Building study-related relationships

How student relationships and readiness affect academic outcome in higher education

ANNIKA FJELKNER PIHL
CENTER FOR ENGINEERING EDUCATION | FACULTY OF ENGINEERING | LUND UNIVERSITY

This dissertation focuses pedagogical development in higher education. More specifically students' academic outcome is discussed from two different perspectives, student perceived readiness and study related relationships. First, the gap between actual readiness and self-perceived readiness and implications thereof are explored. Furthermore, the dissertation shows how students form largely homophilic multiplex networks with a few other students, multiplex indicating that students share more than one type of relation, in this case they are both work- and friendship-based. These semi-professional relationships are important for academic outcome as they combine social and instrumental support which lead to positive synergies as students pool resources and cooperate. The importance of intentionally creating a social structure in and around the classroom where students can form multiplex relationships is discussed. The dissertation offers an in-depth picture of the inherent strength and value of student multiplex relationships, and their educational implications.

ANNIKA FJELKNER is a teacher and pedagogical developer at Kristianstad University. Her teaching mainly focuses the development of academic skills and academic writing, and her research interest focuses academic skills development and student social networks in relation to academic outcome.

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LUND
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DOCTORAL DISSERTATION

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The research presented in the dissertation has a mixed-method approach and applied both quantitative and qualitative data collection methods. Three studies were based on responses from a cohort of business students at a teaching intense Swedish university. The fourth study explored responses from students from two different types of institutions, one teaching intensive and one research intensive university.

One important finding was that there was a gap between self-perceived readiness and actual readiness (Paper I), and results indicated no correlations between readiness and academic outcome. Students were confident in their own skills at the beginning of the semester and did not modify their perception after one semester of studies. Thus, academic staff with teaching responsibility must be more explicit about what is expected of students. Furthermore, student multiplex relations were found to correlate significantly with academic outcome. This finding was further supported by research presented in both Paper III and IV, where students reported that their multiplex relations were important for both social and academic success, as well as well-being. According to the students, it was here the main work with assignments and learning was done (Paper III). These interactions helped students remain engaged in their studies. It was the multiplex relations that remained when learning transitioned online during the Covid-19 pandemic (Paper IV). Many students had only a small number of multiplex relations (1-5 students) and this pattern is consistent with patterns found in Paper II and in the comparative study (Paper IV). Commuter students had fewer relationships than campus students. Finally, there was also a strong tendency toward social homophily in the networks, which could be negative for knowledge development. At the same time, the coexistence of affective and instrumental ties in one relation creates beneficial synergies.

In conclusion, the multiplex networks could be seen as semi-professional work groups based on trust. Like in a workplace, many had their main social life elsewhere, but were joined in the shared enterprise of completing an education. The pooling of skills and knowledge helped students accomplish their goals. One important implication is that education programs and academic teachers need to create relationship rich environments in the classrooms to enable students to work together to create productive and supportive networks and learn to work together with mutual respect. A strategic framework for relationship building is discussed.

Key words: Academic outcome, commuter, higher education, readiness, social network analysis, multiplex relations

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List of publications

The doctoral dissertation is a compilation based on the following papers:

I. Fjelkner, A. (2020). Business students' perception of their readiness for higher education studies and its correlation to academic outcome. *Journal for Advancing Business Education, 2(1), 74–92.*

II. Fjelkner Pihl, A. (2022). The Constructive Overlap: A Study of Multiplex Ties in Students' Study-Related Networks and Academic Performance. *Innovative Higher Education*, 47, 273–295.

III. Fjelkner Pihl, A. (2022). "Ok—I Need Help from Somewhere": The Educational Value of Multiplex Student Relationships in a Commuter College. *Innovative Higher Education, 1-22.*

IV. Fjelkner, A., Roxå, T., & Warfvinge, P. (2021). "It has worked well despite the circumstances" - a study on student social relations and well-being during the pandemic. *Högre Utbildning*, *11*(3).

We designed the study together. I was responsible for data collection together with Warfvinge. Roxå drafted the introduction and the discussion section of the paper, and I the remaining sections. We developed later iterations together. Roxå and I finalized the paper for publication.

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[1] Schmidt, M. (2020). *Persons who frequently use psychiatric emergency services: perspectives on who they are, what their needs are and how they are encountered by healthcare professionals*. Doctoral Thesis. Lund, Lund University.

[2] Källström, L. (2019). *'A good place to live': rethinking residents' place satisfaction and the role of co-creation*. Doctoral Thesis. Lund, Lund University.

Abstract

The present dissertation explores students' perception of their own readiness for higher education and students' study related relations and the effect on academic outcome. The complexity of student engagement and academic success means that it is relevant to conduct in-depth studies of particular student populations, to explore how certain factors play out in that specific context. First, students' perceptions of their readiness for HE studies in relation to academic outcome and socioeconomic and academic background factors were explored. Then, three papers focused students' study-related networks: how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, and how these relations relate to academic outcome; how students perceive their study-related networks, in relation to academic outcome; and, how the emergency transition to online teaching during the Covid-19 pandemic affected students' study-related networks.

The research presented in the dissertation has a mixed-method approach and applied both quantitative and qualitative data collection methods. Three studies were based on responses from a cohort of business students at a teaching intense Swedish university. The fourth study explored responses from students from two different types of institutions, one teaching intensive and one research intensive university.

One important finding was that there was a gap between self-perceived readiness and actual readiness (Paper I), and results indicated no correlations between readiness and academic outcome. Students were confident in their own skills at the beginning of the semester and did not modify their perception after one semester of studies. Thus, academic staff with teaching responsibility must be more explicit about what is expected of students. Furthermore, student multiplex relations were found to correlate significantly with academic outcome. This finding was further supported by research presented in both Paper III and IV, where students reported that their multiplex relations were important for both social and academic success, as well as well-being. According to the students, it was here the main work with assignments and learning was done (Paper III). These interactions helped students remain engaged in their studies. It was the multiplex relations that remained when learning transitioned online during the Covid-19 pandemic (Paper IV). Many students had only a small number of multiplex relations (1-5 students) and this pattern is consistent with patterns found in Paper II and in the comparative study (Paper IV). Commuter students had fewer relationships than campus students.

Finally, there was also a strong tendency toward social homophily in the networks, which could be negative for knowledge development. At the same time, the coexistence of affective and instrumental ties in one relation creates beneficial synergies.

In conclusion, the multiplex networks could be seen as semi-professional work groups based on trust. Like in a workplace, many had their main social life elsewhere, but were joined in the shared enterprise of completing an education. The pooling of skills and knowledge helped students accomplish their goals. One important implication is that education programs and academic teachers need to create relationship rich environments in the classrooms to enable students to work together to create productive and supportive networks and learn to work together with mutual respect. A strategic framework for reflecting on aims of group work with regards to relationship building is discussed.

Sammanfattning

Denna avhandling fokuserar pedagogiskt utvecklingsarbete i högre utbildning, närmare bestämt diskuteras studenters studieframgång i högre utbildning från två olika perspektiv, studenters känsla av att vara förberedda (readiness) och studenters studierelaterade relationer. Studenter är olika förberedda och deras möte med akademiska studier är beroende av såväl social bakgrund som av vilka erfarenheter de bär med sig. Både känslan av att vara förberedd, och andra bakgrundsvariabler såsom personlighet och social bakgrund är faktorer vi inte kan påverka eftersom det är den ryggsäck studenter bär med sig när de påbörjar sina studier. För att bättre kunna planera och genomföra undervisning som bäst möter olika studenters behov är det viktigt att förstå sammansättningen av studentgrupper i specifika kontexter.

I avhandlingen synliggörs att studenter känner sig väl förberedda när de kommer till högskolan och de har tilltro till sin egen förmåga. Studenternas känsla av att vara väl förberedda korrelerade dock inte med studieresultat. Tidigare studieresultat (antagningspoäng) var den starkaste prediktorn för studenter med svensk bakgrund men inte för studenter med invandrabakgrund, som också generellt tog färre poäng än studenter med helsvensk bakgrund trots att båda grupperna gav uttryck för att de kände sig lika väl förberedda. En slutsats som dras i avhandlingen är vikten av att lärare är medvetna om gapet mellan att uppleva sig som förberedd och att verkligen vara det och att lärare och bör vara explicita med vad som förväntas av studenterna. En väg att gå vore ett ökat fokus på formativ återkoppling från både lärare och medstuderande, vilket i förlängningen kan ha positiv inverkan på studenternas kunskapsutveckling. Som lärare kan vi inte påverka hur förberedda studenter är för akademiska studier utan måste arbeta med att försöka överbrygga gapet mellan självupplevd och verklig förbereddhet. Vad som däremot går att påverka är studenternas relationsbyggande som i sin tur har betydelse för hur studenter engagerar sig i sina studier, och därmed också för deras resultat.

Hur lärare organiserar studieprogram och undervisning påverkar studenternas möjligheter att både bygga och underhålla meningsfulla och hållbara studie-relaterade relationer. Vanligtvis planeras undervisning och interventioner antingen på helgrupps- eller individnivå, men fokuserar sällan på arbetsgruppsnivå (mesonivå), eller på de informella arbetsgrupper studenterna själva skapar i början av sin studietid. Dessa arbetsgrupper som jag i diskussionen har valt att se som semiprofessionella nätverk är en underutnyttjad resurs som vi inte vet mycket om. I avhandlingen diskuteras vidare hur lärare kan resonera för att underlätta för studenter att bygga relationer genom att medvetet variera mellan användningen av

studentformerade gruppaktiviteter och aktiviteter där läraren styr vem som arbetar med vem.

Sammanfattningsvis är en slutsats att studenter skapar multiplexa nätverk med några få individer som studenterna skapar både vänskaps- och en arbetsrelation med. Dessa relationer har en positiv inverkan på studenternas studieresultat då kombinationen av socialt och instrumentellt stöd ger synergieffekter när studenterna samlar resurser och samarbetar. Nätverken kan ses som semi-professionella då de är starkt knutna till skolan som arbetsplats och studenterna inte nödvändigtvis umgås privat utan de har sitt sociala sammanhang utanför studentgruppen. Därför är det viktigt att skapa ett socialt sammanhang i och omkring klassrummet för att möjliggöra för studenterna att etablera dessa multiplexa relationer.

En annan slutsats är att nätverken var begränsade i mångfald vilket kan påverka studenternas kunskapsutveckling negativt. För att öka mångfalden i studenternas nätverk kan lärare och studieprogram medvetet verka för att studenter från olika bakgrund arbetar med andra än de vanligtvis arbetar med i klassrummet samt att samarbetet präglas av respekt och intresse för varandra. Detta kan uppnås genom att styra vilka studenterna arbetar med på ett mer medvetet sätt men också genom att ge studenterna uppgifter som kräver genuint samarbete. Lärare måste också bli mer medvetna om hur de sätter samman grupper och effekterna av dessa val. En mer strategisk mix av *high-stakes*- och *low-stakes* uppgifter och mellan självvalda och lärarsammansatta grupper kanske kan öka mångfalden i studenternas nätverk. Avslutningsvis ger avhandlingen en tydligare bild av styrkan och värdet i studenternas multiplexa relationer, och att vissa nätverk hämmar studenters utveckling snarare än gynnar den. Hur och varför är en intressant fråga för vidare forskning.

Prologue – or the setting of the scene

My starting point

Once again, I stand in front of a new group of students in a regular classroom. There are about 50 of them in the room. I'm a bit nervous; they're a bit nervous, anxious to know what is demanded of them and if this session on academic writing will be interesting and useful for them, or simply a waste of time in their view. They don't seem to know each other.

I walk around and chitchat with as many as I can. When I worked as a temporary teacher in elementary school many years ago, my very experienced colleagues repeatedly reminded me how important it was to make sure to look every child in the eyes, at least once every day. It works also in a university classroom. Many years later, I realized the wisdom of taking the time to say hello to the students individually. As I made my way through the classroom, I could feel my own tension evaporate; the new students, who I was sure were going to tear me apart, now suddenly seemed very nice – all of them. They were ok, and they seemed to think that I was ok.

As the weeks pass by, I see them form pairs and groups. I see them struggle, and subconsciously seem to know which of the students will do well, seemingly without an effort on my part, which of them will have to struggle but will get there in the end, and which of them will probably do everything backwards or not at all and will try to argue their way to a pass grade anyway.

Fast forward about a year. I meet the same group of students. They are fewer now, and about half the group sit with fellow students they seem to know very well, grouped together in the front half of the lecture hall. Scattered around the outskirts of that group are other students, who sit alone or in twos, but seemingly demonstratively outside the larger group. I think to myself that it's sad that so many have dropped out. Should I just shrug my shoulders and think that this is the natural course of things, that not all are cut out for higher education? Or is there something we could and should do? We know the problems they face, we know what they need to do about them, we offer all kinds of support. Why is it, then, that we cannot reach them in the way we want or expect?

Students on why relations matter

Relations matter, as depicted above. Both the teacher-student relation and especially student-student relations have intrigued me. To further highlight what this dissertation will focus on, I would like to illustrate how relations matter to students using three vignettes. The vignettes introduce three students with very different experiences of the same program. The vignettes are based on the stories of three of the students interviewed (Paper III) regarding their study-related relations. They illustrate how students perceive these are relevant to their study experience, and the difference in the students' experiences, depending on their individual circumstances.

Vignette 1: Taylor[3]

Taylor was a shy young woman who rarely spoke up in class unless called upon, and then her answers were brief, and she rarely elaborated. This was also the case during the interview. She was 23 years old at the time of the interview and lived in a small town about 30 minutes commute by train from the university. One of her parents had a university degree. It was important to her to be able to study close to home. Her SweSAT[4] score was well below the national average, but her grade point average (GPA) from upper secondary school was above the national average. Taylor had only three people in her total study related network, and she mainly worked with one other girl, Stella:

> We went to the same upper secondary school and cooperated some also there, and we know how we are, how we like to work. We live in the same direction but usually take different trains. We work together prior to, or after lectures. It works really well when we divide the parts between us and then you can sit and work on you own if you feel like it. But, then sometimes, even if we have divided the work, we can meet so that you have someone to toss around ideas with.

Through her one other friend she has access to a few more students in the class, Taylor explained. However, only one of these students had added Taylor to her friendship network (see Paper II or Part II regarding mapping of networks):

> [I don't work with them], they have found their groups in school. I know them so that I can talk about stuff other than school too. That's nice so that not everything is about school. [We talk] sometimes before class or after. I often go to them before class to

[3] N.B. All names are pseudonyms as to ensure confidentiality.

[4] Swedish Scholastic Aptitude Test

> chat. I think I started to talk to I[5] [female student] first, and then she had gotten to know a few people and then it was natural that I had contact with them too.

Although Taylor did not work with these students, she turned to them before asking a teacher if she needed more information or input regarding an assignment. She also explained how one person in her external network, her sister, was an important help in her studies.

Regarding why she had designated such a limited number of people in the class as friends, Taylor explained:

> I think in the beginning, when we first started here, then I kept to Stella and then you saw that during that first month new cliques started to form and then I was outside those cliques. It was safe to stick to someone you knew and at the same time you saw others who didn't know anybody.

She reflected on how she also would not have made it without the help of her sister, who supported her mainly emotionally, but sometimes also offered instrumental help revising, but maybe not with the same result:

> That is, when you work individually and all, then sometimes I don't understand what is asked of me, and then I can turn to them and ask how they have understood it all. So, I feel that without them I would have sat there not knowing how to solve certain assignments. […] But then I work a lot independently as well, so I think it's more to have that security. If you get stuck, you have somewhere to turn to.

Regarding the school network, she concluded that it had been a contributing factor to her academic success.

At the same time, Taylor expressed how she was uncertain about the benefits of studying, as her perception was that it was more important to have work experience than a diploma when applying for a position in her preferred line of work. Of the students interviewed, she worried the most openly about how it was going to be difficult to find a job and how the educational experience had not been as rewarding as she had expected it to be.

Vignette 2: Carl

Carl was slightly older than the other students, 28 years old in the final year, and he lived in a flat on campus together with his girlfriend, who was in the same specialization of the program. Both his parents had a university degree and he talked about himself as the black sheep, as he had been reluctant to pursue university studies and thought he was not smart enough. He had moved away from home to

[5] All full names used are the fictive names given to the students who participated in Paper III. Initials, such as I in this case, signify other students the participants referred to in their interviews.

study. It was hard to get Taylor to elaborate on her own accord, in contrast, it could sometimes be difficult to keep Carl focused on the topic and within a reasonable timeframe. He was very enthusiastic about the topic, liked to explain everything in detail and expressed how he enjoyed the conversation we had during the interview.

Carl's SweSAT score was above the national average, but not high enough to grant him a place in the more prestigious business school, which had been his first choice. His GPA from upper secondary school was above the national average. Carl had 16 people in his network, which means he was a central figure in his specialization. He was a very conscious networker and very aware of the benefits of teamwork. He worked mainly with his girlfriend L and one other friend Eric. They had worked together from the very first semester, and as Carl said: "*why change a winning concept*." He claimed he often had the overall responsibility for the work and:

> Eric has the best general knowledge, but is also the best when it comes to finance. I am more general […]. The fact that I'm studying business was really just a fluke, but Eric is really very interested in stocks and such things […] and that's handy when you write business reports. […] and then we have L, who is in charge of all the finicky details [academic writing].

He was very conscious of what other people had to offer and mentioned one example of how he sought out a classmate, who "was the smartest in our class." He had "heard something about old exams" and thought that if she used them to revise then it must be good. He added: "she is my role model […]. She is that good and very nice and social." Carl added that the most important people around him were the people he worked with and had learned from, and "that you have a group so that you know, you can do this and I can do this."

He thought initially that studying was something he had to do, something that would not really be useful, but he was now overwhelmed by how "I learn so much" and how it "has given me so much because I understand things in a different way."

He was also very conscious of the future value of his network:

> The ones that I think are good, the ones I think will succeed, I obviously spend more energy on them rather than on the others […]. I'm social and talk to everyone, but I don't waste my energy on those people because they don't give anything back. But the people I think are better than I am […] I give them feedback, an exchange of ideas the whole time […] and then with the people I think will do well.

In Carl's case then, he was a very conscious and strategic networker, and his educational experience also seemed to be more rewarding and transformative than Taylor's.

Vignette 3: Monawar

Monawar was 24 years old at the time of the interview and lived in a larger cosmopolitan area about 1.5 hours commute by train from the university, in an ethnically diverse area with considerable socioeconomic challenges. He lived at home and talked of how he helped his mother and his younger siblings, to make sure they did well in school. Neither of his parents had a university degree, and they had both immigrated to Sweden. Monawar was shy and rarely spoke up in class. He sat a bit apart from the other students together with another young man from his neighborhood. He had dropped out during the second year, and then joined the program in the next spring to redo parts he had missed.

Monowar's SweSAT score was well below the national average and his GPA from upper secondary school was slightly above the national average, but lower than that of Carl and Taylor. He had a limited friendship network in the second year. In the first year he had had more relations. He explained: "M and I, we had gone to the same school with Ahmed." He also briefly mentioned two more students: "I'm bad with names, I knew them." Both Monawar and his friend Ahmed dropped out in the second year:

> What happened was that me and Ahmed, we were supposed to do the WIL course together and then we were late and then we gave up […]. There were many things affecting it, personal, home and such. I help out at home. Me and Ahmed worked at the same place at that time and then it was school. I don't know how to describe it. It was too much.

Monawar though the first year was fun, when he knew a few more in the class. Then they split up into different specializations and he worked mainly with one other student, Ahmed. It was hard to get to know the others in the class in the second year, hard to hang out with the native Swedish students he said, and they both dropped out. When they came back a year later and joined a new cohort in the final courses the second year, they had a very limited network.

In the third year, things went better. During the interview, Monawar smiled, leaned forward, and became more energetic when he reviewed the survey, he had filled out the previous semester, pointing to all the students he had gotten to know in the third year and added: "it's fun to discuss things."

Although there were many reasons why Monawar dropped out, his story points to how important his friends in the first year were for his initial study success. He has studied with the two students he mentioned, I and M, and did well his first year. In a sense, I and M helped pull them through, sharing notes and insights as they studied together. In the second year, he could not fall back on these relations, but Monawar was more isolated, and eventually he dropped out. After the summer break, he concluded that he "need[ed] to finish this and graduate." Coming back was difficult and again he was isolated, but in the third year he "really became a

student," and managed to build relations with other people in the specialization, which Monawar described as "very rewarding."

The main aim of this dissertation is to better understand students when they arrive to university. The focus is on how they view themselves, in relation to what they perceive the university expects from them. This is the challenge they face. The next question, and something studied in detail in this dissertation, concerns what resources they utilize while dealing with this challenge. As illustrated in the vignettes, an emphasis is placed on their relations with other students. How do they get to know each other, and how do they use the networks they build with each other? As it turns out, this process is closely linked to their potential success as well as to their general experience.

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Introduction

The prologue describes the starting point of my journey as a doctoral student. Like many teachers before me, it is my own practice that is the focus of my attention in the present dissertation. My journey began in my classroom and with all those questions I asked myself about the students. In a sense, the journey ended in that same classroom, as I attempt to make use of what I have learned when I plan and organize lessons and courses.

The present dissertation is a compilation of four articles that report on the results of inquiries related to pedagogical questions that have puzzled me during my years as a teacher at a specific higher education (HE) institution. It is sprung from questions I have asked myself about the students and their achievement in specific assignments and courses, but also in the program. As I stand in the classroom each year, facing students in different constellations in different courses and modules, I have frequently pondered upon the following issues:

- Teachers think that students are not prepared for HE studies, but apparently students did not think so. If they did, why is it that those who need help the most fail to see that they need help, and are most reluctant to take part in remedial though voluntary sessions? How do students perceive their readiness for HE studies, and do they change that perception as they gain experiences of what it entails to be a student?

- I could see that small student-formed peer groups seemed to play a vital role in student engagement and academic outcome. How are those relations formed, and what are their influence on students' perceptions of their studies as well as their academic outcomes? How can I work to help students form supportive academic relations?

As is evident from the above points, the present dissertation is focused on academic outcome, but from two different perspectives: (1) student readiness and (2) student study-related relations (For the specific aims and research questions, please see Aims (p. 28) and Table 4 (p. 30)).

The first study was practically rather than theoretically driven and was based on a pedagogical project in which I explored student readiness and whether a certain instrument could be used to predict academic outcome. The subsequent two studies (Paper II & III) explored student study-related relations, and especially multiplex relations, in that same cohort of students and how these contributed to academic outcome, but also how students experienced these academic relations. Finally, the

fourth study also revolved around student study-related multiplex relations and how these were affected by the emergency transition from campus to online teaching during the Covid-19 pandemic. The studies are independent, but together they contributed to a more comprehensive understanding of academic achievement in the cohort and program in question.

The overarching or umbrella question (Johnson & Onwuegbuzie, 2004) of the present dissertation is how acquiring more in-depth knowledge of student readiness and student social relations could contribute to my own teaching practice and that of my colleagues, as well as to the planning and organization of the program. The four appended studies have contributed to a varying extent to answering this question.

The three vignettes in the prologue offer a snapshot view of student study-related relationships and how these are central to how students engage with their academic studies. Both readiness and study-related multiplex relations affect how students engage in their studies and how well they succeed. Engagement is a complex issue, as is academic achievement. Both concepts are of overarching importance to the appended studies, and both have been widely studied, which is why they will be discussed in more depth in the next sections.

Student engagement in Higher Education

Students' experiences during their first year largely determine how successful they will be at university. For this reason, it is important to know what expectations students have regarding their university studies. If students' expectations are not met or if the gap between secondary and tertiary education is too wide, they may choose to leave. In 2013, about 55% of students in Swedish HE failed to complete their Bachelor-level studies (The Swedish Council for Higher Education, 2013); this is almost twice the average estimate that as many as one third of students in OECD countries do not complete their diploma (OECD, 2008, in Jansen and van der Meer, 2011). These numbers are mirrored by the results from two studies in two different countries, showing that as many as 40% of students consider withdrawing from university studies during their first year (Edvardsson Stiwne, 2005; Thomas, 2012). According to the latest annual report from the Swedish Higher Education Authority (2021), the situation has not changed much, and less than 50% of business and engineering students in the Swedish HE system had completed their studies three years *after* the nominal graduation time.

Students choose to leave university for several reasons. Thomas (2012) found that students gave an average of 2.1 reasons for leaving: Students may choose to leave university if they are dissatisfied with the social environment or feel they do not fit in; if they are unable to cope with academic demands; or if they are dissatisfied with their choice of study field or for personal reasons (e.g., Krause et al., 2005¸ Thomas,

2012; Yorke, 2004). Thomas (2012) did not mention financial problems, whereas Yorke (2004) and Krause et al. (2005) discussed how financial pressure may make it difficult for students to complete their education, as government funding is declining, and students must work more to support themselves. Factors influencing early departure are summarized in Table 1.

Table 1 Influences of early departure

Yorke (2004)	Davies & Elias (2003)	Krause et al. (2005)	Thomas (2012)
Wrong choice of field of study	Wrong choice of course	Emotional health	Academic issues
Academic difficulties	Academic difficulties	I wanted to change courses	Less engaged in study & peers
Financial problems	Financial problems	Financial reasons	Dissatisfied with HE experiences
Poor quality of the student experience	Personal problems	Fear of failure	Social isolation/not fitting in
Personal problems	Wrong choice of institution	HE did not meet expectations	Fear not achieving future aspirations
Unhappiness with the social environment		Dislike studying	
Dissatisfaction with institutional provision		Physical health	
		Problems with daily travel	
		Paid work commitments	
		Family commitments	
		Found employment	

Note: The table is based on Yorke (2004, p. 20) and extended with factors from Krause et al. (2005) and Thomas (2012).

It must be taken into consideration that the financial situation differs across countries, and in countries like Sweden, where education is free of charge and student funding is available for all for seven years of studies. However, students in the Swedish system also experience financial pressure, as funding is withdrawn if students fail to take the minimum number of credits stipulated by the Swedish Board of Student Finance during the first year (CSN, 2016).[6] Students who have troubles the first semester and who have failed to apply for funding for the full academic year are often stressed for credits at the end of the first semester.

Tinto (1997) emphasized the importance of college as a social community, pointing out that "frequent and rewarding contact between faculty, staff and students in a variety of settings" (p. 9) – also outside of normal, formal classroom settings –

[6] 62.5 % of 60 credits possible each academic year, which means 37.5 credits in two semesters.

is important. Thomas (2012) pointed to the students' own engagement, or lack thereof, in their studies and with their peers as an important factor.

Different factors also affect different student groups differently, for example, older students are more affected by financial issues and less concerned by teaching methods and the social environment than are younger students, due to their circumstances (Yorke, 2004), whereas meeting new people and making friends are very important to young students (Tinto, 1997). Krause et al. (2005) found no single most important factor among the eleven reasons for deferring. Their study covered the same areas as the other three, but, like Davies and Elias' study (in Yorke, 2004), did not cover the issue of not fitting in or social isolation, as did Yorke (2004) and Thomas (2012); however, that aspect is potentially covered in the aspect "personal problems" or that "HE did not meet expectations," respectively. All in all, there are many reasons why students drop out; some are related to the actual HE experiences, and some are not.

One important concept discussed in relation to student academic achievement is engagement. There are many factors involved that affect students' experience of HE. In a seminal work, Tinto (1987) pointed out that one of the most important factors is what takes place in the classroom, and that experience will largely determine whether or not the students will stay. Further, it is important for students to build meaningful relations with fellow students, but also with teaching staff. Students also need support to develop the academic skills required for them to be able to complete their studies.

In later work, Thomas (2012) indicated, for example, that a sense of belonging and engagement are central to retention and completion. Students stay if they know how things work. They also hold a more positive view of their peers and their teachers. In contrast, students who think of dropping out are less engaged already from the beginning and often consider leaving after their first semester. This means that retention measures are most successful and effective in the first semester and influence the students' academic experience (e.g., Thomas, 2012; Tinto, 1987).

