41*(3), 455-472. doi:10.1111/j.1467-8535.2009.00961.x

Lim, C. P. (2002). A theoretical framework for the study of ICT in schools: a proposal. *British Journal of Educational Technology, 33*(4), 411-421. doi:10.1111/1467-8535.00278

Lindberg, O. J., Olofsson, A. D., & Fransson, G. (2017). Same but different? An examination of Swedish upper secondary school teachers' and students' views and use of ICT in education. *The International Journal of Information and Learning Technology*, *34*(2), 122-132. doi:10.1108/IJILT-09-2016-0043

Lippman, L., Moore, K., & McIntosh, H. (2011). Positive Indicators of Child Well-Being: A Conceptual Framework, Measures, and Methodological Issues. *Applied Research in Quality of Life*, *6*(4), 425-449. doi:10.1007/s11482-011-9138-6

Liu, D., Kirschner, P. A., & Karpinski, A. C. (2017). A meta-analysis of the relationship of academic performance and Social Network Site use among adolescents and young adults. *Computers in Human Behavior*, *77*, 148-157. doi:10.1016/j.chb.2017.08.039

Lloyd, J., Dean, L. A., & Cooper, D. L. (2007). Students' Technology Use and Its Effects on Peer Relationships, Academic Involvement, and Healthy Lifestyles. *NASPA Journal*, *44*(3), 481-495. doi:10.2202/1949-6605.1832

Marginson, S., & Dang, T. K. A. (2017). Vygotsky's sociocultural theory in the context of globalization. *Asia Pacific Journal of Education*, *37*(1), 116-129. doi:10.1080/02188791.2016.1216827

Marker, C., Gnambs, T., & Appel, M. (2018). Active on Facebook and Failing at School? Meta-Analytic Findings on the Relationship Between Online Social Networking Activities and Academic Achievement. *Educational Psychology Review*, *30*(3), 651-677. doi:10.1007/s10648-017-9430-6

Matthews, G., Lippman, L., Guzman, L., & Hamilton, J. (2006). *Report on cognitive interviews for developing positive youth indicators.* Washington, DC: Child Trends.

Nancy, L., Willem, J. P., & Tjeerd, P. (2008). *Pedagogy and ICT Use: In Schools Around the World Findings from the IEA Sites 2006 Study* (Vol. 23). Dordrecht: Dordrecht: Springer Netherlands.

nef, (2009). National Accounts of Well-being: bringing real wealth onto the balance sheet. New economics foundation, London

OECD (2001), The Well-being of Nations: The Role of Human and Social Capital, OECD Publishing, Paris, https://doi-org.ezproxy.ub.gu.se/10.1787/9789264189515-en.

OECD (2004). OECD identifies "disappointing" use of ICT in upper secondary schools. OECD Publishing, Paris.

OECD/JRC (2010), Assessing the Effects of ICT in Education: Indicators, Criteria and Benchmarks for International Comparisons, *JRC, Ispra (VA)*, https://doi.org/10.1787/9789264079786-en.

OECD (2015). Students, Computers and Learning: Making the Connection, *PISA*. OECD Publishing,

Paris. doi:http://dx.doi.org/10.1787/9789264239555-en

OECD (2017a). PISA 2015 Results (Volume III): Students' Well-Being, *PISA*. OECD Publishing, Paris. https://doi.org.ezproxy.ub.gu.se/10.1787/9789264273856-en.

OECD (2017b). PISA 2015 Assessment and Analytical Framework: Science, Reading, Mathematic, Financial Literacy and Collaborative Problem Solving, revised edition, *PISA*. OECD Publishing, Paris. http://dx.doi.org/10.1787/9789264281820-en

OECD (2017c). PISA 2015 Technical Report, *PISA*. OECD Publishing, Paris. Retrieved from http://www.oecd.org/pisa/data/

OECD (2018a). ICT investment (indicator). doi:10.1787/b23ec1da-en (Accessed on 05 December 2018)

OECD (2018b). PISA, Programme for International Student Assessment. Retrieved from https://www.oecd.org/pisa/

OECD (2019), *How's Life in the Digital Age?: Opportunities and Risks of the Digital Transformation for People's Well-being*, OECD Publishing, Paris, https://doi.org/10.1787/9789264311800-en.