Several factors are believed to affect student *engagement*, which involves "the amount of time and effort students put into their studies and other educationally purposeful activities" (Kuh et al., 2006, p. 6) and has been suggested to work as a proxy for quality. Furthermore, as Kuh et al. (2006, p. 8) showed that student engagement is something universities can potentially affect through:

> purposeful student-faculty contact, active and collaborative learning, and institutional environments perceived by students as inclusive and affirming and where expectations for performance are clearly communicated and set at reasonably high levels.

Engagement can be seen a 'meta-construct' (Kahu, 2013, p. 758), encompassing four approaches to engagement: the behavioral, psychological, socio-cultural, and holistic perspective. While each approach has its advantages and problems, Kahu

(2013) claimed that all are important to understanding the complexity of engagement, as the different approaches tell different parts of the story of student engagement. She presented a conceptual framework that bridges the different perspectives and embeds them in the social-cultural context, as displayed in Fig. 1 (Kahu, 2013, p. 766). While not claiming to cover all possible influences on student engagement, the model nonetheless offers a framework for understanding the complexity as well as the influences and consequences of student engagement.

The student is at the center of the model. Without going into too much detail, the model clearly depicts the complexity of student engagement, and how difficult it is to say that one given aspect has a fundamental impact on student success. It is also impossible to offer one general success model. Instead, the model seems to suggest that student engagement and success are fundamentally embedded in a social context; it is a local affair, or even a completely personal affair. If expressed in social learning theory terms, learning could be seen as "activity by specific people in specific circumstances" (Lave & Wenger, 1991, p. 529) and a construction of identity. Interestingly, other students, or relations with peers, are not present in the model.

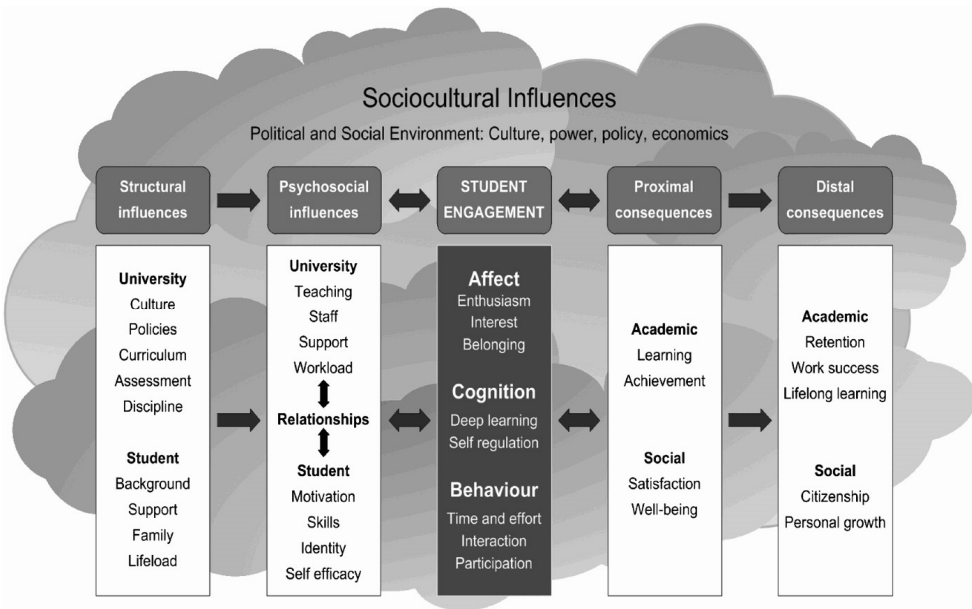


Figure 1 Kahu's model of student engagement
Note: From: Kahu, E. R. (2013). Framing student engagement in higher education. *Studies in Higher Education*, 38(5), 758-773. Copyrighted by Taylor & Francis Group. Available at: www.tandfonline.com

That relations with peers and faculty are important to engagement and learning has been well documented. Thomas (2012) divided factors that foster student

engagement into academic and social engagement (Table 2). Social engagement (Thomas, 2012) is built when students engage in stable and ongoing relationships with both teachers and peers (e.g., Kuh et al., 2006; Thomas, 2012). Factors that help build academic and social engagement are summarized in Table 2. Tinto (1975) referred to how many friends students have, whereas Thomas (2012) listed interaction with friends and peers.

To form social engagement, or a sense of belonging, interaction with friends and peers, social activities hosted by the student union, for example, and other extra-curricular activities offered are important. However, students are affected by the social environment of the program and services offered, but a positive and understandable academic experience is even more important (e.g., Thomas, 2012; Tinto, 1987). Interestingly the two listed student/staff contact in different categories, where Thomas (2012) placed student-staff contact in the category *Academic engagement*, whereas Tinto (1975) placed contact with teachers/staff in the *Social integration* category. According to Thomas (2012), the problem is not that we do not know enough about student engagement and retention, but that it is difficult to use this knowledge, plan and implement activities to impact student success. Another problem is that research on specific measures and what works in one setting might not be easily transferable into a different context (Trowler & Trowler, 2010).

Table 2 Factors that help build academic and social engagement

Tinto[7] (1975)		Thomas (2012)	
Academic Integration	Grades/performance	**Academic Engagement**	Student-staff contact
	Perceived personal development		Building on prior learning
	Academic self-esteem		Active learning
	Enjoying subject		Prompt feedback
	Enjoying studying subject		Time on task
	Identification with academic norms and values		High expectations
	Identification with role as student		Respect for diverse learning styles
			Co-operation among students
Social Integration	How many friends you have	**Social engagement**	Interactions with friends and peers
	Contact with teachers/staff		Student unions
	Enjoying being at university		Shared living
			Extracurricular activities

Learning is challenging. A college education involving moving away from the family is perhaps even more so, as it involves a variety of changes. The focus of the present dissertation is on student perceived readiness and study-related social relations in a specific study program. These two aspects are both situated in the psychosocial realm in Kahu's model (Figure 1). Perceived readiness is linked to

[7] Draper,S.W. (2002, May 14) *Tinto's model of student retention*. Available from University of Glasgow's webpage: URL http://www.psy.gla.ac.uk/~steve/XXXX.html (visited 2016 October 21)

both self-efficacy beliefs and skill, and social relations to relationships, situated in the middle of the psychosocial realm, thus linking University and Student. Peers are not present in the model, but could be perceived to be part of Relationships, also in the psychosocial realm of the model. Kahu (2013) exemplified how being part of a learning community is important and focused on how relations with staff or teaching practices are important factors that foster engagement. My focus is on relations between students and how these and student readiness contribute to academic achievement.

Academic achievement is one of the proximal consequences of Kahu's model. All studies compiled in the present dissertation are to some extent, directly or indirectly, linked to academic outcome. In the literature, academic achievement, outcome and success are used somewhat synonymously, and as Kahu's model depicts, it is a complex issue, which is why the next section aims to define academic outcome in relation to academic success.

Academic outcome and academic success

At first glance, academic outcome and academic success seem to mean the same thing, and the two terms are in fact sometimes used interchangeably in the literature. Academic outcome is often measured as a course grade or grade point average (GPA), which is perceived as a limited view of academic success (e.g., York et al., 2015), whereas academic success is a much wider concept. It has also been debated whether course grades or GPA are even reliable measures of stipulated course learning objectives (Olsson, 2007; York et al., 2015).

In an attempt to capture desired outcomes and post-college indicators of student success, Kuh et al. (2006, p. 7) proposed the following definition of academic success:

> student success is defined as academic achievement, engagement in educationally purposeful activities, satisfaction, acquisition of desired knowledge, skills and competencies, persistence, attainment of educational objectives, and post-college performance.

This definition aims to capture all aspects that affect how successful students are in college in relation to pre-college experiences, student behavior in college and institutional conditions which lead to post-college outcomes. The focus of the model is on student behavior in college, for example study behaviors, peer involvement and time on task, and institutional conditions such as peer support, teaching and learning activities, and First-year-experience (FYE) activities, all of which are aspects universities can potentially affect and in that way foster student engagement, which is thought to be central to success in college.

In an evaluation of literature on academic success and of Kuh et al.'s (2006) framework, York et al. (2015) found that the definition of academic success was

necessarily broad and complex. They further found incongruence in the literature, as academic success was broadly defined, but often narrowly measured as GPA or course grades, that is, as academic outcome/achievement or the quality of students' academic work, rather than as academic success. Further problems discussed were that the different factors in Kuh et al.'s model were not properly operationalized, and engagement is a mediating variable rather than an outcome and as such should not be a part of the model (York et al., 2015). A further problem is that it is not possible to evaluate all aspects relevant to academic success at the same time.

Based on a review of the literature on academic success, York et al. (2015) developed their Conceptual Framework for Examining Academic Success. The framework is similar to Kuh et al.'s (2006) definition of academic success and comprises six out of the original seven factors (Table 3): academic achievement (GPA & grades), satisfaction, acquisition of skills and competencies, persistence, and career success, where academic achievement is seen as a proxy for both attainment of learning outcomes and acquisition of skills and competencies. Based on their literature review, they also offered examples of instruments to be used to measure the different factors.

Table 3 Factors of academic success

Authors	Khu et al. (2006)	York et al. (2015)
Title	*What Matters to Student Success*	*Conceptual Framework for Examining Academic Success*
Dimensions	Academic achievement	Academic achievement
	Satisfaction	Satisfaction
	Acquisition of desired knowledge, skills and competencies	Acquisition of skills and competencies
	Persistence	Persistence
	Attainment of educational objectives	Attainment of learning outcomes
	Post-college performance	Career success
	Engagement in educationally purposeful activities	

In sum, the complexity of student engagement and academic success means that it is relevant to conduct in-depth studies of particular student populations, to explore how certain factors play out in that specific context and to explore what that means for students, teachers and the organization of a program. Predicting or understanding the premises of student success would allow the program to more effectively enable students to focus their efforts and to succeed. There is not a single most effective way to do so, but many factors on different levels affect the student experience and achievement.

In the following sections, the relevance of the main focus areas of the present dissertation – student readiness and social relations – is presented.

Student readiness

Student self-rated readiness is also a well explored area. Previous research has often explored students' self-rated readiness after one semester of studies or prior to their studies (Jansen & van der Meer, 2007) using a range of different instruments, often in relation to academic outcome. As there is a documented gap between university and student expectations (e.g., Barrie, 2004; Jansen & van der Meer, 2007; Swedish National Agency for Higher Education, 2009), it is relevant to explore how students adjust their self-rated readiness after having studied for one semester.

Previous studies have indicated that a high percentage of students feel prepared to undertake HE studies (Jansen & van der Meer, 2011). Jansen and Suhre (2011) explored the link between student *ex ante* self-rated readiness, study behavior and outcomes. Student expectations and preparedness affected study behavior and academic outcome. Students who had higher self-rated readiness skills for time management and information processing also performed better. It seems that *ex ante* self-rated readiness, at least regarding time management and information processing skills, are possible predictors of academic outcome. From an educational and institutional perspective, it seems relevant to investigate this possibility further.

At this point in my exploration, the need to contextualize the literature into a Swedish context became apparent. What about students at my university?

Additionally, as one of my questions about the students focused on whether and how students changed their perception of their readiness after one semester of study, it was relevant to measure self-rated readiness both prior to their studies and after one semester. A further aim was to determine whether the survey results could predict academic outcome. This means that Paper I extends previous research, because it explores *the change in perception* and at the same time contextualizes the literature, as I explored whether the instrument chosen could be used as a tool to predict outcome in a Swedish higher education context.

Student social networks and multiplexity

Studies on student social relations and academic achievement have typically explored student friendship and learning relations (e.g., Eggens et al., 2007; Hommes et al., 2012; Rienties & Tempelaar, 2018). Students with many social relations have been found to also have better academic achievement than do students who are less successful socially. Previous studies have largely focused on different relations independently, although naturally there is a great overlap between the different types of relations, that is students form multiplex relations with one another (e.g., Chen et al., 2012; McCabe, 2016; Fjelkner Pihl, 2022). I was particularly interested in the small, tightknit groups of students in the classroom, where seemingly most of the work took place.

I could not, based on my experience, relate to the literature on student social relations and found that the independent analysis of student relations was somehow

oversimplistic. For this reason, I wanted to acknowledge that several relations largely overlap and that it may be these so-called multiplex relations that positively affect learning and academic outcome. Multiplex relations occur when individuals share several relations, for example, if you are friends but also work together (e.g., Kuwabara et al., 2010; McCabe, 2016; McPherson et al., 2001).

Both McCabe (2016) and Chen et al. (2012) have discussed student multiplex relations, but not specifically in relation to academic outcome. Research has indicated that overlapping (multiplex) study-related relations are more likely to remain after college (McCabe, 2016) and have also been more resilient during the Covid-19 pandemic (Elmer et al., 2020; Fjelkner et al., 2021). There are a few studies on multiplex relations in organizational studies (e.g., Kuwabara et al., 2010) which indicate that multiplex relations have a positive effect on outcome in education as well (e.g., Shah et al., 2017).

In sum, the appended papers and this dissertation summary contribute to the literature by exploring how students form working, learning and friendship relations and to what extent these overlap in multiplex relations as well as by looking at how uniplex and multiplex relations relate to academic outcome (Paper II). Furthermore, how students perceive their multiplex relations is explored in Paper III, and Paper IV discusses students' perceptions of how student multiplex relations were affected during the Covid-19 pandemic.

Studies focusing on multiplex relations in HE are rare. Thus, the present dissertation adds to the literature by shifting from the study of independent student friendship, learning, and working relations to a more complex understanding of student relations and possible implications for practice.

And why are these issues important?

Student readiness, personality profile or various other background variables are factors we cannot affect, as they constitute what the students bring with them when they enter HE. However, having deeper knowledge about how these factors play out in a specific context would faculty to better meet the needs of a specific cohort of students. Thus, we could modify how we meet or work with a specific group of students based on our knowledge of the composition of the group.

What we can affect, though, is their study-related relations, as these are actively created by the students in the specific context that we offer them as they start their education. In fact, how teachers plan and organize programs and teaching will affect students' possibilities to build and maintain meaningful and sustainable academic relations. Normally, interventions are planned on either a cohort (class) or individual level, whereas interventions on a meso-level, or academic network level, would possibly be more effective. It is possible to affect how and under what circumstances they meet, and work with, other students, so that students can possibly help improve

each other's outcomes. In order to work with these academic networks, certain criteria must be fulfilled. Academic staff with teaching responsibilities need to a) understand how students create networks in the specific context, b) follow the development of these networks in a specific cohort, and c) plan interventions on a program level rather than on a course or module level. How this could potentially be done is something that is further reflected on in the discussion section.

The present dissertation is a compilation of four articles, three of which focus student study-related relations, which I specifically set out to explore. One article, Paper I, can be seen as a foundation for the subsequent two (Paper II & III), as it explored the students' perception of readiness, socioeconomic background factors, and how these factors were related to academic outcome. This paper then formed a background for the two subsequent papers regarding students' perception of their study-related networks, how these overlap, and the relation to academic outcome. Finally, Paper IV explored the effects the emergency transition to online teaching during the Covid-19 pandemic had on students' study-related networks in three cohorts at two different types of universities. Thus, the present dissertation generates more in-depth knowledge of student readiness and student social relations and presents a discussion on potential implications for faculty and the planning and organization of courses and study programs.

Structure of the dissertation summary

The present dissertation is a compilation of four papers. Paper 1 discussed students' perception of their readiness for HE studies related to background factors and *academic outcome* (achievement) measured by number of credits earned in nominal time in the specific study program studied. It is important to remember that academic outcome is only one aspect related to academic success in HE. The concept is also relevant to Paper II, which focused on students' social networks and how uniplex and multiplex relations contribute to academic outcome. Both Paper III and IV also touched upon the concept, but did not measure academic outcome directly, but rather explored the students' experience of the transition to online teaching during the Covid-19 pandemic and how they felt the change affected academic outcome. Thus, the dissertation summary will have the following structure. First, I will present aims and research methodology, with epistemological assumptions, research design and ethical considerations. Then theoretical points of departure, method, and results of Paper I (Readiness) will be presented in Part 1. Thereafter, Part II presents the aims, theoretical points of departure, method, and results of Papers II-IV (Social relations).

Aims and research question

The focus of the present dissertation is on how student readiness and social relations contribute to academic outcome in a specific study context. The umbrella question is: *How could having more in-depth knowledge of student readiness and student social relations contribute to my own teaching practice and that of my colleagues, as well as to the planning and organization of the program?*

Specific aims of the individual papers

I. To explore the students' perception of readiness, socioeconomic background factors, and how these factors were related to academic success.

II. To explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, and how these relations relate to academic outcome.

III. To explore students' perception of their study-related networks, and the relation to academic outcome.

IV. To explore the effects the emergency transition to online teaching during the Covid-19 pandemic had on students' study-related networks.

Overview of appended papers I-IV

Table 4 presents a snapshot overview of the aim, research questions, methods, and main findings of the appended papers.

Table 4 Summary of aim, RQ, data collection and main findings of Paper I-IV

Paper	Aim	Research Questions	Data collection	Main findings
I	To explore the students' perception of readiness, socioeconomic background factors, and how these factors were related to academic success.	(1) In this cohort, how do students appraise their readiness prior to their studies? (2) In this cohort, how do students appraise their readiness after one semester of study? (3) In this cohort, to what extent does students' self-rated readiness predict academic outcome? (4) In this cohort, which background factors best predict academic outcome?	Survey & archival data (Ladok)	Previous GPA, socioeconomic background and commuting were significant predictors of academic outcome, but not so for immigrant students. They also earned fewer credits in nominal time than did native students. There were no correlations between REQ results and academic outcome. Students were confident in their own skills, and there was a gap between self-perceived readiness and actual readiness.
II	To explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, and how these relations relate to academic outcome.	(1) To what extent do students in a specific program develop relations with other students and what are the characteristics of the networks formed? (2) What is the relation between students' friendship, learning and academic work networks and academic outcome in this specific context? (3) What is the relation between students' multiplex relations and academic outcome in this specific context?	Social network analysis closed-roster survey & archival data (Ladok)	There was a substantial overlap between the friendship, working and learning networks. Both uniplex friendship and multiplex (mpx) relations correlated positively and significantly with academic outcome, but the mpx relations contribute more to outcome. The tendency for homophily based on gender and ethnicity was strong and increased in the mpx networks.
III	To explore students' perception of their study-related networks, and the relation to academic outcome.	(1) How do commuter college students describe their study-related mpx relationships? (2) How do commuter college students form study-related mpx relationships?	Individual semi-structured interviews	The study-related network helped students remain engaged and the mpx relations were central to academic outcome, as they provided both task-related and emotional support. Students had small number of mpx relations they relied upon, but weak ties to other students were important as a source of inspiration and information. Several barriers to participation were found. These barriers were enablers for most and barriers for some.
IV	To explore the effects the emergency transition to online teaching during the Covid-19 pandemic had on students' study-related networks.	(1) What are the effects of the Covid-19 pandemic on students' study-related networks in two types of universities? (2) How do students describe the effects of the Covid-19 pandemic on their social network in relation to study outcome and cooperation with other students?	Social network analysis closed-roster survey & open-ended questions	Students lost 50% of their social relations during the transition to online learning, and networks became more fragmented. The most resilient were mpx relations, and these networks lost contact with each other. The transition seemed to have affected campus students more than commuter students, who had smaller networks overall. Students missed the informal interaction on campus,

Methodology

The present dissertation has a mixed-method approach, as I intentionally mixed quantitative and qualitative data collection methods to enable a more complex understanding (Shannon-Baker, 2016) of students' academic success and study-related networks in a specific context.

My research interest revolves around the subgroups of students that I have seen before me in the classroom. I first became curious to know more about how teachers, consciously and subconsciously, classify the students in broad categorizations in attempts to understand what is going on in the classroom and to make predictions about their study outcome. Later, my interest developed to focus more on actual subgroups in a student cohort, how they form, and take on different shapes and sizes, and how they seemingly affected how well the students did both academically and socially. I was curious to know more about these subgroups, their effect and how my own teaching and/or the organization of the program could be organized to enable more students to form what I understood to be supportive sub-groups. Thus, I moved from a more deductive approach, where I explored broad categorizations as possible causes of academic outcome, to a more inductive exploration of the students' subjective experience and descriptions of their subgroups in relation to academic outcome.

I started out with a set of preconceptions and hypotheses, in this case the diffuse assumptions academic staff in the program shared about what background variables explained why certain students succeeded and others did not. What struck me was that we really did not know much about the actual background of our students at all. Furthermore, we mostly do not test these preconceptions, but look for evidence in our surroundings that will confirm our views. Therefore, in the first longitudinal survey paper, I decided to test the preconceptions, my own and those of my colleagues, about student readiness and background variables and the relation to academic outcome. The theoretical background and empirical results of this paper forced me to adapt my conception of who the students are and what contributes to their success. The analysis of individual background factors alone provided a limited explanation of academic outcome, as so much social action takes place among students, and their social relations could be just as important to their academic success.

Thus, the next step in my inquiry was to move from the broad background categories to the actual subgroups. The question was how to document these subgroups. I first considered mapping the groups through observations. When I

discussed the approach in a doctoral course, a fellow participant opposed the whole idea, claiming that it would be my representation of the groups and not that of the students themselves. This discussion caused me to reconsider, to look for other ways of formulating my question and how to best answer it, finding a method that would be based on the students' own experience of their relations, rather than my deduced perception of their groups.

Therefore, I decided to use Social Network Analysis as a research method to map the study-related networks. First, I used a quantitative data collection method to explore how the networks related to student background factors and academic outcome. Then I used a qualitative method to let the students express how they experienced their study-related relations.

Epistemological assumptions

The mixed-method approach has evolved as a third methodological approach in response to the dichotomy between the quantitative and qualitative research approaches, and a belief in the possible value of both (Johnson & Onwuegbuzie, 2004). Mixed-method research has a less clear connection to one philosophical paradigm, as one main standpoint is that the researcher should be free to choose the paradigm and research method depending on the research question (Johnson & Gray, 2010). However, mixed-method research is commonly underpinned by different strands of pragmatism (Biesta, 2015), realism or critical realism (Shannon-Baker, 2016). Pragmatism is outcome oriented (Johnson & Onwuegbuzie, 2004), emphasizes shared meanings and joint actions, and Biesta (2010) claimed that pragmatism should be seen as an approach, a philosophical tool, rather than as a paradigm, and that the ultimate purpose of engagement in philosophical analysis should be to find practical solutions to problems.

Thus, Pragmatism offered me a way of embracing the understanding that different paradigms can have something to offer and that the use of multiple paradigms may contribute to more nuanced understandings of a specific problem or phenomenon (Johnson & Onwuegbuzie, 2004). This means that it is possible for me to adhere to both the Realist ontological view that "there is a world that exists independently of our perceptions, theories and constructions" and a Constructivist epistemology that implies that "our understanding of the world is inevitably a construction from our own perspectives and standpoints" (Maxwell & Mittapalli, 2010, p. 150).

In addition, it offers me a possibility to acknowledge my own subjectivity throughout the research process, but also my aim to be objective in the collection and analysis of the data (Shannon-Baker, 2016). Thus, the overall research approach in the research process was that of abduction, which is in line with the understanding of Pragmatism, that there is no pure deduction or induction, but rather a process in which the researcher uses certain classifications and theories to explore the

empirical material, and at the same time remains open to learning from the material and willing to develop the theoretical understanding (e.g., Alvesson & Sköldberg, 2009)

In sum, the use of abduction and a mixed-method approach allowed me to form an increasingly rich understanding of the phenomena in question.

Research design - case study approach

This dissertation is a compilation of four papers that involved various research methods. Overall, I argue that this dissertation has a case study approach. First, the case study is preferred when examining contemporary events, and its strength is that it can deal with a full variety of evidence (Yin, 1994). Furthermore, case studies can be based on any mix between qualitative and quantitative evidence and are suitable when investigating a phenomenon in its real-life context. It is not a matter of whether a case study is qualitative or quantitative, but rather the choice of what to study and what we can learn from doing so (Olsson, 2007). The aim of the present dissertation was to explore how various factors in a specific context, a cohort of business students in a teaching intense university, contribute to academic outcome. The aim was to ask what implications the results would have for my own teaching practice, and for my colleagues and the said study program; as such, this case could be said to partly illustrate the complexity of factors that teachers encounter in their classrooms.

Further, the case study is well suited for inquiries into relationships and processes. It enables a systematic exploration of a specific context and generates an understanding of it. There has been a drift towards multi-site research in higher education, which means that there is a risk that we miss out on the "science of the singular" (Cousin, 2009), that is, research aimed at grappling with the complexity and depth of a unique case. According to Simon (1996), although the case study is not suitable for grand generalization, its result can be used to either confirm or contradict a grand generalization. In this case, the factors explored are well researched, but the insight into this specific context will enable an understanding of similar cases or situations (Cohen et al., 2007). The specific context is a heterogenic cohort of business students in a teaching-intensive university where students largely follow the same courses for three years. The timeline is visualized in Figure 2.

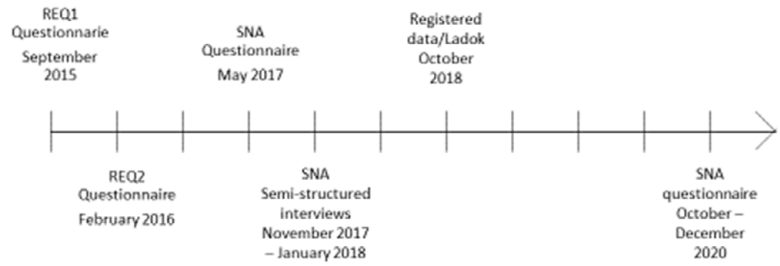


Figure 2 Timeline for the dissertation

Yin (1994) classified case studies as either exploratory, explanatory, or descriptive, depending on the research question. The exploratory case study is used to generate hypotheses and the explanatory case studies to test theory, whereas the descriptive case study is used to describe a specific phenomenon in a particular real-life context (Cohen et al., 2007). The present case study is mainly descriptive, although parts of the results also discuss how certain factors co-vary and possibly predict academic outcome. Taken together, the papers present a picture of the complexity of engagement and academic achievement rather than simple cause-and-effect explanations.

Thus, the present dissertation had a mixed-method approach and involved both quantitative (I, II, IV) and qualitative (III, IV) research designs. The perspective is that of the students and the individual level. Table 5 presents an overview of the designs and methods used. The included papers used a variety of data collection methods, such as quantitative survey data (I, II, IV), register data (I), individual interviews (III), and qualitative survey material (IV). Data analysis involved statistical analysis in SPSS (I, II, IV), Social Network Analysis in Ucinet (II, III, IV), and qualitative content analysis (III, IV). The data collection methods will be further discussed in the remainder of this chapter.

Table 5 Overview of research designs and methods

Papers	I	II	III	IV
Designs	Longitudinal, descriptive & quantitative (REQ)	Cross-sectional, descriptive, and quantitative (SNA)	Cross-sectional, & qualitative	Cross-sectional, descriptive, and both qualitative and quantitative
Sample	Cohort of freshmen business students (n=184)	Cohort of sophomore business students (n = 109)	Senior business students, (n = 13)	Senior business and STEM-students, (n = 97)
Data collection	Survey & archival data (Ladok)	Social network analysis closed-roster survey & archival data (Ladok)	Individual semi-structured interviews	Social network analysis closed-roster survey & open-ended questions
Data collection period	Sep 2015-Oct 2018	May 2016	Nov-Dec 2016 & Jan 2017	Nov - Dec 2020
Analysis	Descriptive statistics, Paired-sample T-test; standard Multiple regressions	Quadratic Assignment Procedure (QAP) & Degree centrality in Ucinet; Descriptive statistics, Bivariate correlation & multiple regressions	Qualitative content analysis	Descriptive statistics, Chi-square tests, Independent-samples t-tests, Chi-square tests, Degree-centrality in Ucinet & qualitative content analysis

Research context

This is mainly a case study of a business program at Kristianstad University (HKR). This means that all four papers were conducted in the HE context of southern Sweden. Paper I-III focused one cohort of business students at Kristianstad University (years 2015-2018), whereas Paper IV was a comparative study between business students at Kristianstad University and students enrolled in two programs at the Faculty of Engineering at Lund University (Fall 2020).

The business program, HKR (Paper I-III)

Kristianstad University (HKR) is a teaching-intensive institution established in its present form in 1977, but has roots dating back to 1835 (early teacher education) and 1893 (nursing school). It is situated in the south of Sweden, about 45 minutes by train north-east of Lund University. The focus of the university is on Bachelor-level professional education, such as pre-school and teacher education, nursing, and business administration, where graduates have a good labor market, but it also offers smaller more niche programs and online education. There are about 50 programs at the undergraduate and graduate level, and currently also two newly established doctoral programs (health science and teacher education). In total, there are currently approximately 15,000, both full-time and part-time, students enrolled, about 40% of whom are enrolled in online courses and programs. HKR has a strong local focus, where about 70% of students come from the region and remain in the same region after graduation. At the same time, a large share of the students and

faculty commute to school either by car or train, many from larger metropolitan areas between 1 and 2 hours away (HKR, 2022).

Although HKR is not a full university[8], its faculty members conduct research in several areas such as education, health and social science, biomedicine, and business. Currently, the university has three research platforms and 12 research environments.

HKR students come from various backgrounds. Due to the focus on pre-school and primary school teacher and nursing education, 72% of students are female. About one fifth of the students are first- or second-generation immigrants. Students are generally also to a larger extent from a non-academic background. In sum, about 46% of the student body either have non-academic and/or immigration backgrounds (HKR, 2022).

The business program was first introduced in 1985. In the late 1990s, it developed into its current structure with four specializations in the first year (Accounting and auditing, Bank and finance, International business and marketing, and Optional specialization) and about 500 undergraduate on-campus students. Students from the fourth optional specialization then join one of the other three specializations in their second year. Most of these students choose to join the Accounting and auditing specialization, and thus this specialization is almost twice as large as the other two. The business program enrolls about 200 new students each academic year. In addition, there are another 2400 students enrolled in various freestanding courses, mainly online. This means that the campus taught undergraduate program constitutes only 16% of the total number of business students.

There are about 35 faculty employed to teach in the business program each year, where 57% are lecturers, 26% associate professors, and 9% professors. In comparison, the School of Economics in Lund – the university and business school that is situated closest to HKR – has 11% lecturers, 44% associate professors and 21% professors (EFL, 2020). The business faculty at HKR has diverse research interests such as: entrepreneurship, governance, policy and strategy, industrial economics, finance, auditing, corporate social responsibility, and other marketing related areas.

The program has a strong focus on quality in teaching, and as a result, the business program was one of three undergraduate business programs in Sweden that were deemed excellent in the latest national quality evaluation carried out by the Swedish National Agency for Higher Education in 2011-2012, together with the business programs at Stockholm School of Economics and Jönköping International University. According to the evaluators, the students' Bachelor's theses held a very high standard on four out of five learning objectives. The program was especially

[8] In Sweden, the difference between a university (universitet) and university college (högskola) is that a university has a general permission to award degrees at the doctoral (third cycle) level in any subject. A university college has to apply for permission from the Swedish Higher Education Authority to award doctoral-level degrees in a specific subject area.

commended for its academic skills track and the way it made sure to fulfil all learning objectives stipulated by the Higher Education Ordinance, throughout the whole program and in various courses (HKR, 2012).

In the specific cohort explored, the class of 2015, few of the students live on or close to campus, and in this cohort about 70% commute to school between 1-3 hours a day; 37% have an immigrant background, and only 30% have two parents with an academic degree. The average Swedish scholastic aptitude test score of the cohort is significantly below the national mean score. The class of 2015 was seen as representative of both previous and subsequent cohorts.

Students were divided into three classes of between 40-70 students each, which they followed throughout their full 3-year program. It is a full-time program (180 credits) that runs for six semesters, where each semester is typically divided into 3-4 7.5- or 15-credit modules. Students normally take one course at a time, and a full-time 7.5-credit module normally runs for 5 weeks, and a 15-credit course for 10 weeks. The number of hours of instruction differs, but students should be offered a minimum of 9 hours of teacher-led classes per week, and the rest of the time is to be devoted to group work and self-study. It must be noted that this organization of courses is typical of this specific program and that the organization of modules and division of credits differ across business programs in Sweden and even across different programs and subject areas within HKR. Instruction is normally a mixture of lectures, seminars, and workshops.

The whole cohort follows the same courses in the first year, although they are sometimes split into smaller classes according to specialization. In the second year, students take three courses together and in the third year one. The structure of the program might change slightly, but overall, this has been the structure at least since the Bologna process in 2007.

This means that the context under study differs from those in the many reported research studies on student social networks in university settings, where students had more flexibility to choose their courses, and/or where students to a larger extent live on campus and form networks in their living arrangements/dormitories, in extra-curricular activities or in organized learning communities.[9]

The student population of the present study was less culturally diverse than is the case in studies focusing on ethnicity or student social networks and ethnic background. The Swedish Higher Education Agency advocates widening participation and recruitment based on gender, social background, foreign (non-Swedish) background, and domicile (counties and municipalities). Students with foreign background are categorized as: a) born in Sweden with two foreign-born parents, b) immigrated before 7 years of age, or c) immigrated between the 7 and 18 years of age (Swedish Higher Education Authority, 2019). On average nationally, the proportion of native students at Swedish universities was 76% in 2016/2017,

[9] see for example McCabe (2016) for a description of a large public research university in midwestern USA.

students born in Sweden with two foreign-born parents 9%, and 14% were students who had immigrated to Sweden (both b & c).

Students were purposely divided into work teams during their first semester, mixing students by gender, language background (native/immigrant background) and place of residence (commuter/on campus) to enable them to form study-related relations. Together, these groups solved different study-related tasks.

Here it is noticeable that I have problems with what terms to use. There are several reasons. First, when I carried out Paper I it was politically difficult to discuss students of immigrant background. As I was interested in learning more about the diversity of the group, but also in language background in relation to academic writing/language proficiency I decided to inquire into their language background. Second, in contrast to the US or the UK for example, where ethnic background is often discussed, this was, and still is not, unproblematic. Instead of discussing different ethnic groups official agencies such as the Swedish Higher Education Authority use the terms Swedish or foreign background or talk about immigrants rather than pointing to any specific ethnic background.

Since 2015 it has become more accepted to discuss immigration issues, but it is difficult. For example, there is no equivalent to the UK term BAME (Black, Asian, Minority, Ethnic). This glide is evident also in the terminology in my papers, where I moved from using the terms language background and non-native students to discussing student of immigrant background. I am unsure if the distinction is important, as for me the main aim has always been to focus improvements in the program for the best of all students.

Context Paper IV

Paper IV was a comparative study carried out in two cohorts of students from a research-intensive technical university, Lund University's Faculty of Engineering (LTH), and one cohort of business students from a teaching-intensive university, Kristianstad University (HKR). The research-intensive university is one of the oldest and largest research universities in the country, with over 40,000 students. The teaching-intensive university is a younger, regional university focusing mainly on undergraduate education. It has approximately 15,000 students. The composition of enrolled students differs between the universities. In contrast to students at the research-intensive university, students at the teaching-intensive university more often come from non-academic backgrounds. Students at the teaching-intensive university have relatively lower grade point average (GPA) from upper secondary school and lower mean Swedish Scholastic Aptitude Test (SweSAT) scores; they are also more likely to commute longer distances to school.

Ethical considerations

As an educational researcher, I see research as an intervention into the lives of the participants, regardless of the data collection method. Clearly, I need to adhere to ethical principles stipulated by, for example, the Swedish Research Council (Swedish Research Council, 2021), that is, the demand for information, approval and confidentiality. In addition, the experience should be respectful but preferably also enjoyable, and at best it should contribute in some way to the life of the participants (Hoffecker et al., 2015).

The surveys

The surveys carried out in Paper I (REQ1 and REQ2) and II (SNA), and that provided the secondary data used in Paper III, were all carried out in a classroom setting. The reason for this choice was twofold; first, this approach enabled a higher response rate, which would possibly lead to higher reliability. A high response rate was especially important for the analysis of the social networks in Paper II (Rienties & Tempelaar, 2018). Second, the classroom situation enabled me to explain the rationale behind the surveys and to answer any questions about the questions in the survey as the students worked their way through the questions. Furthermore, it enabled me to clearly talk to the students about informed consent, ensure confidentiality in the storage and processing of the collected material, and that the material would not be used for purposes other than research. Furthermore, I explained how long it would take and that they could stop answering the survey at any point without having to say anything or explain why, in line with the guidelines of the Swedish Research Council.

Hopefully, the fact that I took the time to talk to students as a group but also individually during the sessions meant that most students found the task interesting and pleasant at best, or insignificant at worst. If they in any way found the questions problematic my hope is that they would have openly protested or stopped answering the questionnaire. I can never be sure that that was the case, but as 213 students were present in the classroom when I distributed REQ1 and only 197 filled out the questionnaire, I hope this is a sign that students did not feel pressured to comply. It must be noted that I asked permission of a colleague to distribute the survey during a lesson, I was not responsible for the specific lessons or the course, nor was I involved in grading of any kind at the specific point of time when the questionnaires were distributed.

With that said, it is important to acknowledge that some students may have felt pressured to fill out the surveys to comply with what the teacher said and wanted, in fear of future grades, or simply because they went with the flow and did what all the other students did.

Did the surveys have any potential to contribute anything to the participants? To a certain extent I think they did in different ways. The two surveys related to Paper I regarded how students perceive their readiness for HE studies. The surveys enabled students to reflect on their study skills, such as time management, reading or computer skills upon entering HE, but more importantly after one semester of studies. The second questionnaire gave them the opportunity to reflect on their learning during the first semester, which is a type of metacognitive reflection students are rarely asked to do, albeit important for life-long learning.

In Paper II, students were asked to mark students they were friends with, had learned from or worked frequently with. The survey questions allowed students to reflect on the relations they had in the cohort. The subsequent interviews revealed that students had found it interesting to map their network, and that they learned something about the composition of the cohort.

There are problematic issues with both questionnaires that could potentially have caused conflicts or negative feelings in the participants. In Paper I, weak students could potentially have felt disheartened when they filled out the questionnaire, as the questions may have reminded them of their fear of failure. At the same time, the high ratings on the scales rather indicated that students felt confident in their skills rather than the opposite. More problematic were questions regarding language background and educational level of parents, which may have caused individual students to feel stigmatized.

Regarding Paper II, students with few or no relations may have felt ill at ease when answering the social network survey. In that situation, it became blatantly obvious for some participants that they had few friends in school, which may have been problematic for them. It was impossible for me to know whether that was the case. As in any other classroom situation, I circulated among and greeted all students, and asked them if everything was ok. Hopefully this made every student feel included and welcome, something that I find important to achieve in any classroom situation.

One important ethical issue pertaining to SNA surveys is how to handle data on the relationship between participants and non-participants. Non-participants have not agreed to participate in the study, yet participants provide information about their relationships and may also discuss details of their relationships in follow-up interviews, for example. Clearly, this situation means there are potential privacy and ethical issues, regardless of whether the choice to not participate was conscious, as discussed in Korir et al. (2020). The main reason for the researcher to still use the data is that the loss of the relational data referring to all non-participants would severely affect the metrics of both the whole network and on ego-network level. This is also the reason why I chose to use all the relational data collected by the SNA surveys (Paper II & IV), which is one way of dealing with the dilemma according to Korir et al. (2020). A second way would have been to ask non-participants for permission to use the data after the data collection took place, and

then remove any responses should they still opt out. A third way would have been to remove all non-responders.

Neither of these options seemed feasible, as I wanted as complete a picture of the cohorts as possible. A further limitation of the data would have led to a limited understanding of the complexity of the networks, which would have affected any conclusions drawn. I found that problematic, especially as the possibility that any student or teacher would identify any of the students in the networks was deemed limited. The images of the networks were discussed with students who participated in the interview, and they were not able to identify themselves in the friendship networks. Therefore, it did not seem likely that a non-participating student would be able to do so. Furthermore, the networks were only used as a discussion point concerning how they experienced the overall cohesion of the cohort and not individual points in the networks.

Paper IV involved an online survey, as it took place in the middle of the Covid-19 pandemic in fall 2020. I visited five online lectures to present the paper in the same way I had done in the physical classroom in previous studies. Students were informed that they would be sent a letter with a link to the study via the learning platform used in their course. The message also included an introduction explaining the rationale behind the survey, a presentation of the research aim and team, and informed students about how the material would be used; it ensured confidentiality in the storage and processing of the collected material, how long it would take, and told them they could stop answering the survey at any point.

The research team had asked the teacher responsible for the course for permission to approach the students and cleared access with the head of department. This survey regarded students' network relations and how these had been affected as teaching transitioned online. The survey also included open questions that allowed students to reflect on how the transition had affected their cooperation with other students, academic achievement, and sense of well-being.

Like with Paper II, the questions regarding relations maintained may have caused conflicts or negative feelings in the participants, especially if that person had limited relations in the first place or had lost a large share of their relations due to the transition to online teaching. This was also the case. Some students did feel concerned. At the same time, the open questions enabled students to give voice to their concerns and to reflect on their situation, which may also have been helpful to them. In two of the three cohorts, the response rate for the online survey was much lower than for the surveys that took place in the classroom, as is typical of online surveys (Cohen et al., 2007). The response rate in the third cohort was much higher (70%) mainly because one person in the research team had recently taught a course for that cohort. Here it must be noted that that person did not handle the data collection, and only saw results and responses in aggregated form, so as to protect the anonymity of the respondents.

The interviews

The students interviewed had all taken the initial social network survey the previous spring, so they were familiar with the study. I approached the students first via e-mail and scheduled a personal meeting with the 15 individuals who had volunteered. The meetings followed the same outline. I first engaged in some small talk with the students, then I informed them of the aim of the interview, and that they could stop the interview at any point without providing an explanation. They were also asked to sign a consent form before the interview took place, and I asked them if they were comfortable with me recording the interview. All interviews, which lasted between 35-60 minutes depending on how talkative the students were, were recorded and transcribed. Students were given aliases to ensure confidentiality and only I have access to the key.

Access and trust were easily established. I already knew the students well because I had taught in various courses and modules throughout their first two years in the Business program. This means I had an insider position, which entails a possible problem of trustworthiness regarding students' accounts, given the unequal power relation (Fontana & Frey, 2000). I was a teacher rather than researcher vis à vis the students. This type of research can be both advantageous and problematic. Clegg and Stevenson (2013) wrote that insider researcher means having "a fish in the water, part of the habitus, with a feel for the rules of the game" (p. 7). At the same time, the power relation problem is evident in all types of interviewer-interview relationships and any interview situation, which can never be fully objective or neutral (Olsson, 2015).

The semi-structured interview format allowed for a relaxed atmosphere where students could talk in depth about their experiences. It also allowed the dialogue to deviate, much like a normal conversation (Taylor & Bogdan, 1998). I used an interview guide as a loose structure for the interviews, but questions were slightly paraphrased in each interview situation to better fit the conversation. If students touched upon anything sensitive, I often let them talk even if the conversation strayed off topic, showing my honest interest and concern, before moving on or steering back to the actual question (Cohen et al., 2007). I think that, in this respect, the interview sessions were both respectful and enjoyable, but also contributed to the life of the participants, as described by Hoffecker et al. (2015).

Many students spontaneously said it had been interesting to reflect on their time as students, their relations and how they had progressed. In one instance it was painful, as one student expressed regret and that she felt restricted to one study friend and a handful of acquaintances in class. My hope is that it was still a good experience, as I let her describe her experiences without passing judgement. In other cases, the discussion enabled students to reflect on a positive development. One example is Monawar. During the interview, he smiled, leaned forward, and became more energetic when he reviewed the network survey. He pointed to all the students he had cooperated with in the third year and added: "it's fun to discuss things."

This brief snapshot from one of the interviews points to the importance of what took place in the interview apart from what was said. Sometimes facial expressions, tone of voice, position or even the energy in the room strengthened or contradicted what was said. I attempted to capture these moments in short notes during and directly after the interview, which were then included as short memos in the interview transcriptions.

Like with relational data collected in the SNA survey, use of the information from the interviews could potentially be problematic, as participants referred to non-participating friends. At the same time, the handling of the empirical material from the interviews does not differ from what happens in any other type of interview situation, as interviewees often discuss matters that concern other people who have not consented to be part of the study. The students who took part in the interviews discussed their relations with other students in the cohort, most of whom had given their consent to participate in the SNA survey but did not want to be interviewed. This situation could therefore give rise to privacy issues (Korir et al., 2020). Thus, it was even more important to ensure that the quotes used in the articles focused on the experiences of the participants rather than on what went on with other students in the cohort. Here I agree with Borgatti and Molinas (2003, in Korir et al., 2020), who stated that participants have the right to their own experiences and perceptions and have the right to share these.

Part I: Readiness

Paper 1 sprung from the questions I frequently pondered regarding why so many of our students had troubles during their first year and yet seemed reluctant to take part in remedial activities, or simply to listen to our advice or even take advantage of all the extra material or help offered on the learning platform. I was also curious to know more about our students, as I doubted many of the coffee-room explanations, such as "these are all students from non-academic backgrounds" or "it's the commute. All commuter students do less well than non-commuting students" or "Upper secondary school does not prepare them properly. They don't have the academic skills needed." Further in in the discussion, it was obvious that we did not know how many students commuted or where they lived or anything about their background. As it turned out, sitting there in the coffee room, we had very little knowledge of who our students were, let alone their perception of their own readiness and how that changed when they met – for some – the harsh truth of HE studies.

In this section, I first present the theoretical perspectives that constitute the foundation of the paper, then the research questions of Paper 1, which explored the students' perception of their readiness for HE studies in relation to academic outcome and socioeconomic and academic background factors. The chapter will also briefly present the results and contribution of the paper as well as a reflection on how this paper is related to the subsequent papers. For a more detailed report of the statistical analyses, please see the appended article (I).

Theoretical points of departure

Paper 1 explores student readiness in relation to academic outcome. Therefore, the chapter will start with a brief discussion of this concept. Thereafter, I will discuss academic outcome in relation to readiness and finally explain the contribution of this paper. More specifically, the paper explored the following research questions:

(1) In this cohort, how do students appraise their readiness prior to their studies?
(2) In this cohort, how do students appraise their readiness after one semester of study?

(3) In this cohort, to what extent does students' self-rated readiness predict academic outcome?
(4) In this cohort, which background factors best predict academic outcome?

Readiness for higher education and academic outcome

One aspect discussed in relation to FYE is the transition gap or the difficulty of moving from secondary to tertiary education. How well students manage this transition depends on how well prepared they are academically, that is, on their Readiness for HE. Readiness can be defined as how ready students are to meet the challenges of HE, academically and socially, and what expectations students have concerning their HE experiences. Another definition of student readiness is how ready students are to undertake the challenges of HE studies and succeed without remedial interventions. Success, in this case, means completing a required, credit-bearing course in order to continue to the next course (Conley, 2011). Research has consistently shown that many students fail to meet the requirements of their first module, and such failure results in high drop-out rates (e.g., Barrie, 2004; Jansen & van der Meer, 2007; Swedish National Agency for Higher Education, 2009). This failure is explained by referring to a mismatch between the HEI's and the student's expectations and skills, and the fact that students lack what Barrie (2004) referred to as 'precursor abilities,' which include reading, presentation, Information and Communication Technology (ICT), writing and information processing skills.

Efforts have been made to minimize the gap, for example, in Australia (Krause et al., 2005) and the Netherlands (Jansen & van der Meer, 2011). Moreover, in Sweden (Skolverket, 2016) school reforms were introduced in 2011 to better prepare students for HE. Despite this, both students and teachers alike experience a mismatch between student and university expectations (e.g., Barrie, 2004; Jansen & van der Meer, 2007; Swedish National Agency for Higher Education, 2009). I also experienced this mismatch in my classroom and was interested in exploring whether students changed their perception of their skills or readiness as they gained more experience of HE studies. This question sprung from the initial questions I formulated in the classroom (see Introduction), more specifically: *How do students perceive their readiness for HE studies, and do they change that perception as they gain experiences of what it entails to be a student?* If they do, why do they fail to take part in non-compulsory teaching sessions where they could obtain the instructions and training they need?

Many instruments have been developed that attempt to measure student experiences and expectations in various ways to predict academic outcomes (Entwistle & McCune, 2004). Le et al. (2005) constructed the *Student Readiness Inventory* (SRI) based on psychosocial and study skills identified in a meta-analysis by Robbins et al. (2004). The aim was to construct an instrument that could predict both academic outcome (GPA) and persistence. In a follow up study, the SRI was found to significantly predict college GPA (Petersen et al., 2006). One drawback of

the original instrument was that it consisted of 3 domains (Motivation, Academic-related skills, Social engagement), 10 constructs and 305 items, which made it time consuming to administer (Le et al., 2005). A follow-up study used a limited version of the SRI instrument with 108 items, but the instrument is still extensive if the goal is to have an easy-to-use predictive instrument.

One less extensive instrument is the Readiness Experience Questionnaire (REQ), which Jansen and van der Meer (2011) developed to explore student expectations and readiness. The readiness part, which was used in Paper 1, is based on the assumption that self-efficacy is related to motivation and performance attainment, as explained by Bandura and Locke (2003). Studies on self-efficacy, based on Bandura's Self-efficacy Theory, have shown that students' self-efficacy beliefs, or their self-confidence that they will succeed in their studies, are connected to academic success (e.g., Freudenberg et al., 2010; Simpson, 2006). Likewise, Weine's Attribution Theory implies that the more you feel you have the required skills for a task, the more motivated you will be and the more likely it is that you will succeed (Jansen & van der Meer, 2011). Furthermore, Le et al. (2005) found a very strong correlation between the two factors Motivations and Skills. Thus, there seemed to be a possibility that students' ratings of their Readiness, based on their perception of their academic skills, would be a plausible brief predictive instrument teachers could use.

The skills inventory of the REQ measures student readiness on six scales: Time management, Written communication, Group work, Information processing, ICT and Verbal communication; these have been found to correlate with students' perception of readiness, study behavior and study outcome (Jansen & Suhre, 2011; Jansen & van der Meer, 2007; Jansen & van der Meer, 2011), in line with the findings of Le et al. (2005). Jansen and van der Meer (2007) found that students who performed better have better study behavior and rated themselves higher on time management and information processing. Hence, I wanted to further explore whether the REQ instrument, at least regarding time management and information processing skills, could be used to predict academic outcome.

The aim of Paper I was to use the six skills scales of the REQ to explore student self-rated readiness, how this perception changed (if at all) during the first semester of studies and the correlation with academic outcome. A further aim was to identify which background factors best predict academic outcome in this cohort of business students, the goal being to learn more about this specific cohort of students.

Paper I – Data collection, analysis & results

Aim and research questions

The aim of Paper I was *to explore the students' perception of readiness, socioeconomic background factors, and how these factors were related to academic success.* The research questions developed to fulfill the aim of the study were:

(1) In this cohort, how do students appraise their readiness prior to their studies?
(2) In this cohort, how do students appraise their readiness after one semester of study?
(3) In this cohort, to what extent does students' self-rated readiness predict academic outcome?
(4) In this cohort, which background factors best predict academic outcome?

Data collection, participants & procedure

Paper I was a longitudinal study based on a validated instrument measuring student self-assessed readiness. Data were collected in three steps: students filled in a questionnaire measuring their readiness for HE studies both prior to and after their first semester of studies (REQ1 – early September 2015; REQ2 – late February 2016). Academic outcome measured as total credits registered during the period was retrieved from the university computer system LADOK in October 2018, when students had completed their Bachelor-level studies.

Paper I was partly based on archival data from Ladok, a student administration system used in all universities in Sweden to measure previous achievement and academic outcome. First, students' upper secondary school grade point average (GPA) and SweSAT were used as academic predictors. GPA was the admission entry points registered in the university student administration system; it is an average of the upper secondary school grades. Second, Ladok data on student academic outcome, measured as completed credits within the specific business program, were used as the dependent variables. The cut-off date was 31 October 2018, that is, three years after enrolment, and after the final resubmission date for the Bachelor's dissertation that same year. This is then much less generous than the graduation rate as measured by the Swedish Higher Education Authority, which measures graduation rate three years after graduation (Swedish Higher Education Authority, 2018). The reason for this approach is that I was interested in how students managed their studies in nominal time, that is, three years of study in a Bachelor's program. The archival data were then used as academic predictor and dependent variables also in Paper II, as secondary data.

Participants were students who had enrolled in the business program at Kristianstad University in fall term 2015. Data collection took place at five time

points (*Figure 2*, p. 32). In *Paper I – Readiness Experience Questionnaire (REQ*) – data collection took place at two time points (REQ1 and REQ2) in a cohort of 213 business students who were enrolled in the business program at Kristianstad University in fall term 2015. The sample for REQ1 was 181 students who were approached during a lecture. They were informed about the purpose of the study and told they had the right to decline participation. 181 students answered the initial survey (85% response rate). About 51% of the students were females and 31% had an immigrant background. The follow-up questionnaire was also distributed in the same cohort during a lecture at the beginning of the second term, following the same procedure (n = 113; 54% response rate) for REQ2 (See Methodology chapter for further details on participants and ethical considerations).

Statistical analysis

Paper I involved statistical analyses, which were all carried out in SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24 Armonk, NY: IBM Corp.).

The two conditions, ex ante and ex post readiness scales, were first compared in a paired sample t-test. Second, the individual contribution of the REQ scales and student self-efficacy beliefs about academic outcome was assessed in a standard regression. Academic outcome was the dependent variable and the self-efficacy predictors, the REQ scales and student self-rated readiness were the independent variables. Third, both academic and socio-demographic predictors were entered into a multiple regressions model exploring their individual contribution to academic outcome. Differences were considered statistically significant if $p < 0.05$, and confidence intervals had a 95% confidence level.

Results

What is the relation between students' perceptions of readiness, socioeconomic background factors, and academic success?

Students appraised their readiness for HE studies both prior to and after one semester of study on six scales. A paired sample t-test indicated a significant difference in scores on the scales Time management, Written communication, Information processing and Verbal communication. Prior to their studies, students felt most certain about their readiness for HE studies regarding ICT, Time management and Group work, and less sure about Written communication, Information processing and Verbal communication. However, this perception changed after having completed their first semester. After one semester of studies, students' ratings of time management decreased, whereas the ratings of Written communication, Information processing and Verbal communication increased. The higher ratings on these scales could be attributed to the fact that teaching efforts

during the first semester focus on academic writing, format and referencing, and information search; thus, students felt more confident regarding those scales after one semester. The score for ICT remained high. There were no differences due to the various background factors.

Neither REQ scales nor readiness predicted academic outcome after three years. First, standard regressions were performed with academic outcome as the dependent variable and the self-efficacy predictors (student readiness and REQ1 and REQ2 scales) as independent variables. The result was the same for all students, native speakers and students of immigrant background alike. Second, both academic and socio-demographic predictors were entered into a multiple regressions model. For all students, previous GPA, socioeconomic background and time spent commuting were significant predictors of academic outcome. For native speakers, the result was like that of the whole sample. The three significant predictors – previous GPA, socioeconomic background, and time spent commuting – were predictors of academic outcome. However, for students of immigrant background, there were no significant correlations between any of the predictors and outcome, not even GPA. Likewise, neither time spent commuting nor parents' social background predicted academic outcome for this group.