Palincsar, A. S. (1998). Social Constructivist perspectives on teaching and learning. *Annual Review of Psychology, 49*(1), 345-375. doi:10.1146/annurev.psych.49.1.345

Park, S., Kang, M., & Kim, E. (2014). Social relationship on problematic Internet use (PIU) among adolescents in South Korea: A moderated mediation model of self-esteem and self-control. *Computers in Human Behavior, 38*, 349-357. doi:10.1016/j.chb.2014.06.005

Peiró-Velert, C., Valencia-Peris, A., González, L. M., García-Massó, X., Serra-Añó, P., Devís-Devís, J., & Dasgupta, K. (2014). Screen Media Usage, Sleep Time and Academic Performance in Adolescents: Clustering a Self-Organizing Maps Analysis. *PLoS ONE, 9*(6). doi:10.1371/journal.pone.0099478

Pollard, E., & Lee, P. (2003). Child Well-being: A Systematic Review of the Literature. *Social Indicators Research, 61*(1), 59-78. doi:10.1023/A:1021284215801

Ponzo, M. (2011). Does the Way in which Students Use Computers Affect their School Performance? *Journal of Economic and Social Research, 13*(2), 1-27.

Rasmussen, M., Meilstrup, C., Bendtsen, P., Pedersen, T., Nielsen, L., Madsen, K., & Holstein, B. (2015). Perceived problems with computer gaming and Internet use are associated with poorer social relations in adolescence. *International Journal of Public Health, 60*(2), 179-188. doi:10.1007/s00038-014-0633-z

Rodriguez-Gomez, D., Castro, D., & Meneses, J. (2018). Problematic uses of ICT among young people in their personal and school life. Comunicar: Media Education Research Journal, 26(56), 91-100.

Román Carrasco, M., & Murillo Torrecilla, F. (2012). Learning environments with technological resources: a look at their contribution to student performance in Latin American elementary schools. *Educational Technology Research and Development, 60*(6), 1107-1128. doi:10.1007/s11423-012-9262-5

Roorda, D. L., Jak, S., Zee, M., Oort, F. J., & Koomen, H. M. Y. (2017). Affective Teacher-Student Relationships and Students' Engagement and Achievement: A Meta-Analytic Update and Test of the Mediating Role of Engagement.(Report). *School Psychology Review, 46*(3), 239. doi:10.17105/SPR-2017-0035.V46-3

Salomon, A., & Ben-David Kolikant, Y. (2016). High-school students' perceptions of the effects of non-academic usage of ICT on their academic achievements. *Computers in Human Behavior, 64*, 143-151. doi:10.1016/j.chb.2016.06.024

Schreiber, J. B., Nora, A., Stage, F. K., Barlow, E. A., & King, J. (2006). Reporting Structural Equation Modeling and Confirmatory Factor Analysis Results: A Review. *The Journal of Educational Research, 99*(6), 323-338. doi:10.3200/JOER.99.6.323-338

Skryabin, M., Zhang, J., Liu, L., & Zhang, D. (2015). How the ICT development level and usage influence student achievement in reading, mathematics, and science. *Computers & Education, 85*(C), 49-58. doi:10.1016/j.compedu.2015.02.004

Stein, C. M., Morris, N. J., Hall, N. B., & Nock, N. L. (2017). Structural Equation Modeling. *Methods in molecular biology (Clifton, N.J.), 1666*, 557. doi:10.1007/978-1-4939-7274-6_28

Sullivan, L. E. (2009). Reliability. In The SAGE glossary of the social and behavioral sciences (pp. 445-445). Thousand Oaks, CA: SAGE Publications, Inc. doi: 10.4135/9781412972024.n2170

Sung, Y.-T., Chang, K.-E., & Liu, T.-C. (2016). The effects of integrating mobile devices with teaching and learning on students' learning performance: A meta-analysis and research synthesis. *Computers & Education, 94*, 252-275. doi:10.1016/j.compedu.2015.11.008

Tennant, J. E., Demaray, M. K., Malecki, C. K., Terry, M. N., Clary, M., & Elzinga, N. (2015). Students' Ratings of Teacher Support and Academic and Social-Emotional Well-Being. *School Psychology Quarterly, 30*(4), 494-512. Retrieved from http://search.ebscohost.com/login.aspx?direct=true&db=ehh&AN=111551131&site=ehost-live. doi:10.1037/spq0000106