Finally, only 26% of students enrolled earned 180 credits within the nominal time. The overall share of students of immigrant background declined slightly during the 3-year period, but the real effect was evident when analyzing to what extent students earned the nominal 180 credits in three years. Here only 15% of students of immigrant background enrolled in the first year earned 180 credits in nominal time, compared to 34% of the native students.

What did I learn?

The aim of Paper I was to explore whether the REQ instrument could be used to predict academic outcome. It could not. Still, the study was useful, as I learned several important things about my students and these have impacted both my teaching practice and how the program works with academic skills during the first year.

First of all, I realized that students did change their perception of their skills, albeit not in the direction I thought they would. Ratings on most scales increased, but for Time Management they decreased. This may mean that students felt they had developed their skills during the first semester, especially their writing, presentation, and information search skills. Because the program focuses on developing academic skills during the first semester, this was an important and positive finding. Furthermore, students seemed to explain failure as bad time management rather than as realizing they needed to improve their academic skills. At the same time, it could also mean they realized they needed to work more and spend more time on their studies, which is positive.

Regarding background factors that could explain academic outcome in the cohort, the most important thing I learned was that, in line with previous research, GPA from upper-secondary school was the strongest predictor, but only for native students. Also, time spent commuting had an effect, although perhaps not as great as expected. Most surprising was that an immigrant background had such a great impact that it seemed to outweigh any of the other predictors. Frankly, the gap between native and immigrant students was larger than I had expected, which I found troubling, and it indicated that something had to be done. The fact that only 26% of all students took their degree within the nominal three years meant to me than it was not only immigrant students who struggled, but a large share of students lagged behind, for different reasons, but surely due to lack of academic skills and academic literacy when they entered HE. The trouble was that the study also indicated they truly could not gauge their own skill level.

One implication for my teaching practice was the need to be more explicit regarding what is expected of the students, by use of sample texts and formative feedback provided by teachers as well as peers in peer discussions and peer-review sessions. In this way, students had more opportunities to gauge their skills on several occasions during the first year. The paper also led to more work with literacy development throughout the program by using other students as study mentors, but also simple teaching interventions in which teachers, for example, help students get an overview of the textbook or using buzz groups during lectures where students discuss important concepts or questions.

I had now learned more about my students, the composition of the cohort and about readiness. The development of my teaching practice had directed my focus to the importance of formative feedback not only from teachers, but also from peers. Success in HE does not only entail linguistic or writing skills, but also the ability to decode "the language of education," that is, to know what is important and how to behave to succeed. This social code is something students learn from other students rather than from teachers. Engagement and academic success depend not only on factors such as study skills and course alignment, but also on socio-cultural circumstances related to whom you interact with in class. As Kahu (2013) pointed out, student engagement and success are deeply embedded in a social context. Therefore, studies looking at specific student populations are needed to determine what characterizes specific student cohorts and the groupings among them. Who are they and what drives them? How do they form relationships, with whom and why? What implications do these relations have for the students' view of what it means to be a student and to study the specific subject area? Thus, I turned my attention to the social aspects of the classroom, which I will discuss in more detail in the next chapter.

Part II: Study-related relations

If student self-reported readiness does not appear to be linked to academic outcome, as was often the hypothesis formulated in my coffee rooms, then what is? Given that language, but also commuting, appeared relevant, I decided to focus more on what happened during the studies. As described above, there is a tendency for students who need supplementary support not to participate in such activities, I decided to focus on students' social contexts, that is, the other students in the cohort. Becher and Trowler (2001) as well as Roxå and Mårtensson (2015) and subsequent studies on HE teachers have shown that such teachers rely on a few trusted colleagues when making decisions about research and teaching. Could it be that students also make their decisions about study effort, degree of engagement and ambitions in similar small networks of trusted fellow students? To open this black box, I had to move into the realm of network studies and social network analysis.

In this section, I first present the theoretical perspectives that constitute the foundation of papers II-IV. Then I present the aims and research questions, data collection, analysis, and results of each paper. After the presentation of each paper, there is a reflection on how the paper is related to the subsequent papers. For a more detailed report of the statistical analyses, please see the appended articles (II-IV).

Theoretical points of departure

This section presents a brief introduction to social network analysis (SNA) in higher education and a section with definition of concepts relevant to the papers in question. Finally, a brief overview of research on student social networks and academic outcome is presented.

Social network analysis – a brief introduction

Social network analysis (SNA) involves a set of methods used to analyze relational data, that is, contacts, ties, connections, or group attachments between agents in a relational system (Scott, 1991). These agents, or social actors, can be individuals, such as students, politicians, or researchers, but also organizations or groups, such as families or households. The linkages between these actors refer to the structure of the relationships (i.e., size of the network or type of interaction), but are at the

same time defined by the content of that relationship, for example, social capital or social support (Hollstein, 2014). In the case of the present dissertation, the relational system is the pattern of relations within a student cohort, measured as, for example, the network's size and centrality for individual students. The relationships involved both affective (friendship) and instrumental (work/learning) support. SNA has been widely used in a range of fields, for example, anthropology, medicine, sociology, history, economics, communication, and education (Hollstein, 2014).

SNA in HE is fragmented, according to a review by Biancini and McFarland conducted in 2013. They pointed to how SNA allowed for a social understanding of educational settings, and studies included in the review explored the social networks of students, staff, faculty as well as relationships between research groups and universities. There was early work on both student and faculty networks, but notably more work on faculty than on student networks. They further found that there was no well-defined cohesive research community, and that almost all work included in the review was of Anglo-Saxon origin, mainly from the US.

According to Biancini and McFarland (2013), the aspects studied included the role of housing and its effect on network formation and the impact of university studies, for example, the development of political beliefs during the college years or how education affected students' attitudes toward race. Other studies have focused on factors affecting network formation; racial segmentation, the role of dorms and learning communities are recurring themes. Finally, studies have explored how social networks impact academic achievement and retention. Biancini and McFarland (2013) concluded that there was a lack of descriptive work on how students experience college from a network perspective, and that there was little understanding of the nature of friendship groups and the social structures that impact these relations.

A later development in SNA research is the use of a mixed-methods approach, where quantitative social network data are complemented with qualitative empirical material, in an attempt to untangle the complex and "messy" reality of social relations, for example, in HE (Froehlich et al., 2020; McCabe, 2016), and in other areas such as anthropology and immigration studies (Carrington, 2014). As I was interested in untangling the "messy" reality of student relations in the classroom, and especially better understand what I later learned to call multiplex networks, a mixed-method approach was suitable.

Definition of important concepts

Social network analysis is a set of methods developed to explore the structure of the social world rather than a theory of social structure (Scott, 2000). Many of the methods are highly technical and involve advanced mathematics. Thankfully, there are several programs available that do not require the researcher to be a trained statistician or mathematician, although it would have helped as the programs and available manuals are not as user friendly as, say, SPSS. There is also a wide range

of concepts and measures used. Here I will first briefly present a selection of SNA-related concepts that are relevant to understanding the present dissertation: sociograms, multiplexity, density, centrality, homophily, and propinquity.

Sociograms are the graphs used to visualize the connections, that is, the relations (lines or ties) between elements (or points/alters/node). SNA is based on graph theory, where graphs mean graphs of networks that "express the qualitative patterns of connections among points" (Scott, 2000, p. 64). The graphs are mirror images of adjacency matrices recording the absence (0) or the occurrence of a specific type of relation (1). The ties can be both undirected, directed and valued. An undirected tie indicates only the existence of a relation, whereas a directed tie also shows the direction, for example that Anna has indicated that she is friends with Tom. Then the tie is represented by an arrow that points from Anna to Tom. Ties can also be valued, which means that a tie also represents the intensity (or frequency) of the relationship. The ties in the graphs in Figure 3 (see p. 62) are arrows, which means they are directed, but they are not valued. This is true also of the ties in the graph displaying the multiplex networks (see Figure 3-d), as these ties simply display the presence of (1) a multiplex relationship.

Multiplexity is one of the most widely used measures of intensity. The multiplicity of a tie is simply the number of separate types of relations that constitute a relationship (Scott, 2000). In the case of the present dissertation, if Anna and Tom are both friends and work together, they have a multiplex relationship. As explained above, these relations were not valued, as I created a matrix in Ucinet based on the students' responses, which recorded the presence (1) or absence (0) of multiple relations.

Density refers to the overall level of linkages among points and is expressed as the proportion of the maximum possible number of lines in a network (Scott, 2000). It is used to measure the cohesion in networks. In a network where ties indicate flow of information, a high level of density would indicate a high flow of information in that network. There is a limit to how many ties a person can maintain, which means that the density tends to decrease the bigger the network is (Carrington, 2014). Granovetter (1973) also showed that strong tie networks (kinship) are denser than weak tie (friendship) networks. Hence, density is highly context dependent, which means that it is not suitable to use for comparing different networks. In the present dissertation, I used density as a measure to explore the density of the friendship, learning, working and multiplex networks in a specific context.

Centrality refers to the importance of an actor in a network, which can mean different things depending on the context or relations studied; for example, it can refer to popularity in a friendship network, or power or status. One of the most used centrality measures is degree centrality (Carrington, 2014). In Paper III and IV, *Freeman's in-degree centrality* was used to measure centrality for the working/learning/friendship networks (Grunspan et al., 2014). In-degree centrality is the number of incoming ties, which is a measure of how prominent or sought after an actor is in the network. In-degree centrality was used to limit the bias inherent in

self-reported network lines (Hanneman & Riddle, 2005). This is important, as the use of in-degree centrality allowed me to also include non-responding students in the analysis, the goal being to present a more unbiased image of the different networks. At the same time, there is an ethical problem with using information about non-responders (Korir et al., 2020), which is further discussed in the chapter on ethical considerations (pp. 38-39).

Yet another important concept is *homophily*, as we tend to form relations with people we perceive as similar to ourselves based on sociodemographic or behavioral factors. According to McPherson et al. (2001), we primarily form relations based on ethnicity, but also based on age, religion, education, occupation, and gender. In Paper II, the level of homophily in the networks was measured using a so-called E-I Index in Ucinet, which is useful in determining whether individuals interact more with others based on specific background characteristics. In the case of Paper II, I aimed to explore "the coffee-room explanations," that is, the attributes language background, gender, social background, place of residence and academic outcome. Even though ethnicity is a strong determinant of social relations, Wimmer and Lewis (2010) found that other factors such as cultural interest or socioeconomic status could surpass ethnic homophily. Furthermore, if students are exposed to multiethnic environments, inter-ethnic relationships are promoted but not long lasting (Baker et al., 2011). Universities seem to have limited ability to reduce segmentation (e.g., Mayer & Puller, 2008; McCabe, 2016), although Antonio (2012) found that most student friendships are at least somewhat mixed.

Finally, *propinquity* (or proximity) is closely related to homophily in the sense that it means a similarity based on location. Even in our modern times, when it is possible to form ties with people in other physical locations online, the sharing of space (in school or at work) or neighborhood (where you live) is a fundamental aspect of tie formation (McPherson et al., 2001). One of the attributes discussed above, place of residence, is based on the idea that students form relationships based on propinquity, that is, that students who live close to each other and who commute together are more likely to form ties with each other.

Student social networks and academic outcome

There is ample evidence in the literature showing that student social networks, and students' positions within these networks, affect academic outcome (e.g., Bianchini & McFarland, 2013). Well-integrated students are more motivated to complete their studies, and conversely, students with weak social ties are more likely to drop out. The extent to which an individual student needs these relationships varies (Leary et al., 2001), for example, an older student (e.g., Krause et al., 2005) or a commuter student (e.g., Alfano & Eduljee, 2013; Biddix, 2015).

Relationships in education are still often treated as separate, independent constructs (uniplex) and are operationalized in various ways. In educational SNA research, it is common to distinguish between instrumental, work-related relations

and affective, friendship relations (e.g., Rienties & Tempelaar, 2018). According to Hommes et al. (2012), friendship relationships are expressive, based on trust and involve passive information diffusion. The more instrumental working and learning networks offer more hands-on support, such as note sharing or solving assignments together.

The results have been somewhat inconclusive, but overall, centrality in a social network has been positively linked to academic success, as measured by GPA (e.g., Grunspan et al., 2014). For example, Hommes et al. (2012) fond that students' social network relations contributed more to academic outcome than did prior performance, and that low-performing students were in the periphery of the network. In contrast, Tómas-Miquel et al. (2016) found a positive relationship between centrality in the academic (work) network and academic success, and a negative one for friendship network centrality.

The size and structure of networks vary, but students normally have more friendships than work relationships (e.g., Rienties et al., 2013; Shah et al., 2017). However, Chen et al. (2012) found that Chinese Master's in public administration (MPA) students had more academic ties than friendship ties, in contrast to Anglo-Saxon studies, and reflected on how that could partly depend on culture and partly on the fact that the MPA students worked part-time and had their main networks elsewhere. Also, McCabe (2016) found that students formed different types of networks partly depending on ethnic background and that some network types were more supportive than others.

Both Chen et al. (2012) and McCabe (2016) discussed how some student relations were multiplex, that is, students could be both friends and work together. Multiplex relations offer both affective and instrumental support and have been found to be more resilient during the shift to online education during the Covid-19 pandemic (e.g., Elmer et al., 2021); moreover, such relations tend to remain after college (McCabe, 2016). McCabe (2016) further found that the academic multiplex ties were more likely to offer support, but that some networks did not offer adequate instrumental support. Thus, a multiplex relation could be assumed to be particularly strong due to the overlap between instrumental and affective ties.

A multiplex relationship could also be conceptualized as a strong tie, and as such more linked to emotion and identity than are weak ties (Granovetter, 1973). Strong ties are important to change in values and behavior (Centola, 2018), whereas weak ties are important to information flow. For example, Rienties and Tempelaar (2018) showed that information exchange in friendship relations outside the formal team led to less groupthink and more creative solutions in group assignments. This means that, although multiplex relations are important, too few friendship relations may also impact academic outcomes, as they provide access to expertise and critical reflection. The relation between multiplex relations and academic outcome in HE is underexplored. In one study, Hood et al. (2017) explored multiplex relations and team performance among business students. They found that conflicts impacted

team performance negatively only if the team members were also friends, whereas team conflict between non-friends had a positive effect on outcome.

Paper II – Data collection, analysis & results

Aim and research questions

The aim of Paper II was *to explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, and how these relations relate to academic outcome*. The research questions developed to fulfill the aim of the paper were:

(1) To what extent do students in a specific program develop relations with other students and what are the characteristics of the networks formed?
(2) What is the relation between students' friendship, learning and academic work networks and academic outcome in this specific context?
(3) What is the relation between students' multiplex relations and academic outcome in this specific context?

Data collection, Participants & procedure

Paper II on *Student multiplex study networks* involved a social network analysis study in the same cohort of 146 business students as in Paper I, but in their second year, 106 students (men: n =40; women: n=56) with a response rate of 73%. The network data was collected by use of paper-based closed network (e.g., Rienties & Hosein, 2015; Rienties, & Tempelaar, 2018; Tómas-Miquel et al., 2016), roster collection survey (Tómas-Miquel et al., 2016) in class during a lecture in spring 2017. The study had an explanatory design (Hollstein, 2016). Participants received a list of all students enrolled in their specialization and marked who they had worked with, learned from, and who they were friends with.

Furthermore, Paper II was based on secondary data from Paper I. More specifically archival data regarding academic outcome and socio-economic background factors collected in the REQ1 survey were used in the analysis.

Analysis

To explore the structure of the working, learning and friendship networks two types of analyses were performed. First a quadratic assignment procedure (QAP) was performed, correlating each pair of matrices (Hanneman & Riddle, 2005), to assess whether a pair of networks is structurally similar at a system level. Second,

Krackhardts E-I index was calculated to measure the extent of homophily in the difference networks, that is, the tendency for students to form relations with other students like themselves (Hanneman & Riddle, 2005).

Finally, to analyze the effect of students' position in the networks and background factors on academic outcome (dependent variable), multiple linear regression models were performed in SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24 Armonk, NY: IBM Corp.).

An actor's centrality in a network is an indication of how important that person in in that specific network. The measure used in this case was Freeman's in-degree centrality (Grunspan et al., 2014), which is a measure the number of incoming ties of everyone in the network. It is an indication of how sought out or prominent an actor is in the network (Hanneman & Riddle, 2005). Centrality measures were analyzed in UCINET v. 6, a soft-ware program developed for social network analysis (Borgatti, Everett and Freeman, 2002). Networks were visualized in Netdraw, in UCINET.

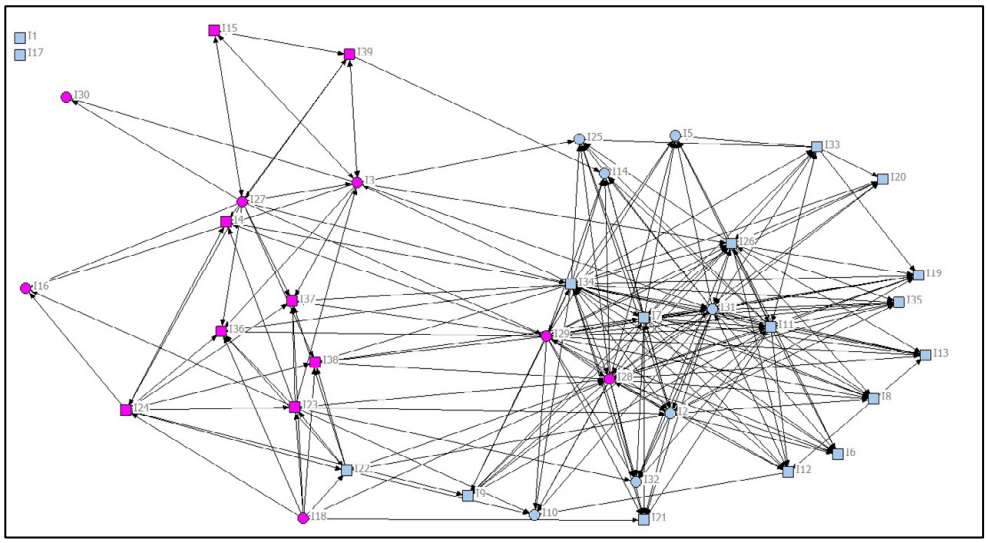
Result

How do students form working, learning and friendship relations, to what extent do these overlap in multiplex relations, and how do these relations relate to academic outcome?

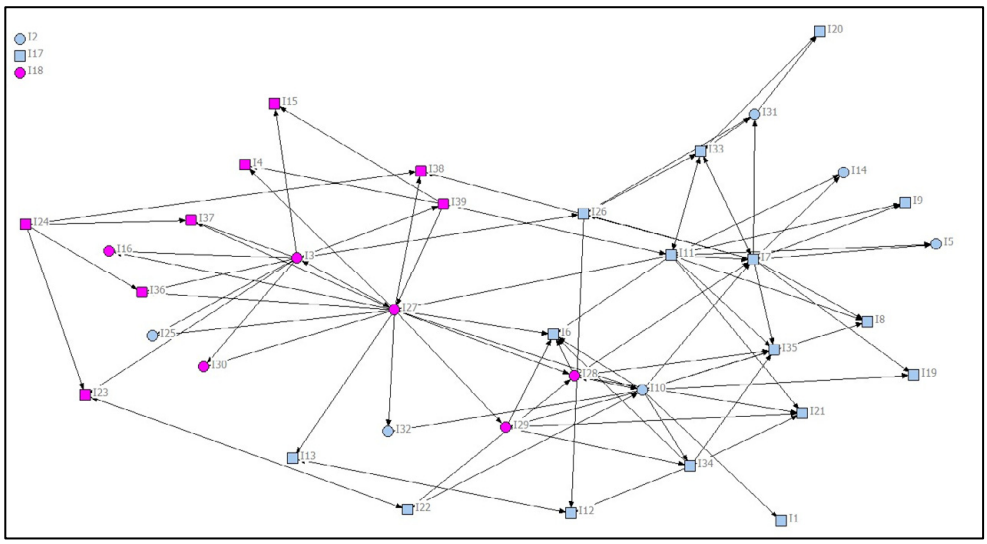
The aim of Paper II was to explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, and how these relations correlate with academic outcome. The visualization and descriptive statistics of relational data provided insight into the complexity of relationship building in a cohort of students (N=146; n=109; response rate 75%). Students had more friendship, than learning and working relations (see Figure 3). The pattern was similar in all three specializations, and on average students reported on having 7 friendship relations, 2.8 learning and 2.4 working relations. Some had very large friendship networks, whereas others were very selective and said they interacted with only a few people on a regular basis. Students had multiplex relations with only a few other students, 2.7 relations on average. Immigrant students had significantly fewer relations than did Swedish students, on average.

A Quadratic Assignment Procedure analysis (Hanneman & Riddle, 2005) indicates how similar two matrices are. Overall, the analysis indicated that if students are friends, there was a 33% probability that they also worked together. If so, they were also likely to have learned from that person (0.465/47%). Typically, the very core of each student's network consisted of a few individuals with whom network members reported having all three relations, that is multiplex relations (Hanneman & Riddle, 2005) as displayed in Figure 3. In line with McCabe (2016), relations were considered multiplex if nodes shared all three possible relations. This means that students who worked together, were often also friends with and had learned from each other. All coefficients were significant ($p < 0.001$), suggesting

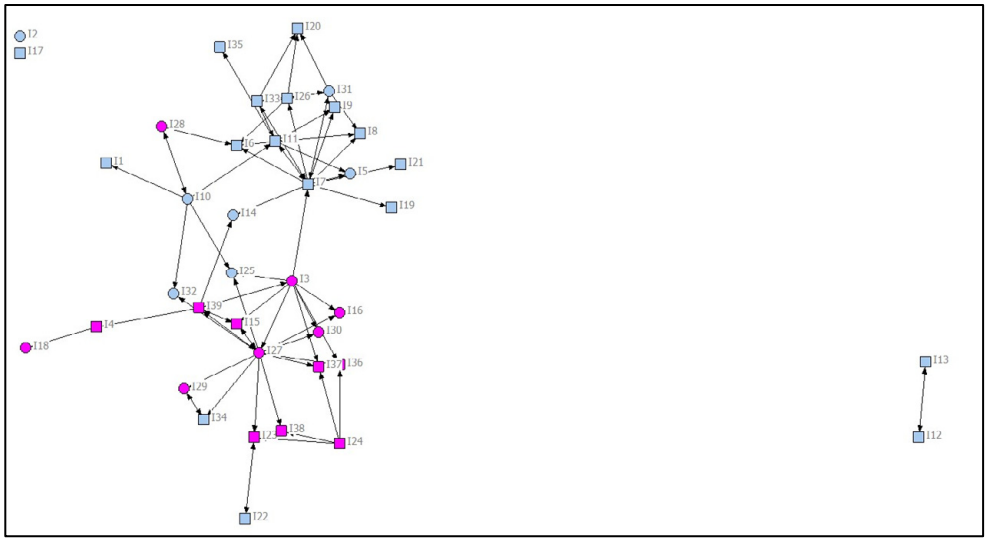
strong relationships that are unlikely to have occurred by chance (Hanneman & Riddle, 2005). There was no significant difference between commuting and non-commuting Swedish students. There were significant differences between commuters and non-commuters only amongst immigrant students, where commuter immigrant students had approximately 50% less working and friendship relations than did non-commuting immigrant students.



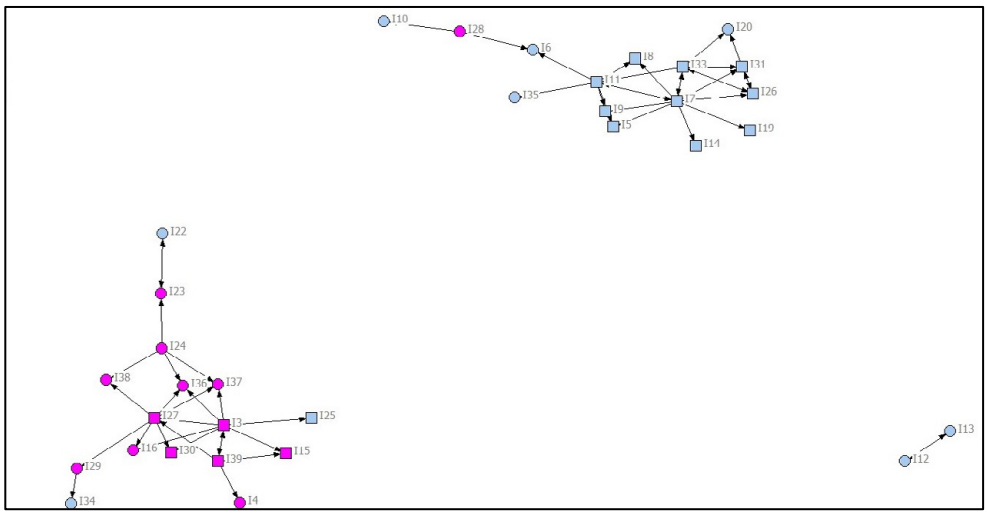
a) Friendship network



b) Learning network



c) Working network



d) Multiplex network

Figure 3 Networks in Specialization C

Note: Square nodes = female students; round nodes = male students. Blue = native students. Another version of figure 5 was originally published in appended Paper II (Fjelkner-Pihl, 2021).

RQ1 explored the on what basis students formed study-related relations. The result indicated that students formed largely homophilous networks based on gender and ethnicity (native/immigrant). The tendency for homophily becomes stronger in the learning than in the larger friendship networks, and the strongest in the working networks. Educational background of parents and high school GPA had less impact on group formation. There was also a divide between commuter and non-commuter students. For example, Specialization C is divided into two clusters (Fig. 4). Commuter students living along the south-west train line form one cluster (black nodes) and non-commuters another (pink nodes). A large share of students who commute had an immigrant background (round nodes in Fig. 4).

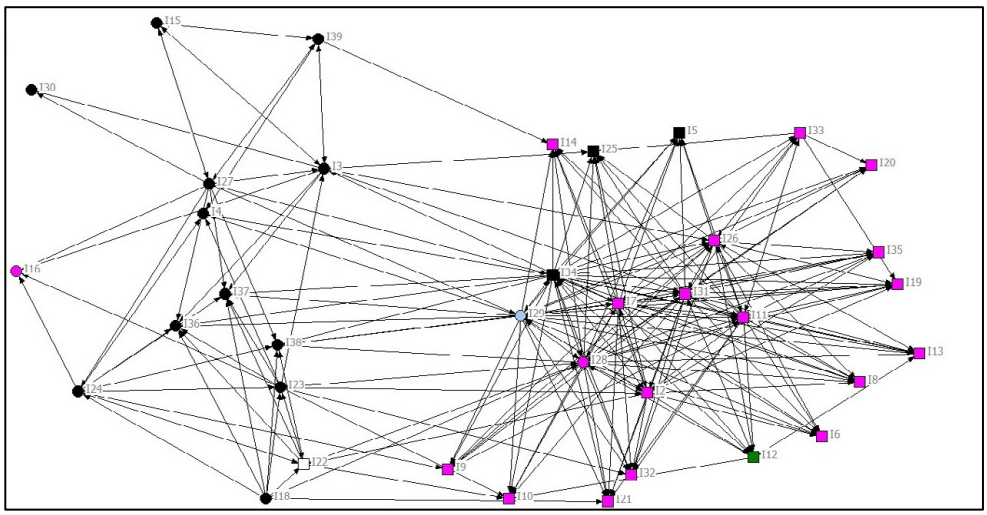


Figure 4 Friendship Network in Specialization C and Place of Residence

Note: Black nodes commuted along the southwest line, whereas white, blue, and green nodes commuted in other directions. Pink nodes were residents or commuted less than 30 minutes. Figure 4 was originally published in appended Paper II (Fjelkner-Pihl, 2021).

RQ2 explored the relation between the different networks and academic outcome.

GPA, language background and gender explained 25% of the variance in academic outcome. As values for in-degree centrality of the friendship, learning and work networks were entered into the model, only GPA, language background and centrality in the Friendship network were significant. The number of a student's school related friendship relations was positively related to academic outcome, whereas this was not true of the working and learning relations.

One main contribution of Paper II was the focus on multiplex relations and relation to academic outcome (RQ 3), where previous network research mainly focused separate relations (uniplex). A multiple regression model indicated that both

centrality in the multiplex network, but also the uniplex networks were significantly related to academic outcome.

What did I learn?

The aim of Paper II was to explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, and how these relations correlate with academic outcome. The study helped me visualize the relationship patterns in the cohort, thus making the picture clearer and more opaque at the same time. McCabe (2016) visualized and showed how students formed different types of networks partly based on background, which she called samplers, compartmentalizers and tight-knitters. She also pointed to how the academic multiplex ties were especially valuable to the students but did not explore them quantitatively. Paper II extends her research as it focuses and visualizes the multiplex networks, and also shows how these contribute to academic outcome.

What stuck with me the most was the extent of isolation of a quite large group of students. Some were isolates, but that meant they were on the way out, and had probably decided to leave the program, but the others who mainly communicated with one or two other students, not more. I find it sad and rather worrisome that you can study together for two years, sit in the same classroom for ten or twelve hours a week and then only talk to two or three out of around 40 people.

The level of social homophily was also striking. The study confirmed my preconception, but also indicated that the tendency was stronger than I perhaps had realized. It was also interesting to see how birds of a feather really do flock together, and that the tendency became stronger the smaller the network. It is in line with previous research (McPherson et al., 2001), but in a way I was still surprised as to really how strong it actually was.

Finally, the quantitative SNA inquiry did not provide any answered to how students would talk about their network relations, who and why or why not, the type of support they offered, and the relation to academic outcome. The answers to these questions were to be found, at least partly in the semi-structured interviews in Paper III.

Paper III – Data collection, analysis & results

Aim and research questions

The aim of Paper *III was to explore students' perception of their study-related networks, and the relation to academic outcome*. The research questions developed to fulfill the aim of the study were:

(1) How do commuter college students describe their study-related multiplex relationships?
(2) How do commuter college students form study-related multiplex relationships?

Data collection, participants & procedure

Paper III – Students' experiences of their multiplex study networks – involved semi-structured interviews. Respondents were selected based on sequential purposeful sampling (Palinkas et al., 2015) from among students who had marked interest in being interviewed in the initial SNA survey (Paper II, n = 106). The objective was for the sample to reflect the composition of the cohort regarding specialization, gender, previous achievement, and background (i.e., commuter/campus students, native/immigrant background) and provide rich data.

15 students volunteered to take part in *semi-structured interviews*. The paper SNA-survey was used as a discussion point, to facilitate the students to focus on both structural and compositional information about their networks. Interviews were held during the fall semester of the third year. During the interviews, the students could elaborate upon their perception of the meaning of HE, and their study-related relations, that is, whom they were friends with, had learned from and worked with. In addition, questions explored the students' view of the composition of different networks, their open, study-related network, their perception of their networks in relation to academic achievement.

Analysis

The material was transcribed in NVivo, and initial codes added as notes. The material was then thematically coded (Braun & Clarke, 2006). The analysis was data driven. Initial codes, which were for example based on recurring words, were grouped together to generate themes. For example, one theme was *Meeting spaces* (see Table 6) with subcodes such as "first group work" or "commute." The themes were then discussed with my PhD supervisors in several iterations. The independently judged the themes prior to the discussions.

Table 6 Theme "Meeting spaces," subthemes and examples

Subthemes	Examples of meaning units
First group work & from commuting	It was them I got to know first. In the first and second course. For example, J lived in X [city] too. We got to know each other on the train. […] then it was S who was friends with W, so we started hanging out. (Inez)
First group work & old acquaintances	I mainly hang out with Jamie, and G. […]. I knew R a bit from before. He and I come from the same place, and he was going out with the sister of a friend of mine. Then we ended up in the same group in the first course and G was also in that group. (Frank)
From high school, propinquity	M and I, we went to the same high school as S. We usually work at home, or we also sit in building X. We study in X [city] as we all live in X. […]. (Monawar)
Orientation week	I have to say that orientation week is important to go to. It's no joke. /…/ I feel as if not that many have quit because all my friends are still here, but I think that many, those who didn't participate /…/ they were directly a bit on the outside. (Penny)

Note. Table from article III (Fjelkner-Pihl, 2022).

Result

How do students form their study related networks?

Paper III was a qualitative study that explored students' perception of their study related multiplex networks. The interviews that the multiplex relations were central to the students. They provided both emotional and instrumental support, and it was there they perceived that most working and learning took place. Students pointed to how they learned how to study and to write better, how to be better organized, and how to be more engaged in extracurricular activities.

Students mainly formed multiplex relations with students they had met in four ways, through group work in the first semester, induction week, old friends from high school, and fellow commuter students. Furthermore, they formed multiplex relations with students they perceived as similar in some aspect. They talked about how they had the same level of ambition, worked in the same way, or complemented each other. As Paper II indicated, the students formed networks based on homophily which was also something the students themselves perceived and talked about. For example, they said that they worked closely with a few girls or boys of the same age, only with other commuters or only with other locals. This means that their stories indicated that their networks were based not only on *homophily*, mainly based on language background and gender, but also *propinquity*, or proximity, as also explained by previous research (e.g., Rienties & Tempelaar, 2018).

Students pointed to that it was the more exclusive multiplex network that contributed the most to learning and engagement. The larger friendship network was still important as it provided access to a larger pool of relations for information, and with whom they can potentially develop multiplex relations. Students with limited friendship relations seemed to lack both access to information and have limited possibilities to form multiplex relations. The interviews suggested several barriers to participation for students in this specific context. Students mainly talked about *situational* and *dispositional* barriers to participation. One situational barrier all students discussed in the interview was commuting.

The commute was mainly described as a barrier, for example *as a hurdle* that students learned to overcome or that caused them to drop out. Commuting was also seen *as a divide*, as some local or resident students mainly divided students into *us* (residents) and *them* (commuters). The commuters themselves also preferred forming groups with other commuters, especially those who commuted in the same direction. At the same time, commuting was also described as a *meeting place*, where students got to know each other, as they recognized each other or saw someone reading the same course book on the train. This is also where they discussed readings and assignments or exchanged information. For some it seems the commute was perceived as something positive rather than a barrier.

Two institutional barriers which were specifically addressed were the *assigned groups* in the first course and the *induction week*. Most students interviewed found it difficult to work with new people in the beginning, but they realized these group assignments helped them form both friendship and working relations that later developed into multiplex networks. If the groups worked out well, they formed long lasting relations and often continued working together. For Swedish students the induction week was important as it gave them a larger pool of potential people to approach to form friendship or working relations with. For some students who chose not to participate, it became an institutional barrier which they later never really overcame. They remained in the periphery of the cohort. The reason for not participating could be personality, but also religious and cultural backgrounds. Immigrant students pointed out that most immigrant students they knew avoided those kinds of activities.

What did I learn?

One important finding was that students found that their multiplex relations contributed to both social and academic success. They said that it was in these networks the main work was done and that these relationships helped them remain engaged in their studies. It was interesting to see that they were very clear about how the different networks provided different kinds of support. Students said the friendship network made school fun, but also provided access to information. They further talked about how they were "in the same boat" and "understood each other", which was important for both learning and engagement.

Another important insight was that students who lacked access to the larger friendship network risked becoming locked into their limited network early on in their studies due to various barriers to participation. A lack of relationships impacted their academic achievement, knowledge development and sense of belonging. Group work during the first semester was one important enabler of group formation, as were orientation week activities (induction week) and the commute to and from school. Another insight was that students who chose not to participate in induction week, or who worked in less successful groups during the first semester, remained peripheral.

Finally, students referred to both the drawbacks and benefits of group work and explained how they preferred working with their multiplex relationships, especially on assignments that were decisive for their course grade, or what I have chosen to call high-stakes assignments. At the same time, they also spoke of how they enjoyed getting to know new people and how working with other students motivated them or challenged them to do better.

Paper IV – Data collection, analysis & results

Aim and research questions

The aim of Paper III was *to explore the effects the emergency transition to online teaching during the Covid-19 pandemic had on students' study-related networks.* The research questions developed to fulfill the aim of the study were:

(1) What are the effects of the Covid-19 pandemic on students' study-related networks in two types of universities?

(2) How do students describe the effects of the Covid-19 pandemic on their social network in relation to study outcome and cooperation with other students?

Data collection, participants & procedure

Paper IV – on student social relations and well-being during the pandemic – involved an online multi-site survey exploring student working, learning and friendship networks in three different programs from two universities, one teaching and one research intensive university.

The study used a mixed-method approach. Individual level relational data was collected via an online survey. Again, the roster collection method was used to explore student networks as described in the previous paragraph. Like in Paper III, the survey explored student *working, learning and friendship networks*. The survey also included qualitative open questions exploring the students' perception of the effect of the transition to online teaching on their study-related network, and how that change had affected academic outcome.

The survey was distributed via e-mail in late fall 2020. 97 out of 319 students responded to the survey leading to a 30% response rate (men: n =38; women: n=59). One major difference between the two schools that was thought to impact students' school related networks and the experience of the transition to online teaching was the share of students who commuted to school. 68% of the participants from HKR commuted as compared to 9 and 4% respectively in the two programs from LTH. Students were in the middle of their third year. Students were approached during online lectures. They were informed about the purpose and procedure, and that

participation was voluntary. Students were further ensured confidentiality in the handling and presentation of data, in line with ethical guidelines of Swedish Research Council (2021). Even though two of the authors were affiliated to two of the programs, none of them were actively engaged in teaching at the time of the survey.

Analysis

For the relational data in Paper IV, Freeman's out-degree centrality was used to measure centrality for the working and friendship networks (Grunspan et al., 2014). The out-degree measures the number of outgoing ties which give an indication of how influential actors are in the network and with how many others they can exchange information (Hanneman & Riddle, 2005). The whole network analysis of friendship and working networks in program A was carried out in UCINET and networks were visualized in NetDraw (Borgatti et al., 2002).

The answers to the open questions in the survey were thematically analyzed and coded. Answers regarding study outcome, cooperation with other students and well-being were initially coded as either worse, same, or better. The open answers were thematically coded by two authors individually, then discussed and refined before being used in the statistical analysis. Vague answers were coded as missing.

In the statistical analyses, Dependent-samples t-test were used to test for group level difference in network size under the two conditions pre-Covid campus teaching and during Covid-19 online teaching. Independent-samples t-tests were used to test for group level differences in net- works and self-reported well-being, cooperation, and study outcome between student groups. Student descriptions of their well-being and cooperation with other students were coded as qualitative variables: Worse = 1, Same/better = 2. A Chi-square tests for independence was used to explore the relationship between these qualitative variables. Finally, a One-way between-groups analysis of variance (ANOVA) was conducted to explore the impact of difference in number of relations on self-reported study outcome. Qualitative responses regarding study outcome were coded as a qualitative variable with three categories (worse/same/better).

Differences were considered statistically significant if $p < 0.05$, two-tailed. SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. IBM Corp.) was used for all analyses.

Result

What effect did the emergency transition to online teaching during the Covid-19 pandemic have on students' study-related networks?

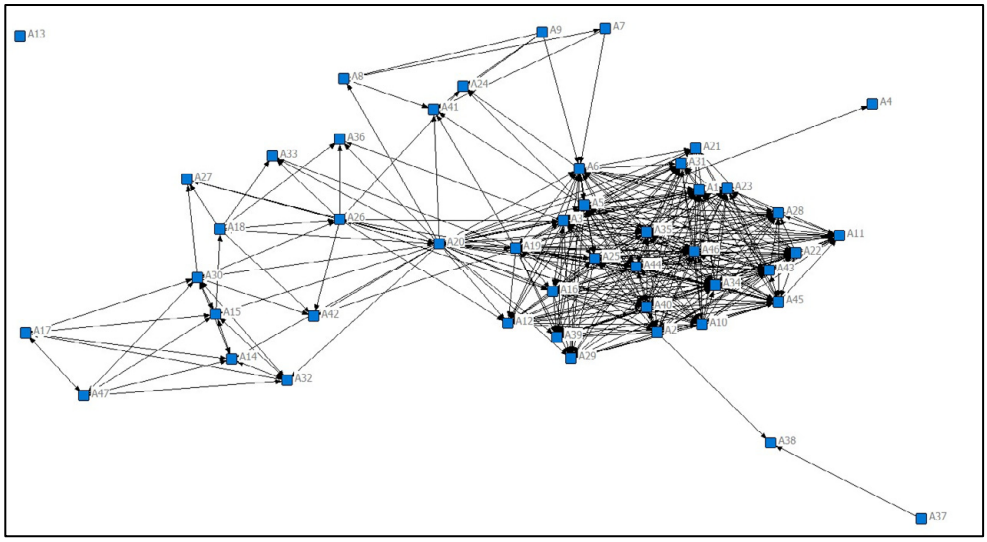
The analysis showed how students lost more than 50% of their study-related relations, and up to 57% of their multiplex relations. In line with previous research,

students generally had more friendship relations overall than working or multiplex relations (e.g., Fjelkner-Pihl, 2021; Rienties & Tempelaar, 2018). Networks became more fragmented after the transition to online teaching, and the multiplex network the most so as displayed in Figure 5 and 6. In the open answers, students explained how they kept a few strong relations and lost more peripheral ones. The survey indicated a similar loss of relations also in the other programs studied. There were significant differences in number of relations in both universities, although students at LTH lost more relations in actual numbers as they had more relations overall than did HKR students in this sample.

The networks in Figures 5-6 depict student friendship and multiplex relations prior to Covid-19 what remained after the transfer to online teaching. A multiplex relation, that is when a student both cooperate and socialize with another node, is depicted with a red tie in Figure 6.

Regarding association between background variables and the change in number of friendship and working relations after the transition from campus to online teaching, independent sample t-tests indicated that there were significant differences in scores between the two schools regarding changes in the *working network*, and in the *friendship networks*. This was also the case regarding the scores for non-commuters and commuters, which is to be expected since there was a substantial overlap between school and commuting. 68% of students from the HKR were commuters, whereas only 7% from LTH. The pattern was the same for the multiplex network. Overall, students from LTH, and non-commuters, experienced the greatest changes in their networks due to Covid-19 and the change from campus to online teaching.

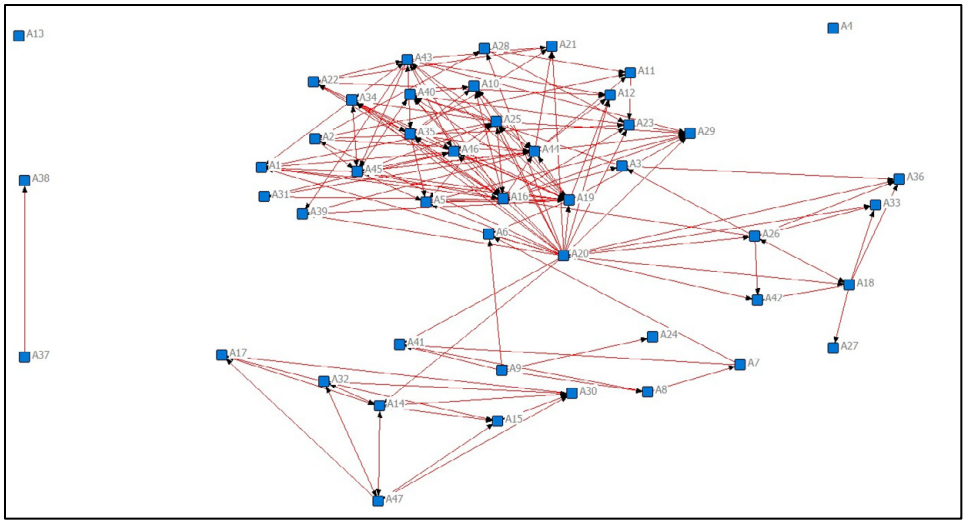
The association between change in the working and friendship networks and reports of well-being and cooperation, was explored by use of independent-sample t-tests. Overall, a larger mean loss of relations for students meant they indicated they felt worse, or that the cooperation between students was worse when teaching was conducted online. Regarding well-being, there was significant difference in the mean change in the working networks for students who reported a decline in well-being and students who reported no change or improvement in well-being. Students who had lost more work and multiplex relations on average reported a decline in well-being.



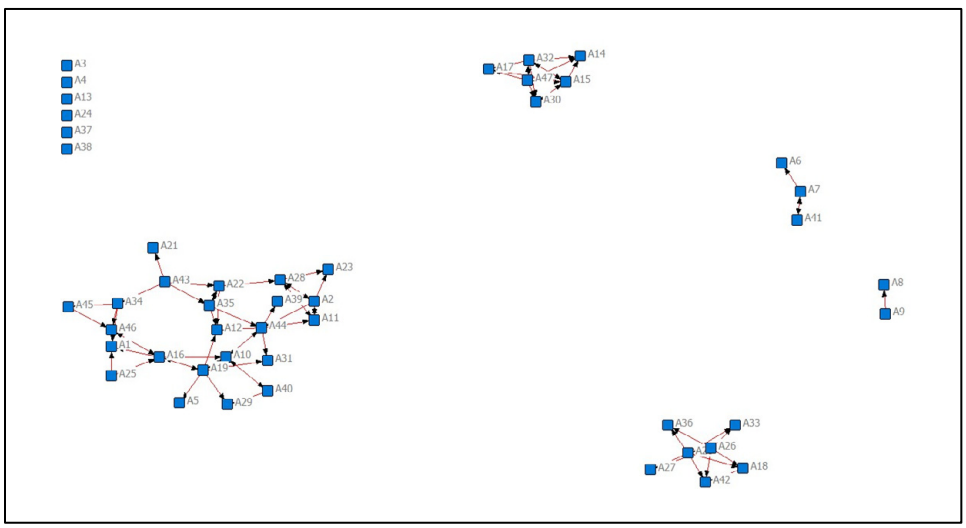
A) Friendship network campus teaching

B) Friendship network online teaching

Figure 5 Student friendship networks in group A: pre-Covid-19 campus teaching vs. online teaching



A) Multiplex network campus teaching



B) Multiplex network online teaching

Figure 6 Student multiplex networks in group A: pre-Covid-19 campus teaching vs. online teaching

A one-way between-groups analysis of variance was used to explore association between change in the working and friendship networks and outcome. There was no statistically significant difference between groups, but students who had lost more relations on average also reported they did less well.

However, when the scores of the two groups non-commuters and commuters were compared significant differences were found for commuters and differences in

the multiplex and work networks at the $p < .05$ level in the LOT scores for the three groups. Commuter students who reported they did worse regarding study outcome during the pandemic had lost more relations in their multiplex networks. Students who reported they had the same outcome as before the pandemic had only lost on average 0.4 relations. Post-hoc comparisons using the Bonferroni test indicated that mean scores for students who did worse was significantly different from students who did the same or better.

Student responses to open-ended questions indicated that the transition had had a negative impact on their study outcome. At the same time, 48% of the students in this sample did not find that the transition to online teaching had had a substantial effect on their study outcome, and 15% claimed that the transition had even led to better study results, as they could plan their time better and had more time to study as they spent less time with friends and on commuting.

Regarding study outcome, students said they could now study at their own pace and did not have to spend as much time socializing. Some also reflected on how maybe also the format of the examination, or the grading had changed making it easier to pass examinations. Students said they had kept a few supportive relations who had supported them in their studies. Especially for the commuter students multiplex relations continued almost as usual, and they now met on Zoom or communicated via different social media.

At the same time the open answers indicated a sadness or sense of loss. 60% of the students reported that contact between students had decreased and they missed the interaction in and around the classroom. They kept their multiplex relations they had worked closely with previously, and it was foremost peripheral study-related relationships were lost. Hence, the personal network was defoliated from outside in, and students now interacted with only their core multiplex relations. Students reported on how the loss of interaction lead to that they did not get other perspectives on things as they now only worked with the same limited number of relations. They also lacked the constant sharing of what goes on in a course, what is required of different assignments and what the course literature is really saying. Campus students found it more difficult to maintain this flow of formative feedback in an online environment than did the commuter students.

What did I learn?

The most important lesson from Paper IV was how students maintained their multiplex relations when teaching transitioned online, and mainly lost contact with peripheral study-related relationships. The personal network was depopulated from the outside in. In a sense, this finding confirmed the results from Paper II-III and strengthened the insight that student study-related multiplex networks are worth focusing on.

Furthermore, the open questions provided insight into how important the informal flow of information in a classroom is, something we are perhaps not always

aware of. Nonetheless, students now became aware of how the loss of interaction led to them not getting other perspectives on things as well as how they lacked the constant sharing of information about what goes on in a course, what is required of different assignments and what the course literature is really saying.

Finally, it was interesting that there seemed to be a difference between campus and commuter students, in that campus students found it more difficult to maintain the flow of formative feedback online than the commuter students did. They also reported to a greater extent that the transition had affected their feeling of well-being. The difference has led to questions about whether and how networks and their meaning differ depending on the type of HEI and what that might mean for the organization and planning of study programs and courses.

Discussion & implications

What I set out to learn from this research was how acquiring more in-depth knowledge of student readiness and student social relations could contribute to my own teaching practice and that of my colleagues, as well as to the planning and organization of the program. The four appended papers have contributed to a varying extent to answering this question. In this section, I aim to tie the most central aspects together and reflect on the implications for teaching practice, and the planning and organization of HE courses and programs. Although the findings of the present dissertation should not be generalized due to the uniqueness of the context, they can still potentially provide valuable insights into student readiness for HE and student study-related networks that may be relevant to other contexts as well.

In the first study, I explored student readiness and whether a certain instrument could be used to predict academic outcome. The subsequent two papers (Paper II & III) focused multiplex study-related relations, in that same cohort of students and how these contributed to academic outcome, but also how students experienced these relations. Finally, the fourth study also revolved around student study-related multiplex relations and how these were affected by the emergency transition from campus to online teaching during the Covid-19 pandemic. The papers are independent, but together they contributed to a more comprehensive understanding of academic achievement in the cohort and program in question.

In the first part of this chapter, I will discuss readiness in relation to academic outcome and in the second student social relations. The third part explores a strategic framework for group formation which may aid teachers to reflect upon how to use group work to build a relationship rich environment in and around the classroom.

Readiness and academic success in higher education

The focus of paper I was students' perception of their own readiness for HE studies as a predictor of academic outcome. The main predictors of academic outcome were previous GPA, socioeconomic background, and commuting, but not so for students in the sample with an immigrant background, who earned fewer credits in nominal time than did native students. It seems that the language background outweighed all other predictors. Immigrant students earned fewer credits than required, which

meant that fewer immigrant students were eligible to write their Bachelor's dissertations in their final semester or complete their studies in nominal time.

Contrary to my expectations, the results indicated no correlations between REQ results and academic outcome. Students were confident in their own skills at the beginning of the semester. Most surprisingly, they did not modify their perception after one semester of studies. One important finding was that there was a gap between self-perceived readiness and actual readiness (i.e., outcome in the first year), which may be one reason why about 40-50% of students leave the Business program or other study programs in the first year.

One additional finding was that, for immigrant students, previous GPA (previous performance) did not predict academic outcome. This may mean that the upper secondary school grades for this group were inflated. At the same time, the REQ results indicated that immigrant students were equally confident in their skills, although their results in the first semester revealed that they did not have the necessary academic skills to manage. This may mean that the gap between perceived skills and actual skills is even larger than for native students.

What I learned from this study was how important it is to acknowledge the gap between self-perceived readiness and actual readiness. The question is how we can make use of this insight. It is clearly not enough to tell the students what is expected, and the trend in the program is that those who need the most help are reluctant to take part in remedial workshops or classes on academic skills. A reason for this may be that they simply do not think they need it.

One important implication is that academic staff with teaching responsibility must be more explicit about what is expected of students. One way is to provide clear text examples and show students what to strive for rather than just explaining what is expected. Such a practice would be beneficial for all students and might enable them to better understand what they should strive for in their work (e.g., Lauvås & Jönsson, 2019; Santesson & Sigrell, 2016). This level of clarity may be even more important to students with an immigrant background. An increased degree of explicitness in academic expectations may also benefit native students whose parents have no HE degree, as this group is also at a disadvantage, at least regarding completing their studies in nominal time.

Another option would be to increase the level of formative feedback in the different courses. Formative feedback can take various shapes, it could mean feedback from teachers, but also from peers. Black and William (2009, in Lauvås & Jönsson, 2018, p. 20) defined formative feedback as:

> Practice in a classroom is formative to the extent that evidence about student achievement is elicited, interpreted, and used by teachers and learners, or their peers to make decisions about the next steps in instruction that are likely to be better, or better founded, than the decisions they would have taken in the absence of the evidence that was elicited.

Formative feedback is essential to students' long-term epistemological development. It helps shape students' experiences and conception of the world as they meet people with different backgrounds and experiences enabling them to test and evaluate new ideas (Henderson et al., 2019).

Social relations and academic success in higher education

Students benefit from relationship-rich environments (e.g., Felten & Lambert, 2020; McCabe, 2016). In line with previous research, student uniplex friendship networks (degree) correlated positively and significantly with academic outcome (e.g., Rienties & Tempelaar, 2018). One contribution of Paper II is that it showed how student multiplex relations contributed significantly to academic outcome. This was further supported by both Paper III and IV, where students reported that their multiplex relations were important for both social and academic success, as well as well-being. According to the students, it was here the main work with assignments and learning was done (Paper III). These interactions helped students remain engaged in their studies. Furthermore, it was the multiplex relations that remained when learning transitioned online during the Covid-19 pandemic (Paper IV).

The different networks provided different kinds of support. Students said the friendship network made school fun, but also provided access to information. Both types of support are central to academic achievement (e.g., Hommes et al., 2012). According to the students, it was their multiplex relationships that were central to their academic achievements, as they provided both task-related and emotional support (e.g., Rienties & Tempelaar, 2018). Students referred to how they were "in the same boat," "understood each other," and how that was important for both learning and engagement.

Many students had only a small number of multiplex relations, typically 1-5 students, and this pattern is consistent with patterns found in the cohort (Paper II) and in the comparative study between students at the Faculty of Engineering, Lund University and Kristianstad University (Paper IV). Previous research has indicated that commuter students have fewer relationships than do campus students and are less likely to fully engage with their studies or participate in extra-curricular activities after class (e.g., Biddix, 2015; Pokorny et al., 2017). This picture was only partly confirmed in this study. Commuter students overall had fewer friendship and multiplex relations (Paper II & IV) than did students who live on or close to campus. The difference was only significant for immigrant commuter students, who also typically earned fewer credits in nominal time. This is in line with Gianoutsous and Rosser's (2014) study, which showed no difference in retention and academic standing between commuters and non-commuters. At the same time, it is important to note that there was a significant difference between LTH and HKR students,

where LTH students had significantly more friendship and multiplex relationships overall. This latter observation possibly calls for further studies comparing institutions and their varying characteristics.

The larger friendship group is important to students, as it provides them not only with information and social support, but also with a pool of potential multiplex relationships. Students who lack access to the larger friendship network run the risk of becoming locked into their limited network already at the beginning of their studies. In the interviews, Taylor explained (Paper III) how *"new gangs were created, and I was outside*," and Monawar found "*the second year was difficult.*" They both struggled. Taylor was unsure of the relevance of getting an education, and Monawar dropped out for a year. Their stories illustrate the drawbacks of a small multiplex network, with few ties into other multiplex networks. The lack of relationships may ultimately impact not only academic achievement, but also students' epistemological development and sense of belonging.