Tingir, S., Cavlazoglu, B., Caliskan, O., Koklu, O., & Intepe-Tingir, S. (2017). Effects of mobile devices on K-12 students' achievement: a meta-analysis.(Report). *Journal of Computer Assisted Learning, 33*(4), 355. doi:10.1111/jcal.12184

Topor, D. R., Keane, S. P., Shelton, T. L., & Calkins, S. D. (2010). Parent Involvement and Student Academic Performance: A Multiple Mediational Analysis. *Journal of Prevention & Intervention in the Community, 38*(3), 183-197. doi:10.1080/10852352.2010.486297

Trepte, S., Reinecke, L., & Juechems, K. (2012). The social side of gaming: How playing online computer games creates online and offline social support. *Computers in Human Behavior, 28*(3), 832-839. doi:10.1016/j.chb.2011.12.003

Ullman, J. B. (2006). Structural Equation Modeling: Reviewing the Basics and Moving Forward. *Journal of Personality Assessment, 87*(1), 35-50. doi:10.1207/s15327752jpa8701_03

Uslu, F., & Gizir, S. (2017). School Belonging of Adolescents: The Role of Teacher-Student Relationships, Peer Relationships and Family Involvement *. *Kuram ve Uygulamada Egitim Bilimleri, 17*(1), 63-82. doi:10.12738/estp.2017.1.0104

Verbeek, P. (2015) Beyond Interaction: A Short Introduction to Mediation Theory. *Interaction, 22*(3), 26-31. doi: 10.1145/2751314

Vygotsky L S (1978) Mind in Society: The Development of Higher Psychological Processes. Harvard University Press, Cambridge MA.

Wastiau, P., Blamire, R., Kearney, C., Quittre, V., Van De Gaer, E., & Monseur, C. (2013). The Use of ICT in Education: a survey of schools in E urope. *European Journal of Education, 48*(1), 11-27. doi:10.1111/ejed.12020

Yarcheski, A. A., Scoloveno, E. M., & Mahon, E. N. (1994). Social Support and Well-Being In Adolescents: The Mediating Role of Hopefulness. *Nursing Research, 43*(5), 288-292. doi:10.1097/00006199-199409000-00006

Appendix A: indicators for ICT use

Table 3 *Indicators for ICT us outside of school for leisure (ENTUSE)*

Item	How often do you use digital devices for the following activities outside of school?	M	SD
IC008Q01TA	Playing one-player games.	2.38	1.495
IC008Q02TA	Playing collaborative online games.	2.66	1.631
IC008Q03TA	Using email.	2.98	1.234
IC008Q04TA	ICT use outside of school for schoolwork	2.83	1.633
IC008Q05TA	Use of ICT at school in general	4.26	1.165
IC008Q07NA	Playing online games via social networks (e.g. <Farmville®>, <The Sims Social>).	1.92	1.367
IC008Q08TA	Browsing the Internet for fun (such as watching videos, e.g. <YouTube™>).	4.29	.977
IC008Q09TA	Reading news on the Internet (e.g. current affairs).	3.14	1.334
IC008Q10TA	Obtaining practical information from the Internet (e.g. locations, dates of events).	3.20	1.231
IC008Q11TA	Downloading music, films, games or software from the internet.	2,92	1.431
IC008Q12TA	Uploading your own created contents for sharing (e.g. music, poetry, videos, computer programs).	2.02	1.326
IC008Q13NA	Downloading new apps on a mobile device.	2.79	1.110

Table 4 *Indicators for ICT use outside of school for schoolwork (HOMESCH)*

Item	How often do you use digital devices for the following activities outside of school?	M	SD
IC010Q01TA	Browsing the Internet for schoolwork (e.g. for preparing an essay or presentation).	3.08	1.083
IC010Q02NA	Browsing the Internet to follow up lessons, e.g. for finding explanations.	3.12	1.076
IC010Q03TA	Using email for communication with other students about schoolwork.	1.97	1.246
IC010Q04TA	Using email for communication with teachers and submission of homework or other schoolwork.	2.34	1.131
IC010Q05NA	Using social networks for communication with other students about schoolwork (e.g. <Facebook>, <MySpace>).	2.77	1.355
IC010Q06NA	Using social networks for Communication with teachers (e.g. <Facebook>, <MySpace>).	1.78	1.237
IC010Q07TA	Downloading, uploading or browsing material from my school's website (e.g. timetable or course materials).	2.31	1.316
IC010Q08TA	Checking the school's website for announcements, e.g. absence of teachers.	2.03	1.306
IC010Q09NA	Doing homework on a computer.	2.92	1.242
IC010Q010NA	Doing homework on a mobile device.	2.12	1.266
IC010Q011NA	Downloading learning apps on a mobile device.	1.83	1.174
IC010Q012NA	Downloading science learning apps on a mobile device.	1.65	1.150