Intergroup, often friendship, relations provide access to expertise and critical reflection, which has been positively associated with academic performance (Gašević et al., 2013) and creativity (Tomás-Miquel et al., 2016). At the same time, multiplex relationships are important to students both academically and socially as they offer both affective and instrumental support. In the interviews (Paper III) students expressed the importance of this trusted network, and Paper IV pointed to how these were also the relations that remained during the pandemic as teaching transitioned online.

The intergroup, or weak ties, are also important to mitigating problems with social homophily. The quantitative analysis of the network data indicated that most of the multiplex networks were homophilous regarding gender and ethnicity (Paper II). This is not surprising in any way. There is consistent evidence showing that, like most people, students form homophilous networks, that is, they prefer forming relationships with peers similar to themselves regarding, for example, gender, race/ethnicity, socioeconomic background, age, and cultural preferences (e.g., McPherson, 2001; Rienties & Tempelaar, 2018; Rienties et al., 2013) as well as academic performance (e.g., Gašević et al., 2013).

At the same time, students form relationships based not only on preference, but also on opportunity (e.g., Hommes et al., 2012; McPherson, 2001). One opportunity for forming relationships that students mentioned (Paper III) was group work during the first semester. Group work in previous modules has been found to be a strong predictor of friendship relationships that students develop, at least temporarily (Rienties & Nolan, 2014). In this particular setting – where students typically do not live on or around the university campus or where there are no university-associated social or sports clubs – students explained how they met new friends during orientation week activities and the commute to school. According to the students, the friendships that developed into multiplex relationships were those that "worked out," in the sense that students found both the emotional and instrumental support needed for their studies. In line with previous research (e.g., Gašević et al., 2013),

they further mentioned how it was important that they "worked in the same way" or had the "same level of ambition." Students who chose not to participate in orientation week, or who worked in less successful groups during the first semester, remained peripheral. They had a few friendship and multiplex relations, which can be explained by the fact that students are less open to forming new relationships after the first year (e.g., Mamas, 2018).

A strong tendency toward social homophily in student networks could be negative for knowledge development (Curşeu and Pluut, 2013). Students benefit from diversity, as it leads to greater complexity of the collective knowledge in the group. More motivated peers also contribute drive and organization to the group work. At the same time, greater disparity may have a negative effect on both teamwork processes and interpersonal interaction. Students who were interviewed (Paper III) referred to both the drawbacks and benefits of collaboration with others and explained how they preferred working with their multiplex relationships, especially on high-stakes assignments; in this context, the term high-stakes means the assignments were decisive for their course grade. At the same time, they enjoyed getting to know new people and spoke about how working with other students motivated them or challenged them to do better.

In sum, what the findings of the present dissertation have demonstrated is the importance of student multiplex relationships. It seems that, in the second year, students have developed relations with some individuals in the cohort whom they find are more important to them than others. The interviews revealed that they share ideas and beliefs about how things are done, how and what to study for a test, and how to plan, research and write a paper.

Let me return to the introduction of the present dissertation, and the starting point of my research journey. Each year, I see the same scene unfold in front of me in the classroom. In contrast to before I did this research, I now see students form constellations, that is study-related multiplex networks. I knew early on that there was an inherent strength in these networks, and the studies presented here have strengthened and deepened that insight; but these new insights also reveal a risk involved in being locked into a small network with limited resources. The networks differ from each other in composition and outlook, and that matters. Some students benefit from their networks, while others are limited by them.

Here it could be useful to explore these multiplex networks at a deeper level. A better understanding could enable pedagogical intervention on a group level, which may be a more effective way to change student behavior (e.g., Centola, 2020) than interventions on an individual or cohort level. For example, are these multiplex

networks to be considered learning communities or perhaps communities of practice? As the students select and organize their networks themselves, they cannot be considered learning communities, since those are typically organized by teachers, but rather as informal, friendship-based peer networks. Are multiplex networks instead equal to peer groups? A peer group is a small set of people who communicate directly, and who stick together based on age, status, and shared interests (Molina et al., 2014). In a sense, of course the multiplex networks are peer groups, but I would rather argue that the larger friendship networks are peer groups, whereas the multiplex networks have a stronger shared purpose than do peer networks.

One way of furthering this issue is to look at the multiplex networks from an organizational perspective. The mulitplex networks could be said to exist in what Hannah and Lester (2009) describe as the meso-level of a knowledge-intensive organization. The authors distinguish between the micro-, meso- and macro-levels, where the micro-level refers to the individuals in the organization, and the macro-level to the management. The meso-level then, they argue is made up of knowledge-centric networks. The academic multiplex student networks could thus be considered knowledge-centric networks.

How would that then translate to a specific cohort of students, and in what way would that be preferable to simply referring to these formations as student multiplex networks or student peer groups? If we start with the different levels within an organization as discussed by Hannah and Lester (2011), it is possible to see a cohort of students as existing in a similar structure as teachers in a university, where the individual student exists at the micro-level, and the program, policies and curricula constitute the macro-level. The multiplex networks are then found at the meso-level. This distinction is beneficial, as it allows us to explore more clearly what goes on at the different levels (Roxå, 2014).

What distinguishes these networks then? First, the student narratives in Paper III showed evidence of how their multiplex networks were based on a high level of internal *trust*. Students claimed they interacted frequently with the members of their multiplex networks. The students interviewed shared stories with me of how they had met and how they worked together, that is, they had a shared narrative *(saga)* of the history of their multiplex networks. According to Clark (1972), a saga is a shared mission that leads to both shared practices and shared values. More precisely, a saga is:

> unified set of publicly expressed beliefs about the formal group that (a) is rooted in history, (b) claims unique accomplishment, and (c) is held with sentiment by the group. (Clark, 1972, p. 179)

This means that the saga includes both rational explanations of how certain actions led to certain outcomes, but also involves affect, or emotional loading.

The saga then becomes a foundation for trust and loyalty (Clark, 1972), which students also expressed. Loyalty to the group is important, and it is the shared story of "uncommon effort, achievement, and form" (Clark, 1972, p. 183) that leads to both loyalty and pride in one's identity, ultimately reducing isolation and increasing sense of involvement. Translated into HE terminology, being part of a multiplex network helps students create a sense of belonging, which is important for engagement and success (e.g., Kahu, 2013; Thomas, 2012). The students referred to their group as 'us' and other students and groups as 'them' and spoke of their habits and traditions regarding how they worked on assignments or studied together, which pointed to how they had created a "collective understanding of unique accomplishment" that according to Clark (1972) is exaggerated through retelling. As I interviewed students who shared the same multiplex network, this was evident in the stories they shared about assignments they had found especially troublesome and how they had joined forces and worked extra hard to succeed.

Moving ahead, then, we can see to what extent these cultural constructs also resemble communities of practice, that is, people who come together and explore something through a joint enterprise (Wenger, 1998). Regarding enterprise or having a shared idea of what they wanted to achieve, this trait was perhaps less evident in the empirical material. However, several of them talked about how they "were in the same boat" and how they helped each other in their common pursuit of completing the specific assignment, a course, which would take them one step closer to their ultimate goal of completing their Bachelor's studies. Within the frames of the goal of completing their studies, students defined their own enterprise depending on their induvial goal or level of ambition. Some students aimed for the highest grade or already saw themselves as investment bankers, accountant assistants or auditors, whereas others simply wanted to be done with all the courses. With that said, it may be that the strength of the shared enterprise of completing the program (assignment/course) might be just as important or even more important than students' individual goals in explaining the variation in the empirical material. It could potentially be the variation in the respective multiplex network enterprise that explain why some students benefit from and flourish when they exist in their network, while others do not have the same experience.

Apart from the saga and the shared enterprise, the pooling of resources (skills and knowledge) lead to synergies that helped students accomplish their goals. All the student interviewed (Paper III) were rather explicit with what they thought they had contributed with as they worked in their multiplex networks. Sometimes it was motivation, specialized knowledge about stock markets and firms, creative ideas, or academic writing skills. They also explicitly referred to that they had only achieved the result they aimed for because they had pooled their resources and that the synergies created helped them achieve their goals.

Finally, many of the students commuted. These students were friends and worked together but did not necessarily spend any free time with each other. They had their social life elsewhere and came together, all with their own individual goals, but with

their shared enterprise of completing an education. As such their multiplex networks could be seen as *semi-professional* work groups as they did not exist outside the cohort, or the macro-level study program. Furthermore, the interviews pointed to how it was possible for student groups to maintain a strong common enterprise relevant to the study program at hand, even though they only spent time together to study together, otherwise not. Through this understanding, commuting is not particularly important for study success, instead what is important is the strength and relevance of the enterprise of the multiplex network to which one belongs, and the pooling of resources (knowledge and skills) which enable them to reach their goals.

Can we find this organizational form elsewhere? Organizing involves the process of coordinating collective efforts, that is people who work together, creating synergies as they pool their resources to attain a common goal (e.g., Child, 2005). As such, the mulitplex networks involve an organizing component. In the case of the multiplex study related networks, students have a common goal to complete an assignment, a course and ultimately their graduate, but also the individual goals of the individual students, which may be the most important. By cooperating they create synergies that increases the possibility for them to attain their goals. A picture that comes to my mind is that of the American settlers who travelled the Oregon trail. They all had individual dreams and goals but joined together and pooled their resources to accomplish their shared goal of reaching the American West (e.g., De Voto's *Over the Oregon trail*, in Hillerman, 1991).

The question is: How can we organize a relationship-rich environment in the classroom that enables students to build and maintain study-related multiplex relations, and also make use of their inherent strength to create belonging and engagement? This is not an easy task. Students prefer to decide for themselves whom to work with, as they want to work with people they can trust. Arguably, it is important to do so if the tasks are complex, and their course grade is at stake. On the other hand, as we have learned from the discussion on student readiness, they benefit from meeting and working with people with different perspectives and backgrounds (e.g., Gasevic et al., 2013; Tomás-Miquel et al., 2016,). This means we need to be better at ensuring that students work with others whom they usually do not chose to work with. This means that, to a certain degree, we must direct with whom they work if we are to enable more students to reach their full potential. One important tool for this is group work, but given the discussion above, academic staff with teaching responsibility need to be more aware of design choices regarding group work and its potential effects.

There is an abundance of studies on group or teamwork in HE. In a review, Fittipaldi (2020) found that teachers mainly use group work so that students learn teamwork skills and how to collaborate effectively as well as acquire soft skills or interpersonal attributes employers value. Regarding team selection, two techniques are predominant: teacher-assigned groups or self-selection. Teachers often used self-selection, as they felt that students preferred this method. Research has also shown that students prefer student-selected groups, as they find the group working

process more satisfying (Mamas, 2018). However, as the research above has revealed, teachers need to organize group work so that students meet and work with students they do not know and who can potentially enrich their experience further.

A strategic framework for group formation

The aim of the framework suggested here is to offer a tool teachers can use while reflecting on aims of group work with regard to relationship building, and a tool to counteract students' and other people's natural predisposition for social homophily. This is in line with Kuh et al. (2006), who have shown that student engagement is something universities can potentially affect through active and collaborative learning, Below I will introduce the framework and discuss how it may be productive in the actual study program that has been in focus throughout the dissertation.

The framework (Figure 7) consists of two dimensions. On the X-axis, you find type of assignment, ranging from *Low stakes* assignments to *High stakes* assignments. Low stakes in this context means that the assignment is part of the course grade, but not decisive for the final grade of the course. High stakes then means that the assignment makes up a substantial part of the course grade, and as such will affect the final grade of the course. The Y-axis regards group formation and ranges from *Teacher assigned* to *Student-selected*. The choices made are also affected by whether the group work takes place early in the program or in the latter part.

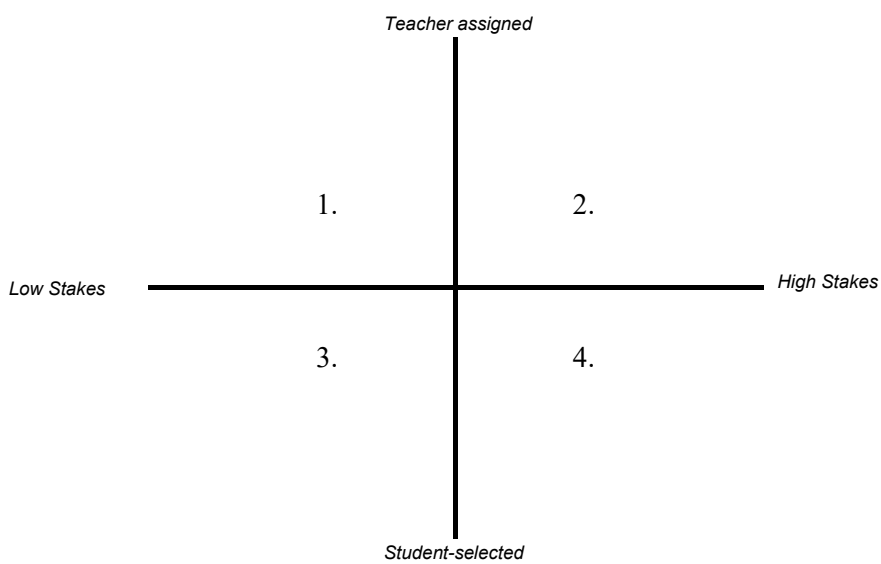


Figure 7 A framework for group design for supporting relationship building

In the first quadrant in the top left-hand corner, (1.) students work on low-stakes assignments in teacher-assigned groups. In the second quadrant, in the top right-hand corner, (2.) students work on high-stakes assignments in teacher-assigned groups. In the third, bottom left-hand corner, (3.) students work on low-stakes assignments in student-selected groups. In the fourth, bottom right-hand corner, (4.) students work on high-stakes assignments in student-selected groups. When and under what circumstances would it be suitable to choose which of the four combinations to support relationship building? I would argue that, depending on when in the program the group work takes place, different mixes of the four design types are suitable.

In the first scenario, (1.) *students work on low-stakes assignments in teacher-assigned groups.* This type of arrangement is a way for students to work with new people to discuss a case, solve a problem or peer review each other's work. The group work is effortless in the sense that not much group coordination is needed. The time frame and the scope of the task are distinct, and the outcome of the group work does not jeopardize the course grade for individual students. In this type of arrangement, students have a good chance of getting to know other students well enough to be able to ask for information or help with an assignment, that is, to help them build weak ties to other students in the cohort/group as well as to students they would typically not interact with. In the case of the program in question, I would use these sessions to mix students who would normally not work together, that is, I would mix gender, age, and immigrant/native students to the greatest extent possible.

One problem here is that not all students may feel they are able to contribute, and some may feel excluded or may not be taken seriously by the other students. They have problems making their voices heard. One way of dealing with this issue is to demand entry tickets to ensure that students come prepared. That way even weaker students are potentially emancipated and feel they have something to share. This type of arrangement is useful as a complement to situation (4.), where *students work on high-stakes assignments in student-selected groups*, to mitigate group-think and increase creativity (e.g., Gasevic et al., 2013; Tomás-Miquel et al., 2016).

The typical situation for students in the first course of the program is scenario (2.), that is, *students work on high-stakes assignments in teacher-assigned groups.* The advantage of this type of arrangement is that teachers can mix students based on various factors (e.g., gender, age, ethnicity, place of residence or specialization). In the first course, students typically do not know anyone, thus, it is helpful for students when groups are teacher assigned, as this allows them to get to know each other. It is here many students form their first friendship ties and, if the group work process functions well, these friendship ties may develop into multiplex networks that remain throughout the whole program.

Negative aspects of this type of arrangement are that the grade on the group assignment will affect the course grade, which especially high-achieving students do not appreciate. If not scaffolded and managed properly, there may also be team

conflicts and problems with social loafing, which may lead to long-lasting divisions among students when they feel their stereotypes are confirmed.

A third potential scenario is that (3.) *students work on low-stakes assignments in student-selected groups*. This type of arrangement is suitable for very brief assignments in class that do not require any preparation. The aim of these types of assignments is to help students reflect on the material covered in class and keep them engaged, for example, in a buzz group. In later parts of the program, students typically work with peers they already know well. This will not help them build new relationships, and they will potentially also not be exposed to as many different perspectives as they would have if they had been divided into teacher-assigned groups.

Finally, in the fourth scenario, (4.) *students work on high-stakes assignments in student-selected groups.* This scenario is what students prefer, and it is important especially in the final part of the program, when students work on their degree projects. When the quality of the work is important, it is important that they can form groups themselves. There is consistent evidence that the quality of the group work is better in student-selected groups (e.g., Curseu & Pluut, 2013; Mamas, 2018). At the same time, we also know that students need input from others to boost creativity (Tomás-Miquel et al., 2016) and understanding of the task (e.g., Lauvås & Jönsson, 2019). For this reason, it is important to create time and space for peer-review or buzz group discussions during the group work process to mitigate these issues.

The design choices a teacher makes will affect the possibilities students have to develop necessary relationships and potentially also improve the quality of learning. In the first year, teacher-assigned groups will enable students to form constructive strong ties and important weak ties within the cohort. Group work and group processes must then be closely monitored to mitigate negative stereotyping and team conflict (Curseu & Pluut, 2013). Frequent use of teacher-assigned groups in combination with low-stakes assignment will allow students to get to know each other without the feeling of risking their course grade; it will also help them build weak ties with each other. This could potentially make it easier to reach out to others to get help with an assignment or to ask for advice. When it comes to high-stakes assignments, when students work together for a longer period at the beginning of the program, they are allowed to develop stronger, multiplex ties with each other, at least in some cases.

The further along students come in their studies, where they have already formed multiplex relations, self-selection is preferable, especially for more complex group assignments, for example, their final Bachelor's dissertation. Research has shown that student-selected groups will help students achieve higher-quality work in complex assignments. At the same time, in order mitigate the negative effects of social homophily on knowledge development and creativity, as well as access to information, students should be offered ample opportunities to work together on low-stakes assignments in class, for example, or to discuss questions related to their high-stakes assignments with representatives of other groups.

Conclusion

The final chapter will present the main conclusions, critical reflections and suggestions for future research.

Main conclusions

The main conclusions of the present dissertation are discussed in relation to the umbrella question: *How can acquiring more in-depth knowledge of student readiness and student social relations contribute to my own teaching practice and that of my colleagues, as well as to the planning and organization of the program?*

I. The most pertinent conclusion regarding student perceived readiness is that students seem to be confident in their own skills, and that self-rated readiness, as measured by the REQ, cannot predict academic outcomes. Previous GPA (previous performance) is a strong predictor of academic outcome for native students in the cohort, but not for students with an immigrant background, who were also generally about one semester behind their native peers. At the same time, the REQ result indicated that they felt equally well prepared. It is important to acknowledge the gap between self-perceived readiness and actual readiness. Academic staff with teaching responsibility must be more explicit about what is expected of students. One way of achieving this would be to increase the focus on formative feedback, which would also be beneficial to students' long-term epistemological development.

II. Students' formation of multiplex networks is positively related to academic outcome. The coexistence of affective and instrumental ties in one relation creates beneficial synergies. The multiplex networks could be seen as *semi-professional* work groups based on trust, with a shared saga and shared enterprise. Like in a workplace, many had their main social life elsewhere, but were joined in the shared enterprise of completing an education. The pooling of skills and knowledge helped students accomplish their goals. As many students do not share social activities outside the classroom, it is vital

to organize a relationship-rich environment *in the classroom* to enable them to build and maintain study-related multiplex relations.

III. To mitigate the strong tendency toward homophily, education programs and academic teachers need to ensure that students work with others with whom they usually do not choose to work and to do so with mutual respect for and interest in the other. Thus, if we are to enable more students to reach their full potential, we must direct with whom they work and design tasks that require true cooperation. One important tool for this is group work, but teachers need to be more aware of design choices regarding group work and its potential effects. A more strategic mix between high- and low-stakes assignments, and student- or teacher-selected groups, may potentially counteract the tendency for homophily.

Critical reflections

The research literature is full of advice on best practice, and the research processes described in published articles always seem to be portrayed as perfectly streamlined. After spending seven years of my life trying to combine teaching and research, I am unsure whether such perfection really exists. There are limitations to all research, and here I will reflect on choices made during the research process that have implications for the conclusions drawn.

This thesis has a mixed-methods approach and is based on mainly quantitative (Paper I, II, IV) but also purely qualitative research designs (Paper III & IV). Using a mixed-methods approach is valuable, especially when researching teaching and learning, as these are considered "messy concepts" – that is, although a student is taking part in an intervention, it does not necessarily lead to the learning intended, and even if it does, it is difficult to determine what factors or mechanisms caused what. Using a combination of methods enables a more complex understanding of the phenomena under study. In the case of the present dissertation, this approach enabled me to gain access to the students' experiences and thus acquire a deeper understanding of the meaning of the multiplex networks.

The appended papers explored student self-rated readiness and study-related relationships in relation to academic outcome using archival data (I, II), paper questionnaires (I, II), individual semi-structured interviews (III), and online questionnaires collecting both quantitative relational data and open qualitative answers (IV).

As discussed in the introduction, I was interested in whether small student-formed peer groups seemed to play a vital role in student engagement and academic outcome. I wanted to know more about them, but I was unsure about how to approach them. Use of a quantitative collection measure enabled me to distance myself from the cohort, allowing the participants to select the other students with

whom they had specific relations (working, learning and friendship). Given my position as an insider researcher, it was especially important that I did not let my preconceptions about students and their potential connections get in the way of their conceptions of their relations.

At the same time, this choice led to possible problems with c*onstruct validity, which is concerned with the accuracy of measuring the phenomenon under study* (Cohen et al., 2007). Quantitative designs for collecting network data are prone to validity problems, because people have different perceptions of the content and quality of their relationships (Wald, 2014). A common problem is that participants may not have the same perception of what constitutes a friendship relation as other participants or the researcher. Although the problem may be reduced by carefully defining the concept, there may still be differences in interpretation, and some students may state that they have very many friends, whereas other students in the sample may not agree with that picture, perhaps due to their different interpretations of the meaning of the word *friend*.

One way of dealing with this issue, which was used in the research presented here, is to employ in-degree centrality measures rather than out-degree, as individual students may overstate the number of friends. Another way would be to let the students define friendship; McCabe (2016) did this and found great variability in students' conceptions. Furthermore, the labels given to the relations explored differ across studies, but the relations measured may be the same. For example, the working relations explored in one module – where teachers assign students, who mainly do not know each other, to teams (e.g., Rienties & Tempelaar, 2018) – may be different from the working relations explored in Papers II-IV. Students reported on who they mostly worked with or had worked with during their studies. It is important to remember that networks are fluid representations of students' perception of their relations.

The use of semi-structured interviews, however, allowed for a more in-depth picture of the complexity of student relationships, but also partly strengthened the construct validity of the quantitative findings and that of the relevance of the multiplex relations and academic outcome. Further use of observations may have enabled me to uncover *how* students interacted and to additionally explore the processes that may enable or hamper engagement and outcomes. Although the interviews offered some insights, this is clearly a limitation and potential approach in future research.

Using quantitative methods may also enable generalization of results. This is problematic in the present case, however, due to the limited number of respondents. Thus, there is a potential issue with external validity, which is concerned with the generalizability of results outside of the context of the specific study (Cohen et al., 2007). The studies upon which this thesis is based are all limited in scope; thus, one must be careful about generalizing the results. The focus of the studies has mainly been on a very specific context: the business program at a Swedish university college. As was obvious in Paper IV, there were differences in student networks

between the university college and university in the same region. At the same time, there may be other HEIs that share features of this specific context. Other teaching-intense HEIs with a diverse student body and a large share of commuter students may find some of the results presented here of relevance. Yin (2009) proposed that case study research should offer analytical generalizations, that is, offer some kind of contribution to theory. In a sense, the findings of Papers II-IV extend McCabe's (2016) conclusion that students benefit from positive academic multiplex relationships.

One problem mentioned above is my position as an insider and the teacher-student relationship, which I discuss in the methodology section (Ethical considerations). This may affect the credibility of the studies. *Credibility* is the equivalent of internal validity in qualitative research, and thus refers to confidence in the truth of the data and interpretations of it (Lincoln & Guba, 1985). At the same time, I had the advantage of an already established relationship of trust, which may have improved credibility (Lincoln & Guba, 1985). A further measure that may strengthen credibility is the method of triangulation, where statistical analysis of the network relations was followed up by conducting individual interviews. For example, this choice enabled a deeper insight into the meaning of the multiplex networks, how they were formed and what they meant to the students. This choice of design made it possible to confirm and deepen discussions about the networks among students as well as to clarify and discuss conflicting experiences. It also enabled a kind of member check, as students verified preliminary results from the network analysis in the semi-structured interviews.

The position as insider posed another problem, that of *dependability*, which is the equivalent of reliability and is closely related to credibility. It refers to the stability of data over time and different conditions, and to what extent a study can be replicated (Lincoln & Guba,1985). To achieve dependability in the analysis of the material in Paper III, two of my PhD supervisors were involved in and discussed the content analysis of student responses until consensus was reached. Furthermore, use of an interview guide for the semi-structured interviews in Paper III further strengthened dependability, as it ensures the same questions were covered. In Paper IV, the open answers were thematically coded by two of the authors individually, then discussed and refined before publishing. Another way to achieve dependability was to try to clearly explain the research design of the two studies that involved qualitative material and be explicit about the methodological choices made.

A third problem with my position as an insider was how to handle my preconceptions of students and try to capture the students' relationships and stories in an impartial manner. To handle the problem of *confirmability* (Lincoln & Guba, 1985), the method of triangulation was used, and in this case of student responses, investigator triangulation was used, as discussed above.

Finally, I feel the use of a more explicit theoretical perspective from the beginning of the research could have contributed to more depth or provide guidance throughout the research process. In the case of the present dissertation, the focus is

on the specific case rather than on a specific theory. One issue with SNA in education is that there is no grand theory, but rather theoretical propositions based on previous research, which then guide the research design. The use of a clearer theoretical framework may have enabled a clearer theoretical contribution.

At the beginning of the research process, Lave and Wenger's work on *Communities of practice* and *Situated learning* was discussed, as were Trowler's (2008) *Teaching* and *learning regimes* and Roxå and Mårtensson's (2015) *Micro-cultures*. However, neither of these models were used to guide the research, but rather as potential lenses to use when discussing the results of the studies. I argue that multiplex networks should perhaps be viewed as semi-professional workgroups and that they share features of communities of practice, such as a common *enterprise* and *saga*.

At the same time, the lack of a clear theoretical frame enabled me to focus on emergent findings, as I did in Paper III. Commuting and commuter students had emerged as an interesting angle in reviewer comments for Papers I-III, which is why that "lens" was used – a lens that in turn led to the discussion on barriers to and enablers of relationship building. In a sense, the exploratory approach has enabled the focus on the case, the specific context, which has been used to critically test existing theory (Yin, 1994), which may thus constitute one important contribution of this dissertation.

Future research

The overarching aim of my research was to explore student readiness and student social relations as well as how more in-depth knowledge could contribute to my own teaching practice and the planning and organization of the program.

The findings presented in this dissertation have not only provided a clearer picture of the inherent strength of students' study-related multiplex networks, but also revealed that there is a risk involved in being locked into a small network with limited resources. The networks differ from each other in composition and outlook; thus, some students benefit from their networks, while others are limited by them. An interesting suggestion for future research would be to consider the students' multiplex relations as semi-professional workgroups and further explore features such as a common enterprise and saga and how different cultures or work processes may potentially lead to different outlooks and outcomes. The use of semi-structured interviews enabled a more in-depth picture of the complexity of student relationships. Using observational methods may uncover how students interact and help explore the processes that enable or hamper engagement and outcomes.

Furthermore, Paper IV indicated there were differences in student networks between the university college and university in the same region. When teaching transitioned online during the Covid-19 pandemic, students maintained their

multiplex relations, but lost contact with peripheral study-related relationships. As they did so, students missed out on the informal flow of information and they became aware of how the loss of interaction led to, for example, a lack of perspectives and information about assignments. The loss of interaction also affected students' well-being. However, commuter students at the university college seemed less affected than did the university campus students. This finding is interesting, and the question is how networks and social interaction differ depending on type of HEI. Is it possible that the potential difference in outlook and needs of different student groups calls for different ways of organizing education, ranging from the organization of courses to the physical facilities offered to students. These questions might be worth further exploration.

A further suggestion for future research is to evaluate the suggested strategic model for group formation. The aim of the model was to serve as a tool that allowed teachers to work more strategically with group formation and to – by employing a strategic mix between high- and low-stakes assignments, and student- or teacher-selected groups – potentially counteract the tendency towards homophily. Here, a longitudinal and ethnographic approach would be interesting, allowing the researchers to follow students and their networks in their real-life environment over time.

Finally, the induction traditions of the program in question were one important barrier to participation but also an enabler, as it was during induction week that students formed a strong attachment to the cohort and program, as well as to the study institution. It was striking how there was a clear difference between the experience of those who participated and those who chose not to for personal or cultural reasons. This choice affected their identification with the program and cohort. The question is how universities or programs could work to create inclusive induction routines that will enable more students, no matter their background, to create strong identifications.

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Paper I

BUSINESS STUDENTS' PERCEPTION OF THEIR READINESS FOR HIGHER EDUCATION STUDIES AND ITS CORRELATION TO ACADEMIC OUTCOME

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ABSTRACT

This longitudinal study explores the link between students' *ex ante* (n=184) and *ex post* (n=113) appraisals of readiness and outcomes in a business program. Results indicate that perceived readiness does not predict outcome. GPA is the strongest predictor for native Swedish speakers but not for non-native speakers in this sample. All students felt well prepared for HE studies, whereas academic outcome in nominal time indicated many were not. One implication is that teachers need to be aware of student overconfidence and early on show what is expected of them performance wise. This is especially important for underprivileged groups.

INTRODUCTION

Teachers have experienced a decline in student readiness for higher education (HE) in the last two decades (Swedish National Agency for Higher Education, 2009). Explanations for the decline are changes in the national curriculum for Upper secondary school which have led to a decline in PISA results, and an increase in the number of students admitted to HE studies. The increase has led to that students with lower grade point averages (GPA) and lower scores on the Swedish Scholastic Aptitude Test (SweSAT) also attend university, which means that there is a greater diversity in student readiness in Swedish HE today. Graduation rates are also low especially in general degree programs with a graduation rate below 50% (Swedish Higher Education Agency, 2018).

For teachers it is challenging to teach a diverse student population. The Swedish National Agency for Higher Education (2009) also pointed to how teachers experienced that academic standards declined in order to deal with low completion rates. Teachers claim the low completion rates are due to the wide spread entry-level skills among students primarily regarding reading, writing, mathematics and general knowledge. Research indicate university teachers assume or expect that students will have a range of skills, such as reading, writing, information search and mathematics skills they in fact do not have (e.g., Barrie, 2004; Jansen & van der Meer, 2007).

Additional challenges to the ranges of students' readiness to undertake HE, are their motivation (Jansen & van der Meer, 2011; Thomas, 2014) and concerns about how to support this diverse student body. The identification of at-risk students may be one way to use scarce resources most efficiently and effectively, thus benefitting the higher education institution (HEI) and students alike (Simpson, 2006). On the one hand, universities are penalized for high non-completion rates, and low-achieving students require considerable resources in terms of academic, administrative and tutorial support. On the other hand, it would be unethical to enroll students who are unlikely to succeed into demanding academic programs. Negative experiences at university may result in low self-confidence among students, while their efforts, time and money could have been spent more appropriately.

This study explored student perception of readiness in relation to academic outcome. It is the results of a longitudinal pedagogical development project carried out among a cohort of Business students enrolled at a teaching-intensive Swedish university. Many students commute, and a large share have an immigrant background or come from homes with no previous academic experience. Given that about 40% of students drop out during their first year, the overarching question was: What do we need to know about our students to better support them during their studies and to improve retention? A further aim was to research what factors affect academic outcomes in this cohort.

Teachers in the Business program believed students' shortcomings and retention problems were due to the educational background of their parents, immigrant background, long commute or overall lack of readiness for HE. Therefore, these factors and their relation to academic outcome are explored in the present study.

FACTORS PREDICTING ACADEMIC OUTCOMES

Many factors influence academic outcomes, making it difficult to predict. In this paper academic outcome is defined as total number of credits achieved in the nominal three years of study. Over the years, researchers have demonstrated correlations between academic outcomes and characteristics students possess prior to embarking on a university program. These characteristics are perceived readiness (Jansen & Suhre, 2011), preparedness (Jansen & Suhre,

2011), learning style (Biggs & Tang, 2011), motivation (Jansen & van der Meer, 2011; Simpson, 2006), intelligence (Rosander & Bäckström, 2014), GPA or previous performance (Campbell & Dickson, 1996; McKenzie & Schweitzer, 2001), personality traits (McKenzie & Schweitzer, 2001; Rosander & Bäckström, 2014; Vedel, Thomsen & Larsen, 2015), self-efficacy (Freudenberg, Brimble & Cameron, 2010; Jansen & van der Meer, 2011; Le, Casillas, Robbins, & Langley, 2005; Simpson, 2006), financial situation (McKenzie & Schweitzer, 2001), family support network (McKenzie & Schweitzer 2001) and other demographics such as gender, socioeconomic background and ethnicity (Krause et al., 2005; Trowler, 2010; Yorke, 2004).

Other factors related to characteristics of students when they are enrolled at a university also influence academic outcome such as student behavior (Jansen & Suhre, 2011), level of engagement (Kahu, 2013; Kuh, 2009; McKenzie & Schweitzer, 2001; Thomas, 2012; Trowler, 2010) and sense of belonging (McKenzie & Schweitzer, 2001; Thomas, 2012; Trowler, 2010). These are potentially the only factors a HEI can influence, because they are related to students' experiences. However, many of these identified factors are intercorrelated. For example, perceived readiness is correlated with preparedness (Jansen & van der Meer, 2011), motivation (Trowler, 2010), nationality (Jansen & van der Meer, 2011), student behavior (Jansen & Suhre, 2011) and engagement (Trowler, 2010). Preparedness also correlate with nationality (Jansen & van der Meer, 2011) and behavior (Jansen & Suhre, 2011), and self-efficacy correlate with motivation (Jansen & van der Meer, 2011; Simpson, 2006). Definitions of relevant factors are presented below, in cases when they are not self-explanatory.

As described above, student *readiness* is one of many aspects that contribute to academic outcome. One definition of student readiness is how ready students are to meet the challenges of HE and to succeed without remedial interventions – that is, how ready students are to complete a required, credit-bearing HE course they need to continue to the next course in the sequence (Conley, 2011). Many fail to meet the requirements of their first module and such failure results in a high drop-out rate that is often explained by referring to a mismatch between the HEI's and the student's expectations and skills. Barrie (2004) referred to these skills as 'precursor abilities,' which include reading, presentation, Information and Communication Technology (ICT), writing and information processing skills.

In a cross-cultural study, Jansen and van der Meer (2011) explored which aspects of readiness could predict overall *perceived preparedness*. They measured preparedness on six scales: Time management, Written communication, Group work, Information processing, ICT and Verbal communication, and found that all scales contributed to students' perception of preparedness, with the exception of ICT readiness. Furthermore, Jansen and Suhre (2011) concluded that students' perceived preparedness is linked to both study behavior and study outcome.

One way to measure preparedness is to simply ask students how prepared they feel for undertaking HE studies. Previous research showed that students' self-efficacy beliefs relates positively to academic outcome (e.g., Freudenberg, Brimble & Cameron, 2010; Simpson, 2006; Le et al., 2005). Likewise, Weine's Attribution Theory explains the positive impact of self-belief, motivation and outcome, suggesting that the more one believes one possesses the skills required for a task, the more motivated one is and the more likely one is to succeed (e.g., Jansen & van der Meer, 2011; Simpson, 2006; Weiner, 1972). Therefore, when researching factors that may predict academic outcome, it is of interest to measure students' self-rated preparedness for HE.

Student engagement is also critical to academic outcome (Kahu, 2013; Kuh, 2009; Trowler & Trowler, 2010). As mentioned above, engagement is a complex concept and correlates with many other factors, making it challenging for researchers (Kahu, 2013). Kahu (2013) defined engagement as a meta-construct encompassing four approaches to engagement

based on different perspectives: the behavioral, psychological, socio-cultural and holistic. While each approach has its advantages and challenges, all are equally important to understanding this complex concept. Kahu (2013) developed a conceptual framework that bridges the different perspectives, embedding them in the social-cultural context. While not claiming to cover all possible influences on student engagement, the model still offers a framework for understanding influences on and consequences of student engagement. In the model, student engagement and academic outcome are fundamentally embedded in a social context; student engagement is a local or even completely personal concept. This highlights the importance of conducting in-depth research on particular student populations and particular settings, which is an important starting point for the present research.

Student engagement is also linked to other variables such as motivation, time management and/or time-on-task. Students who spend considerable time and energy studying and interacting with both teachers and peers outperform those who do not (e.g., Thomas, 2012; Trowler & Trowler, 2010). Previous research has found time management skills to be important in helping students complete their assignments on time. Time management poses a challenge for some students. Van der Meer, Jansen and Toerenbeek (2010) found that only one third of students felt they had developed effective time management and study skills. The link between perception of workload and hours spent studying is not straight forward, however. Kember (2004) pointed out that estimates of hours spent on a task are often inaccurate and that students' perception of workload is a better measure than time spent on independent study or in class. He also linked excessive workload to a surface learning approach, which he explained by the fact that although students know they have to study independently, they are unsure of how to do so effectively.

Motivation correlates with readiness (e.g., Trowler & Trowler, 2010), which in turn correlates with academic outcome. One definition of motivation is "the personal investment that an individual has in reaching a desired state or outcome" (Ambrose, Lovett, Norman, & Mayer, 2010). Thus, the subjective value of the aim and expectation of being able to achieve that aim guide motivation. The value can be linked to intrinsic value (i.e., the satisfaction gained from completing the task) or to extrinsic value (i.e., external rewards such as praise or money). To summarize, many factors affect academic outcome and the review above reflects the complexity of the question.

The aim of the present explorative, longitudinal study is to measure students' self-rated readiness both *before* they start their university studies and *after* one semester, using the Readiness Experience Questionnaire (REQ). This is in contrast to previous research that has measured perceived readiness either before or during/after the first year (Jansen & van der Meer, 2011).

Researchers have explored students' self-rated readiness prior to their actual studies, thus at a time when students may have trouble assessing what is expected of them (Jansen & van der Meer, 2007). For this reason, the present study broadens the scope of previous research by exploring how students' self-rated readiness *changes* after the first semester of university studies. As research shows a mismatch between student and university expectations (e.g., Barrie, 2004; Jansen & van der Meer, 2007; Swedish National Agency for Higher Education, 2009), it is relevant to measure whether students adjust their perception of their readiness after having studied for one semester. Therefore, the present study aims to extend previous research on student readiness and compare student *ex ante* and *ex post* self-perception of readiness. It is proposed that students will moderate their *ex ante* perception of readiness to better match their actual readiness in the *ex post* answers, that is after one semester of studies.

A further aim is to explore the relationship between self-rated readiness and academic outcomes and the extent to which students' self-rated readiness (as measured by the REQ) predicts academic outcomes. This is relevant, because knowing how ex *ante* and *ex post*

perceptions predict performance can, if communicated to students, potentially change students' understanding of what they need to work on to succeed in their studies and, thus, improve their outcomes. It is also relevant for HEIs when designing and providing support to students.

A potential weakness of the use of self-assessed readiness concerns the problem of whether it is possible for students to really estimate their readiness. Research indicates that a high percentage of students feel prepared to undertake HE studies (Jansen & van der Meer, 2011). Jansen and Suhre (2011) explored the link between student self-rated readiness, study behavior and study outcomes. Overall, they found that student expectations and preparedness affected study behavior and academic outcome, although expectations and readiness differed. Students who performed better and had better study behavior also had higher self-rated readiness skills for time management and information processing. It seems that *ex ante* self-rated readiness, at least regarding time management and information processing skills, is a possible predictor of academic outcome. From an educational and institutional perspective, it seems relevant to investigate this possibility further. Thus, this study extends previous research and further explores *ex post* self-rated readiness as a predictor of academic outcome.

A final aim of the study is to identify which background factors best predict academic outcome in this cohort of business students. In sum, the study will address the following research questions:

1. In this cohort, how do students appraise their readiness prior to their studies?
2. In this cohort, how do students appraise their readiness after one semester of study?
3. In this cohort, to what extent does students' self-rated readiness predict academic outcome?
4. In this cohort, which background factors best predict academic outcome?

BACKGROUND FACTORS: THE SWEDISH CASE

In a report from 2018, the Swedish Higher Education Agency discussed widening HE participation and recruitment based on gender, social background, foreign (non-Swedish) background, and domicile (counties and municipalities) (Swedish Higher Education Authority, 2018).

Regarding gender, women are more likely to go on to HE than men are. Among 24-year-olds, 52% of women and only 36% of men were enrolled in HE. In Bachelor's level programs, an average of 60% of students are women. In business programs, however, the share of women and men is about 50%.

Students with a foreign background are categorized as: born in Sweden to two foreign-born parents, immigrated before 7 years of age, or immigrated between the ages 7 and 18 years (Swedish Higher Education Authority, 2018). On average in 2016/2017, the proportion of native students was 76%, students born in Sweden with two foreign-born parents 9% and students who had immigrated to Sweden 14%.

Social background, that is, whether students have parents with a HE degree, affects how prone young people are to go on to HE. The higher the educational level of the parents, the more likely students are to continue studying, both regarding native and non-native students. 85% of students with at least one parent with a PhD go on to higher education studies, whereas only about 22% of students from non-academic backgrounds do so. On the whole, native Swedish students and non-native students who are born in Sweden go on to higher education to the same extent (Swedish Higher Education Agency, 2018).

Retention rates differ across academic programs. On average, 76% of students continue their studies into the second year. There is a large difference across programs, with the lowest rates found for teacher education (68%) and two-year college degree (59%).

Graduation rates also differ across degree programs. Overall, the graduation rate is below 50% in general degree programs and higher in professional degree programs. The highest rates are in midwifery and medicine (89%) and the lowest in engineering (41%). Two thirds of graduates are female. The fact that many students go from one general degree program to another increases the total graduation rate slightly. The Swedish Higher Education Agency measures graduation rates based on the number of entrants to degree programs in a specific year who have been awarded a qualification six years after the official study period. Thus, there is no information on the extent to which students complete their studies in nominal time.

METHOD

The present longitudinal study explored student readiness and its relation to academic outcome in three stages. Students reported on their self-assessed readiness both prior to and after the first semester. Academic outcome was measured after three years, the nominal time for a bachelor's degree.

Setting

The study was carried out in an undergraduate Business program at a Swedish university (N=184; men: *n* =90; women: *n*=94). The university is teaching-intensive, with about 13,000 students enrolled per year. Approximately 200 students enroll in the undergraduate Business program each year. All students admitted to the program have basic eligibility. Students are admitted based on their average Upper secondary school GPA, but because certain quotas of students apply based on their results on the Swedish University Entrance Exam or on a diploma from a Swedish Folk Upper secondary school. Students also have quite diverse socio-economic backgrounds.

The cohort is also diverse regarding the number of students with a foreign background. The average rates for the university in question are 77% native students, 10% students with foreign-born parents and 13% immigrant students. In the case of the cohort under study, the proportion of native students is 63%, thus slightly lower than the national average.

Measures

The instrument used in both the first and the second stage of the study (Table 1) was the Readiness Experience Questionnaire (REQ). Jansen and van der Meer first developed the REQ in a joint project between Groningen, the Netherlands, and Otago, New Zealand, in 2006-2007 (2007, 2012). Because the aim of this study was to explore student self-rated readiness and academic outcome, only the readiness scales from the reduced REQ used in Otago are discussed. The original instrument contains both perceived readiness scales and expectation scales measuring expectations students have regarding introduction to academic skills and differences and/or similarities with Upper secondary school (Jansen & van der Meer, 2012).

Table 1

Response rate

	Distribution	Population	Respondents	Response rate
REQ1*	*Ex ante*	213	184	85%
REQ2**	*Ex post*	213	113	54%

Dependent variable: Academic outcome

In the third stage in the data collection, LADOK, a student administration system used in all universities in Sweden, provided information about student academic outcome measured in terms of completed credits within the specific business program. The cut-off date was 31 October, three years after enrollment, and after the final resubmission date for students' writing their bachelor thesis that same year. This is then much less generous than the graduation rate as measured by the Swedish Higher Education Authority, which measures graduation rate three years after graduation (Swedish Higher Education Authority, 2018).

Self-efficacy predictors of academic outcome

Possible predictors of self-efficacy beliefs are the readiness scales of the REQ that explore *student self-perceived readiness*. The REQ measures student self-perceived readiness regarding Time management, Written communication, Group work, Information processing, Information Communication Technology (ICT) and Verbal communication. Students rated their readiness on a five-point Likert scale (1-do not agree at all/5-totally agree). Table 2 provides examples of items. The scale scores are calculated by adding the item scores and dividing them by the number of unweighted items (Jansen & van der Meer, 2012). Students answered the same questionnaire on the first day of the first semester and a few weeks into the second semester.

Table 2

Sample REQ questions

Readiness scales	No. Items	Sample question
Time management readiness	4	I am good at planning and organizing my studying
ICT readiness	3	I am comfortable using computers for a range of tasks
Written communication scale	4	I can independently write a short report
Information Processing readiness	4	I am confident in identifying the main ideas or main points in a text
Verbal communication readiness	2	I am confident in discussing in small groups
Group work readiness	4	Before coming to university, I worked a lot in groups

A second possible self-efficacy predictor of academic outcome is student self-reported overall perceived *preparedness*. In the initial questionnaire, students rated whether they felt that Upper secondary school had prepared them well for HE (yes/no/unsure/not applicable). The variable was then collapsed into a dichotomous dummy variable excluding the unsure/not applicable responses.

Socio-demographic predictors

The initial questionnaire also included demographic questions such as age, gender, Upper secondary school specialization, language background (native Swedish speaker/non-native), parents' educational background and time spent commuting, as previous research has shown that these factors affect academic outcome (e.g., Krause et al. 2005; Trowler & Trowler 2010; Yorke 2004).

Regarding *language background*, students reported on the mother tongue of both parents. Students with at least one parent whose native language was Swedish were classified as native speakers, whereas students with two parents whose native languages were other than Swedish were classified as non-native speakers.

Social background was measured as educational level of parents. Previous studies have used educational background of parents as a proxy for social background (Schmidt, 2012). Students indicated the highest degree their mother and their father had obtained (compulsory, upper secondary, tertiary). This variable was then collapsed into a dummy variable (0=upper secondary diploma or less; 1=university degree).

Because a large number of students in the cohort *commute* to university, students indicated the approximate time (hours) they spent commuting to class.

Academic predictors

Academic predictors in this study were: Upper secondary school grade point average (GPA) and Swedish scholastic aptitude test scores (SweSAT). Normally, universities admit two thirds of students based on their GPA and one third based on their SweSAT scores.

Grade point average (GPA) is one of the strongest predictors of academic outcome (e.g., Campbell et al., 1996; Rosander & Bäckström, 2014). GPA was the admission entry points registered in the university student administration system; it is an average of the Upper secondary school grades.

Previous research has also found that SAT scores have predictive value, although the research is inconclusive (Kuncel, Credé, & Thomas, 2007; Lyrén, Rolfsman, Wedman, Wickström, & Wickström, 2014). The Swedish scholastic aptitude (SweSAT) scores registered in the university admission system were collected. Not all students have SweSAT scores as this test is optional.

Procedure

Students answered the two questionnaires (REQ1 & REQ2) on paper in a classroom setting, after a brief introduction with information about the procedure, informed consent and confidentiality in processing and the storage of the collected data. Each test sessions lasted approximately 20 minutes.

Where identifiers were missing, responses were not used. The REQ1 sample consisted of 184 Business students, whereas the REQ2 sample was 113 students (Table 2). REQ1 took place immediately after the introduction to the first course of the first semester. REQ2 took place during a lecture in the second semester, and some students did not attend that class for various reasons. A control of the results of missing students in the second sample indicated the drop-out did not distort the outcome of the analyses.

RESULT

The aim of the present study was to explore student self-rated readiness prior to (*ex ante*) and after (*ex post*) one semester of study, as well as the link between the learning approach students identify with and academic outcome. An initial correlation analysis (see Table A1 in Appendix A) indicated a significant difference in outcomes between native and non-native students, with native students outperforming non-native students. The demographic characteristics of these two groups are also presented separately. Only 28% of students in the initial sample achieved the nominal 180 credits in three years; thus, the demographic characteristics of this specific group of students are also presented separately (Table 3).

Demographic characteristics

There was an even distribution of the sample concerning gender with about 50% female students in the three groups: all students (n=184), native speakers (n=127) and non-native speakers (n=57). However, there was a majority of female students in the nominal group (n=52). The majority of students were between 19-21 years old, and 69% were native speakers in the initial sample ('All' in table 3). Fifty percent of students commuted more than two hours every day and some as much as 3-4 hours. The average time spent commuting was about 2 hours for all groups, where the non-native speakers commuted slightly longer on average.

Table 3

Demographic characteristics of the sample (mean/std. dev)

Variables	All (*n*=184)	Native speakers (*n*=127)	Non-native speakers (*n*=57)	Nominal (*n*=52)
Share female students	51%	52%	49%	60%
Age (yrs)	21.7 (3.8)	22 (3.8)	21.2 (3.8)	21.4 (2.6)
Commute (h)	1.94 (1.3)	1.8 (1.3)	2.3 (1.3)	1.7 (1.4)
Share both parents HE	37.5%	44.9%	31.6%	42.6%
GPA[i]	16.9 (2.03)	17.1 (1.9)	16.64 (2.1)	17.7 (1.6)
SweSAT[ii]	0.92 (0.27)	0.97 (.21)	0.77 (. 35)	0.90 (0.27)
Academic outcome[iii]	153.9 (35.7)	163.7 (29.2)	140.6 (36.2)	180

i) Upper secondary school grade point average

ii) Swedish scholastic aptitude test scores, Max score 2, national mean about 0.9

iii) Total no. credits achieved in nominal time (3 years)

37.5% of all students came from homes with an academic tradition, that is, had two parents with a HE degree. Only 31.6% of non-native speakers came from homes with an academic tradition, compared to 44.9% for the native and 42.6% nominal groups. The average GPA also differed between groups, such that the nominal group had a higher average GPA (17.7) than the other groups. The mean SweSAT score for non-native speakers (0.77) was lower than the SweSAT score for native speakers (0.97), but the average score for the nominal group was actually slightly lower (0.90) than for the whole sample (0.92). Regarding academic outcomes, non-native speakers earned on average 23 credits less in three years than native speakers did.

Independent-samples T-tests compared the scores for background factors between the nominal/less than nominal and native/non-native speakers. There was a significant difference in academic outcome between students with nominal outcome (M=180.0; SD = 0.00) and those with less than nominal (M = 135.0; SD = 36.7) in this background variable *(*t (148) = 10.54; $p < 0.001$). There was also a significant difference in Upper secondary school GPA between the nominal (M = 17.7; SD =1.6) and less than nominal (M = 16.61; SD = 2.10) regarding this background variable (t (168) = 3.68; $p < 0.05$). These results seem to suggest that students with a higher GPA also do better and are more likely to complete their studies within the nominal time.

There were significant differences (t (144) = 3.52; $p < 0.05$) in SweSAT scores between native speakers and non-native speakers, as well as in academic outcome (t (126) = 3.31; $p < 0.001$) (see M and SD in Table 3). These results suggest that there is a difference in outcome depending on whether the student is a native or a non-native speaker, in that non-native students on average earned 23 credits less in three years than native students did. Non-native students also performed less well on the SweSAT test. Although the mean GPA was also lower for non-native speakers, the difference was not significant, which would seem to indicate that the grades of these students may have been inflated.

How do students appraise their readiness prior to and after one semester of studies?

Students appraised their readiness for HE studies both prior to and after one semester of study. A paired sample T-test compared the two conditions, *ex ante* and *ex post* readiness scales, as summarized in Table 4. Because the 2-tailed values for Time management, Written communication, Information processing and Verbal communication are less than .05, there is a significant difference between the means of students' self-rated readiness prior to and after the first semester on those scales.

Table 4

Readiness prior to and after the first semester, M (SD)

Table Readiness Scales	REQ1 *Ex ante* (*n*=184)	REQ2 *Ex Post* (*n*=113)	*t (df)*
Time Management	3.97 (0.62)	3.83 (0.64)	2.56 (109)*
Written Communication	3.73 (0.67)	4.14 (0.63)	-6.51 (109)***
Group Work	3.81 (0.77)	3.86 (0.69)	-.67 (107)
Information Processing	3.56 (0.63)	3.78 (0.60)	-3.91 (107)***
ICT	4.34 (0.56)	4.43 (0.64)	-1.77 (107)
Verbal Communication	3.47 (0.90)	3.66 (0.87)	-2.51 (107)*

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

REQ1 indicates that students felt most certain about ICT, Time management and Group work readiness, and less sure about Written communication, Information processing and Verbal communication. However, this perception changed after having completed their first semester (REQ2).

On the time management scale, the students' ratings declined, indicating that they felt they were not as well-prepared regarding time management compared to their initial self-rating. In contrast, the increase in ratings on written communication indicates that the students felt even better prepared after one semester, which could be attributed to the fact that teaching efforts linked to course assignments in the first semester focus on academic writing, format and referencing.

Likewise, students indicated feeling more confident regarding both Information processing and Verbal communication, where the *ex post* scores were higher than the *ex ante* scores on those scales. The differences were significant, indicating that the students felt more confident about searching for information after semester 1. Interestingly, *ex post*, students felt more confident about writing than about both time management and group work, where they scored significantly higher in the first case, and lower but not significantly so in the second case. They nevertheless felt most confident about ICT use, even more so after the first semester, but not significantly so. No significant differences existed between the *ex ante* and *ex post* appraisals on the ICT and Group work scales, and no differences due to the various background factors. There were no significant differences in the REQ scores between the different groups (all/nominal students; native/non-native speaker).

What factors predict academic outcome?

First, two standard regressions were performed between academic outcome as the dependent variable and the self-efficacy predictors, the REQ scales and student self-rated readiness as independent variables. Neither REQ scales nor readiness predicted academic outcome after three years. The result was the same for all students, native speakers and non-native speakers alike (Table 5).

Second, both academic and socio-demographic predictors were entered into a multiple regressions model. After an initial test, gender and age were removed from the model, as they had no significant impact on academic outcome. For all students, previous GPA, socio-economic background and time spent commuting were significant predictors of academic outcome. On average, students with two parents with academic degrees earned 12 credits more in nominal time (Table 5). The model explained 29% of the variance. This result is in line with

Table 5

Predictors of academic outcome for all students, native and non-native speakers

Dependent variable	Predictors	All students *(n=112)*				Native speakers (*n=94*)				Non-native speakers (*n=33*)			
		β	F	df	R2	β	F	df	R2	β	F	df	R2
	REQ1		0.99	7	0.00		0.402	7	0.04		0.62	7	0.14
	Verbal com.	-.70				-.64				-4.93			
Academic	Time mgmt	3.22				-.24				7.33			
outcome	Written com.	-5.13				-9.09				-1.49			
	Group work	-2.83				-.32				-4.45			
	Info proc.	-4.32				3.81				-10.76			
	ICT	-6.66				-4.10				-11.48			
	Preparedness	8.55				9.88				11.08			
	REQ2		0.52	6	0.04		1.01	6	0.10		1.27	6	0.06
	Verbal com. 2	-3.25				-4.57				.05			
Academic	Time mgmt 2	8.48				5.76				-.16			
outcome	Written com. 2	4.80				-6.14				-.06			
	Group work 2	0.48				7.95				-.16			
	Info proc. 2	-7.00				-1.59				.13			
	ICT 2	0.62				-2.59				.01			
	Background variables		6.47***	5	0.28		3.17*	4	0.18		0.38	4	0.19
	GPA	5.00**				5.17**				5.96			
Academic	SweSAT	14.45				-.78				30.01			
outcome	Language background	16.45*											
	Social background	14.90*				9.66				25.01			
	Commute	-5.18*				-5.79*				-4.85			

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

findings from previous research. Although language background was not significant, non-native students who has Swedish as second language, overall, earned about 16 credits less in the nominal time than native speakers did. Interestingly, SweSAT scores were not significantly related to academic outcome.