Table 5 *Indicators for use of ICT at school in general (USESCH)*

Item	How often do you use digital devices for the following activities inside of school?	M	SD
IC011Q01TA	<Chatting online> at school.	2.63	1.506
IC011Q02TA	Using email at school.	2.51	1.271
IC011Q03TA	Browsing the Internet for schoolwork.	3.56	1.155
IC011Q04TA	Downloading, uploading or browsing material from the school's website (e.g. <intranet>).	2.24	1.332
IC011Q05TA	Posting my work on the school's website.	1.87	1.225
IC011Q06NA	Playing simulations at school.	1.63	1.093
IC011Q07TA	Practicing and drilling, such as for foreign language learning or mathematics.	2.32	1.248
IC011Q08TA	Doing homework on a school computer.	2.10	1.1298
IC011Q09TA	Using school computers for group work and communication with other students.	2.24	1.254

Appendix B: output Mplus

```
TITLE: CFA
DATA: FILE IS working file2.dat;
VARIABLE:    NAMES ARE   CNTRYID CNTSCHID CNT
  CNTSTUID UNFTEA1 UNFTEA2 UNFTEA3 UNFTEA4
   UNFTEA5 UNFTEA6 HOMESCH ENTUSE
   BELONG COOPERATE CPSVALUE EMOSUPS
   USESCH unfairteacher ESCS PV1MATH
   PV1READ PV1SCIE PEERENG2
   PARENG2 PEERENG1 PARENG1;

Usevariables are
   PV1MATH PV1READ PV1SCIE;
   CLUSTER = CNTSCHID;
Missing are all (99);

DEFINE:
   PV1MATH=PV1MATH/100;
   PV1READ=PV1READ/100;
   PV1SCIE=PV1SCIE/100;

ANALYSIS: TYPE=COMPLEX;
        ESTIMATOR=MLR;

MODEL:
GACH BY PV1SCIE PV1MATH PV1READ;


OUTPUT: Standardized Modindices;
```

```
TITLE: SEM
DATA: FILE IS working file2.dat;
VARIABLE:     NAMES ARE   CNTRYID CNTSCHID CNT
 CNTSTUID UNFTEA1 UNFTEA2 UNFTEA3 UNFTEA4
  UNFTEA5 UNFTEA6 HOMESCH ENTUSE
    BELONG COOPERATE CPSVALUE EMOSUPS
    USESCH unfairteacher ESCS PV1MATH
    PV1READ PV1SCIE PEERENG2
    PARENG2 PEERENG1 PARENG1;

Usevariables are HOMESCH ENTUSE
    BELONG
     USESCH unfairteacher ESCS
    PV1MATH PV1READ PV1SCIE PEERENG RELPAR SLE;
CLUSTER = CNTSCHID;
Missing are all (99);

DEFINE:
    PV1MATH=PV1MATH/100;
    PV1READ=PV1READ/100;
    PV1SCIE=PV1SCIE/100;
    SLE= MEAN (COOPERATE CPSVALUE);
 PEERENG= MEAN(PEERENG1 PEERENG2);
 RELPAR= MEAN(PARENG1 PARENG2 EMOSUPS);

ANALYSIS: TYPE=COMPLEX;
        ESTIMATOR=MLR;

MODEL:
GACH BY PV1SCIE PV1MATH PV1READ ;
GACH ON HOMESCH ENTUSE USESCH BELONG PEERENG RELPAR SLE unfairteacher
ESCS;
BELONG  PEERENG RELPAR SLE unfairteacher ON ESCS HOMESCH ENTUSE USESCH;
HOMESCH ENTUSE USESCH ON ESCS;
HOMESCH ENTUSE USESCH WITH HOMESCH ENTUSE USESCH;

MODEL INDIRECT:
    GACH IND ENTUSE;
    GACH IND HOMESCH;
    GACH IND USESCH;

OUTPUT: Standardized Modindices;
```