For native speakers, the result was similar to that of the whole sample. The three significant predictors – previous GPA, socio-economic background and time spent commuting – were strong predictors of academic outcome, explaining 23% of the variance. However, for non-native speakers there were no significant correlations for any of the predictors and outcome. GPA did not predict academic outcome. Likewise, neither time spent commuting nor parents' social background predicted academic outcome for this group.

As previous research indicates, students who drop-out tend to do so during the first year. This was indicated by the drop from 200 students enrolled the first semester to 111 students enrolled in the third semester. Only 26% of students enrolled took 180 credits within the nominal three years for a bachelor's degree. The overall share of non-native students declined slightly during the 3-year period, but the real effect was evident when analyzing to what extent students achieved the nominal 180 credits in three years. Here the number of non-native speaking students decreased from 25 enrolled Year 3 to only 17% (Table 6).

There were no significant differences between native and non-native students regarding time spent commuting, number of female students or age. However, there were significant differences between the groups regarding SweSAT scores, GPA and academic outcome. In the nominal group, the number of female students increased, as did the number of students with two parents with a HE degree (Table 3).

Table 6

Distribution native/non-native students through the program

	Year1	Year2	Year3*	Nominal***
Share native speakers	63%	69%	75%	83%
Share non-native speakers	37%	31%	25%	17%
No. native speakers	127	77	65	43
No. non-native speakers	57	34	22	9
Total no. of students	184**	111	87	52

* Students admitted to final semester (Bachelor's thesis)
** 16 missing (200 students enrolled)
*** Nominal = students who complete 180 credits in three yea

DISCUSSION AND PEDAGOGICAL IMPLICATIONS

One aim of this longitudinal pedagogical development project was to explore student self-rated readiness prior to and after one semester of study and its possible link to academic outcome. If successful, administration of the questionnaire among freshmen students and subsequent results would allow teachers to take appropriate preemptive measures in time to improve academic outcome. Contrary to previous research (Jansen & Suhre, 2011; Jansen, André, & Suhre, 2011), the present findings showed that student self-rated readiness and preparedness, as measured by the REQ, did not predict academic outcome.

Given that students often find their first encounter with HE to be shocking and chaotic (Edvardsson-Stiwne, 2005), it is interesting to see how students rated their readiness after having completed their first semester. Because motivation and self-efficacy beliefs are important to academic outcome, it was expected that the more ready the students felt (i.e., the higher their score on the REQ), the better they would perform. It was also expected that scores would decrease when students realized they were not as ready as they had thought. However, instead of feeling less sure of themselves, the scores increased on all scales but one (Time management), and increased significantly for Written communication, Verbal communication and Information processing. There was also no correlation between REQ results and academic outcome.

One possible explanation for this is that the instrument does not truly measure how prepared students actually are, but how confident they feel in themselves. One problem with the REQ used in the present study, and with other self-evaluation instruments, is that students may have problems interpreting the real meaning of the questions (Kahu, 2013) and, therefore, have problems assessing their own ability and skills (Lizzo & Wilson, 2008). In addition, students' conception of what it means to be able to write an essay may not accord with what teachers actually require, as indicated by Hounsell (as reported in Marton & Booth, 2000). This may also be true regarding students' very high rating on ICT use. Responses indicate that students feel confident about efficiently using computers. However, that conception may have more to do with using the computer for gaming, social networking or as a multimedia center than with using it as an academic tool for writing reports or analytics. Teachers in the program reported that students, for example, generally lack sufficient skills to format a paper in Word or use Excel effectively.

Regarding demographic characteristics and academic outcome, the result of this study confirms previous research. For all students, previous GPA, socio-economic background and time spent commuting were significant predictors of academic outcome. On average, students with two parents with academic degrees earned 12 credits more in nominal time. This result is similar with findings from previous research which indicates that student with lower socio-economic status fare less well in HE (e.g., Trowler, 2010). Although gender was not a significant predictor, the number of female students in the nominal groups was about 60%, which is equivalent to levels reported by the Swedish Higher Education Authority (2018).

Non-native speakers, overall, earned less credits in the nominal time than native speakers did. This is also found in the international research, which indicates that students of certain ethnic backgrounds perform less well in HE than do dominant groups (Krause et al., 2005; Trowler, 2010; Yorke, 2001). Interestingly, for the group non-native speakers, there were no significant correlations for any of the predictors. It seems as if the fact of having a language background other than Swedish outweighs all other predictors, although T-tests indicated there are significant differences in mean SweSAT scores, GPA and academic outcome. The share of non-native

speakers enrolled declined only slightly during the three years; however, the share almost halved in the nominal group, that is, the group of students who graduated in nominal three years. One explanation for this drop is that, all other things equal, non-native speakers take 16.45 less credits than do native students (see table 5). This means that fewer non-native students were eligible to write their bachelor thesis in their final semester, and even if they did, they did not have enough credits to complete their degree in nominal time.

Previous GPA (previous performance) is normally a strong predictor of academic outcome, but not so for the non-native speakers in this cohort. One conclusion is that the grades for this group from Upper secondary school might be inflated. In a study on students in compulsory school, Klapp (2015) found that girls and students from homes with no academic tradition were given higher grades based on factors other than achievement. One problem here might be that non-native speakers may take Swedish as a second language classes but are admitted to HE on the same terms as native speaking students. Maybe this is necessary in order to achieve widening participation. However, since the REQ results in this study suggest that students feel equally prepared regardless of both background and outcome, it seems to be misguided benevolence from the school system to encourage students to apply for education which they are not fully equipped to manage and without providing them with necessary skills training.

The most pertinent conclusion of the present study is that students seemed to be confident in their own skills. It is important for teachers to acknowledge this, because this belief indicates a gap between self-perceived readiness and actual readiness and may be one of the reasons why about 40-50% of students leave the Business program during the first year. One implication is the importance for teachers to *show* students what is expected of them, for instance by providing clear text examples, and not only to *tell* them. Such a practice might enable students to see what to strive for in their work. This level of clarity may be even more important to non-native speakers, who earned fewer credits than their native counterparts did. This increased degree of explicitness in academic expectations may also benefit native students whose parents have no HE degree, as this group is also at a disadvantage, at least with regard to completing the studies in nominal time.

In order to be successful in HE, the student must be a good reader and writer. Extra work is needed here. In Sweden many universities lack courses in academic writing for students. One possible intervention could be to purposefully work with literacy development throughout the program, which would benefit not only non-native speakers, but all students. This type of work is now increasingly being undertaken in primary and secondary education, but the present results indicate that additional measures may be needed also in tertiary education.

However, the language skills needed to succeed in HE entail not only actual linguistic skills, but also the ability to decode "the language of education," that is, to know what is important and how to behave to succeed. In this regard, a great deal of work is needed to enable students to better understand the social code and perhaps even how universities organize and prioritize their teaching.

Limitations of the Study

This study is limited in scope as it is a single site study on one student cohort; thus, one must be careful about generalizing the present results. It is only possible to point to significant differences in this specific study sample. More research is needed to better understand the different groups identified in the present study, and to be able to offer effective support measures at the group level. For example, how can we better accommodate non-native speakers? As Kahu (2013)

pointed out, student engagement and outcome are deeply embedded in a social context, but how do we create an environment for everyone? Should we perhaps be considering different forms of graduation? To address these questions, in-depth studies into specific student populations are needed to discover what characterizes specific student cohorts and the groups within them. Who are they and what drives them? How do they form relationships that affect their learning, with whom and why? What implications do these relations have for students' views on what it means to be a student and to study a specific subject area? How do we create an academic environment where all students can reach their potential?

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APPENDIX A

Correlation Matrix

Table A1

Correlation matrix – all students

	Academic outcome	SweSAT	GPA	Age	Gender	Commute	Social backgrd.
Academic outcome	1						
SweSAT	0.15						
GPA	.18*	-.30**					
Age	0.05	.27**	-0.11				
Gender	.19*	-.19*	.25**	0.08			
Commute	-.22*	-0.11	0.04	-0.01	0.06		
Social Backgrd.	0.15	0.06	-0.01	-.17*	-.23**	0.03	
Language Backgrd.	.33**	.34**	0.10	0.09	0.03	-.17*	0.12

* $p < 0.05$
** $p < 0.01$
*** $p < 0.001$

Paper II

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The Constructive Overlap: A Study of Multiplex Ties in Students' Study-Related Networks and Academic Performance

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Abstract

This article adds to a growing body of literature on how various types of social relations can work synergistically to promote students' academic success. Students' study-related social networks affect academic outcome in higher education. The network literature in education generally explores students' various relations separately, rather than their multiplex relations or when *individuals share several relations*. This approach risks missing the full complexity of the student experience. The aim of the present study is to add to the discussion on student social networks and attainment in higher education by further exploring multiplex relations maintained in a specific study program, in which a large share of students in the cohort commute. A survey was distributed to students in one cohort ($n = 146$). The findings revealed that, in this cohort, students' friendship, working and learning networks overlap substantially, and that centrality in the friendship and in the student multiplex networks was positively and significantly related to academic outcome, whereas centrality in the working and learning networks was not. Points for future research are suggested, and practical implications for those supporting student learning in higher education are discussed.

Keywords Social network analysis · Academic outcome · Higher education · Commuter student · Multiplex relations

Introduction

The classroom is a central place for the formation of supportive relations, and university students generally perform better in relationship-rich environments (Felten & Lambert, 2020). The transition to online education during the Covid-19 pandemic

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has made the importance of social relations even more apparent. Students report a decline in well-being as interaction between students has declined and co-studying networks have become sparser (Elmer et al., 2020).

It seems as though the social control and peer pressure existing within student social networks motivate them to succeed (Eggens et al., 2007). As the student body becomes more diverse, and more students live at home and commute to university rather than living on or close to campus (e.g., London Higher, 2019; Pokorny et al., 2017; Thomas, 2019), it may be difficult for them to create and maintain supportive networks. Important work is done on different levels—with faculty, staff and students—to enhance the student experience (Felten & Lambert, 2020). The focus of the present study is on how the students themselves form relations in and around the classroom.

Several studies have explored student friendship and learning relations and their effect on academic outcome (e.g., Eggens et al., 2007; Hommes et al., 2012; Rienties & Tempelaar, 2018). Centrality in a social network has been found to be positively linked to academic success, even though social network relations had a greater effect on student learning than prior performance. At the same time, an independent analysis of student relations may be oversimplistic. For this reason, there is a need to acknowledge that several relations largely overlap and that it may be these so-called multiplex relations that positively affect learning and academic outcome. Multiplex relations occur when individuals share several relations, for example, if you have a friend who is also your co-student and your cousin (e.g., Kuwabara et al., 2010; McCabe, 2016). In addition, studies have shown that overlapping (multiplex) study-related relations are more likely to remain after college (McCabe, 2016) and have also been more resilient during the Covid-19 pandemic (Elmer et al., 2020).

However, studies focusing on multiplex relations in higher education are rare. Network studies have instead focused largely on how different types of relations in isolation contribute to academic outcome. The aim of the present study is to explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations as well as to look at how uniplex and multiplex relations relate to academic outcome. Thus, the present study adds a new approach by shifting from the study of independent student friendship, learning and working relations to a more complex understanding of student relations and academic achievement, and possible implications for practice.

Literature Review

First, there is a need to acknowledge previous research on factors influencing academic outcome. These are partially personal background factors that are difficult for universities to influence. For example, research has consistently found that IQ and previous performance are the strongest predictors of academic outcome (e.g., Cambell & Dickson, 1996; Rosander & Bäckström, 2014). Other factors, for example, engagement (e.g., Kahu, 2013; Kuh, 2009; Thomas, 2012; Trowler & Trowler, 2010 and social network formation (e.g. Biancani & McFarland, 2013; Eggens, et al., 2007; McCabe, 2016) may be influenced by universities, because these factors are

related to students' experiences. However, the picture is complex, and several factors are intercorrelated. The remaining part of the literature review will discuss how student social networks, or study-related relations, affect academic outcome.

Student Friendship, Working and Learning Relations and Academic Outcome

Social network analysis (SNA) offers a structured way to explore student networks, focusing on the relations between actors (Hollstein, 2014). Social networks can be defined as the study of linkages or ties (relations) between a specific set of social actors (nodes) in, for example, a workplace or a family. An actor's importance in a network is generally conceptualized as the actor's centrality within a network, for instance, the number of relations a student has within a specific network (e.g., Grunspan et al., 2014). There is consistent evidence showing that students form homophilic networks, that is, they prefer friends like themselves regarding race/ethnicity, socioeconomic background, age, and cultural preferences. This tendency may be due to either preference or opportunity. Initial group division has been found to be a strong predictor of relations. In modules where students worked together on well-aligned assignments and tasks, students developed cross-cultural friendship relations, at least temporarily (Rienties & Nolan, 2014).

Relations are operationalized differently in different studies, but most studies distinguish between instrumental, work-related relations and affective, friendship relations (Rienties & Tempelaar, 2018). Friendship networks are expressive networks based on trust and involve passive information diffusion (Hommes et al., 2012, p. 747); they are normally considered to involve what Granovetter (1973) defined as strong ties (McCabe, 2016). School-related working and learning networks, on the other hand, provide instrumental support (Chen et al., 2012), such as sharing of notes or solving an assignment together, and as such are often considered to involve weak ties. The number of relations a student maintains varies, but one consistent pattern is that students seem to have fewer learning relations than friendship relations (e.gRienties et al., 2013; Shah et al., 2017).

Centrality in a social network is positively linked to academic success, as measured by GPA (e.g., Grunspan et al., 2014). For example, Hommes et al. (2012) studied the influence of social networks on academic outcome in a Dutch medical school ($n = 301$). They found that social networks were associated with students' social integration, and that social network relations had a greater effect on student learning than did prior performance. Prior performance was found to influence students' centrality in the network, with the high performers being in central positions and the students with the lowest performance being in the periphery (Hommes et al., 2012). In another study, Tómas-Miquel et al. (2016) found a positive relationship between centrality in the academic (work) network and academic success, and a negative relationship between centrality in the friendship network and academic success. Hence, students' social network has been measured in various ways, and there are inconclusive results on which type of relation matters most for academic success (Rienties & Tempelaar, 2018; Tómas-Miquel et al., 2016).

There are two important aspects to consider. First, studies often focus on specific modules and groups constructed by teachers, either as teams in specific modules or learning communities. This means that the inter-group learning relations may be the relations students normally work/learn with. In a cohort of students who take almost all courses together, this could mean that students' *intra-group* working/learning relations are what Rienties and Tempelaar (2018) define as *inter-group* working/learning relations. Second, the types of relations or networks studied have been defined somewhat differently in different studies. In some studies, researchers move between discussing the contribution of students' overall social network to discussing a specific type of relation (e.g., working or learning relation), as if they were identical. This means that it is difficult to determine the contribution of each type of relation or what type of relation is being discussed.

In the present study, friendship networks are defined as peers with whom students socialize in and around the classroom. These are expressive relations, but may include passive information diffusion (Hommes et al., 2012). Academic, working and learning networks include individuals with whom students communicate formally or informally about study-related topics. Thus, the main difference between the present study and previous studies is that students were not assigned to any specific groups at the time of the study. Instead, they reported on whom they considered they had learned from or worked a lot with during the past 2 years of study, rather than just during one module. Based on the above discussion, it is possible to suggest that both students' social (affective) friendship relations and instrumental working and learning relations contribute to academic outcome. Multiplex relations are when students share all three relations. The types of network relations discussed in the present paper and the type of support they offer are summarized in Table 1.

Multiplexity in Students' School-related Networks

Many relations are multiplex, but relationships in education are still often treated as separate, independent constructs (uniplex), which may be misleading. There are few studies on multiplex relations in higher education, but there are organizational studies exploring individual performance benefits of multiplex relationships (Shah et al., 2017), tradeoffs of multiplex relationships and association with job performance (Methot et al., 2016), or on the role of tie content in the evolution of multiplex relations in interorganizational networks (Ferriani & Fonti, 2013). Multiplex relations can be assumed to be particularly strong when affective ties overlap with instrumental ties. Thus, multiplex relations that combine friendship, learning and working relations could be defined as strong ties, which are more closely linked to emotion, identity (Granovetter, 1973) and change in values and behavior (Centola, 2018).

The relation between multiplex relations and performance in an educational setting is underexplored. It is often presumed that social exchange takes place in a similar manner between all types of relationships in a network, although goodwill (social capital) exists to a different extent in relationships. This may mean that it can be theoretically problematic to treat learning, working and friendship relations as though they were identical, as such an approach may lead to erroneous conclusions

Table 1 Types of Network Relations and Support Offered

Type of relation	Definition	Type of support
Friendship	People in class students socialize with in and around the classroom	Affective
Learning	People in class students have learned from during their studies	Instrumental
Working	People in class students have frequently cooperated with during their studies	Instrumental
Multiplex	People in class with whom students share all three relations (friendship/learning/working)	Affective & instrumental

(Shah et al., 2017). It is not possible to determine whether the effects of a friendship network can be solely attributed to the friendship itself, or whether that friendship is interwoven with a work-related component where friends also share instrumental support and information (Methot et al., 2016).

In some of the few studies in this area, Chen et al. (2012) described students' multiplex relations in a Chinese MPA program, McCabe (2016) discussed how students develop academic and social relations, and multiplex relations over time in university in the US, and Shah et al. (2017) explored the effect of uniplex and multiplex relations on performance in teams of middle-manager MBA students. Friendship network density was not significantly related to group performance, although, in groups with strong friendships, constructive controversy boosted performance, in contrast to groups with weak friendship relations, where constructive controversy harmed performance. Hood et al. (2017) explored the effect of conflicts and multiplex relations on team performance in 120 teams of business students. They found that conflicts among team members who were also friends negatively impacted team performance, whereas conflicts between non-friends had a positive effect on team performance.

In sum, the substantial overlap between the different friendship, working and learning relations reported in previous research (e.g., Chen et al., 2012), multiplex relations (McCabe, 2016), and the substantial overlap found in the present data point to the relevance of exploring student multiplex and uniplex relations and academic outcome.

Aim & Research Questions

The aim of the present study was to explore how students form working, learning and friendship relations and to what extent these overlap in multiplex relations, as well as to look at how uniplex and multiplex relations are related to academic outcome. Thus, the present study adds a new approach by shifting from the study of independent student friendship, learning and working relations to a more complex understanding of student relations and academic achievement:

(RQ1) To what extent do students in a specific program develop relations with other students and what are the characteristics of the networks formed?
(RQ2) What is the relation between students' friendship, learning and academic work networks and academic outcome in this specific context?
(RQ3) What is the relation between students' multiplex relations and academic outcome in this specific context?

Method

Research Design

The analysis is based on data from an exploratory survey using self-reports. Quantitative relational data were collected in a paper survey ($N = 109$) at the end of the fourth term of study, where one term equals 20 weeks of study. The present article reports on a quantitative analysis of student uniplex and multiplex study-related relations and their effect on academic performance.

Study Context

The present study focused on a cohort of business students ($N = 146$) at a teaching-intensive university in Sweden in the spring and fall semester of 2016. Few in this cohort lived on or close to campus, and about 70% commuted to school, the commute taking between 1 and 3 h a day. Thirty-seven percent had an immigrant language background, and only 30% had two parents with an academic degree.

Students were divided into three classes of between 40 and 70 students, which they followed for 3 years. This is in stark contrast to the situation for students in most reported studies on student social networks in university settings, where students had more flexibility to choose their courses and/or were more likely to live on campus and form networks within their living arrangements/dormitories or in organized learning communities.

The student population of the present study was less culturally diverse than the populations in studies focusing on ethnicity or student social networks and race. The Swedish National Agency for Higher Education (2018) advocates widening participation and recruitment based on gender, social background, immigrant background, and domicile (counties and municipalities). On average, the proportion of immigrant students was 24% in 2016/2017, which was representative of the population as a whole (SCB, 2021).

Students worked in assigned teams during their first semester, with a mix of students in terms of gender, language background (native/immigrant) and place of residence (commuter/local) to enable them to form study-related relations. Together, these teams solved different study-related tasks. In subsequent courses, students were mainly free to self-select their groups.

Sample and Procedure

Individual-level background data were collected from 146 students (men: $n = 64$; women: $n = 82$) who were part of a cohort of students enrolled in a business administration program divided into three distinct specializations: accounting and auditing (Specialization A), bank and finance (B), and international business and marketing (C). They studied together the first year and to some extent in the second year.

Table 2 Sample characteristics

	A	B	C
N	73	34	39
No. female students	46 (63%)	14 (41%)	22 (56%)
No. native students	46 (63%)	22 (65%)	24 (62%)
Average age (years)	25.8 (SD = 4.9)	24.7 (SD = 2.0)	24.3 (SD = 2.2)
Average SweSAT**	0.87 (SD = 0.30)	0.96 (SD = 0.25)	0.79 (S = 0.29)
Previous GPA**	17.27 (1.92)	16.66 (1.76)	16.55 (2.26)
Academic outcome*	144.10 (SD = 44.57)	151.10 (SD = 40.05)	146.36 (SD = 42.58)
Av. commute ***	2.23 (1.43)	1.49 (1.21)	1.33 (1.31)

* Total credits achieved in three years; ** SweSAT (Swedish national scholastic aptitude test). Max = 2; National average = 0.9; *** Average time (h) spent commuting

Relational network data were collected from 106 students (men: $n = 40$; women: $n = 56$; response rate 73%) (Table 2). The network data were collected via a paper survey in class during a lecture in spring 2017. The completion time was about 30 min, and participation was voluntary.

Students were informed about the aim of the study and how the data would be used and presented. They were asked to give their written consent and were ensured confidentiality in the handling and presentation of data, in line with the university's ethical guidelines.

Measures

The instrument used in the first part of the study mapped the working, learning and friendship relations students maintained. It was assumed that because students were at the end of the second year, they had likely formed both friendship and academic work relations. Information concerning sociodemographic characteristics were obtained from secondary data (Fjelkner, 2020).

Networks

A closed network (e.g., Rienties, & Templaar, 2018; Tómas-Miquel et al., 2016), roster recollection method (Tómas-Miquel et al., 2016) was used, that is, students were asked to select the students they were friends with from a list of names of all the students registered in the given specialization. To explore student networks, participants received a list of all students enrolled in their specialization and were asked to mark students whom they "*work a lot with,*" "*have learned from,*" and "*are friends with.*" Regarding the question "I am friends with," Swedish has two commonly used words for *friend*, one conveying the meaning of close friend (*vän*) and the other someone one is better acquainted with (*kompis*), but still more a friend than a mere acquaintance. The word finally used for friend was *kompis*, indicating that students should mark not only their closest friend/s in the group, but everyone with whom they regularly hang out, at least in class or during breaks.

Sociodemographic Predictors

Sociodemographic predictors included background questions regarding age, gender, upper secondary education, language background (native Swedish speaker/immigrant Swedish speaker), time spent commuting and parents' academic background. The background data used in the present study were secondary data collected in the same cohort for an earlier study on student readiness for higher education studies (REF); that study showed that all of these factors affect academic outcome, in line with findings from previous research (e.g., Krause et al., 2005; Trowler & Trowler, 2010; Yorke, 2004). Students were asked to indicate the language background of their parents. Students with at least one native Swedish-speaking parent were classified as native, whereas students with two immigrant Swedish-speaking parents were classified as immigrant students.

Parents' educational background has been used as a proxy for social background (Schmidt, 2012). Students indicated the highest degree obtained by their parents (compulsory, upper secondary, tertiary). Responses were then collapsed into a dummy variable (0 = upper secondary diploma or less; 1 = university degree). Students reported time spent commuting in the survey. To determine where students commuted from, information on place of residence was collected from the university administration's system.

Academic Predictors

Grade point average (GPA) from upper secondary school and Swedish scholastic aptitude test scores (SweSAT) were used as academic predictors; both were retrieved from the university student administration system. Grade point average (GPA) was measured as the admission entry points, which is an average based on upper secondary school grades. SAT scores have been found to predict academic outcome, although the research is inconclusive (Kuncel et al., 2005; Lyrén et al., 2014). The use of standardized test scores has been criticized due to concerns about issues such as test fairness as well as the risk of built-in biases that might disfavor ethnic and cultural groups (Haughbrook, 2021). However, the predictor was still included, as one third of all Swedish students are admitted to university based on their SweSAT scores.

Analysis

Freeman's in-degree centrality was used to measure centrality for the working/learning/friendship networks (Grunspan et al., 2014). The in-degree centrality measures the number of incoming ties indicating how sought out or prominent an actor is in the network. The in-degree centrality was used to limit the bias inherent in self-reported networks ties (Hanneman & Riddle, 2005). Centrality measures were analyzed using the software UCINET v. 6, a program developed for social network analysis (Borgatti et al., 2002). Networks were visualized using Netdraw, in UCINET. To assess whether a pair of networks is structurally similar at a system level,

a quadratic assignment procedure (QAP) was performed, correlating each pair of matrices (Hanneman & Riddle, 2005).

Whole networks were used to calculate the number of relationships students were involved in, that is, in-degree centrality. Work-focused centrality was measured as the count of the total number of students who indicated a work-related tie with a specific student. To explore RQ 3, two other measures were used: multiplex centrality and uniplex socially focused *centrality*. The multiplex networks were created using the multiplex routine in UCINET (Methot et al., 2016). A tie was considered multiplex only if an individual reported having all three relations with another student.

A bivariate correlations model was used to explore the relation between academic outcome and the various sociodemographic, academic, and network variables. Variables that correlated significantly with academic outcome were then used in subsequent analyses. Hierarchical regression models were used to analyze the effect of students' position in the networks and background factors on academic outcome (dependent variable). Students with no ties were eliminated from the analysis. Differences were considered statistically significant if $p < 0.05$, two-tailed. SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24 Armonk, NY: IBM Corp.) was used for all analyses. The control variable gender was included, in line with other studies in the field (e.g., Eggens et al., 2007; Tómas-Miquel et al., 2016).

Results

Descriptive Statistics

The different networks in each specialization are first presented as graphs, which are generated in NETDRAW (Figs. 1, 2, 3). These graphs are visual representations of the UCINET network data (friends with/learned from/work with), where each node is a student, and each line is a relationship between two students in the networks. The arrows indicate whether ties are reciprocal or unidirectional.

Regarding the extent to which students develop relations with other students and the characteristics of networks formed (RQ1), Figs. 2, 4 indicate that there are differences between the specializations in overall structure, especially the friendship networks, where the network in Specialization C is denser and those in A and B less dense. In line with previous studies, students formed networks based on homophily. Native and immigrant students tended to cluster together in separate groups, as did students of the same gender. Educational background of parents and high school GPA had less impact on group formation. Place of residence had a greater impact, as commuter students partly cluster together depending on where they commute from. For example, Specialization C is divided into two clusters (Fig. 1). Commuter students living along the south-west train line form one cluster (black nodes) and non-commuters another (pink nodes). A large share of students who commute had an immigrant background (round nodes in Fig. 4).

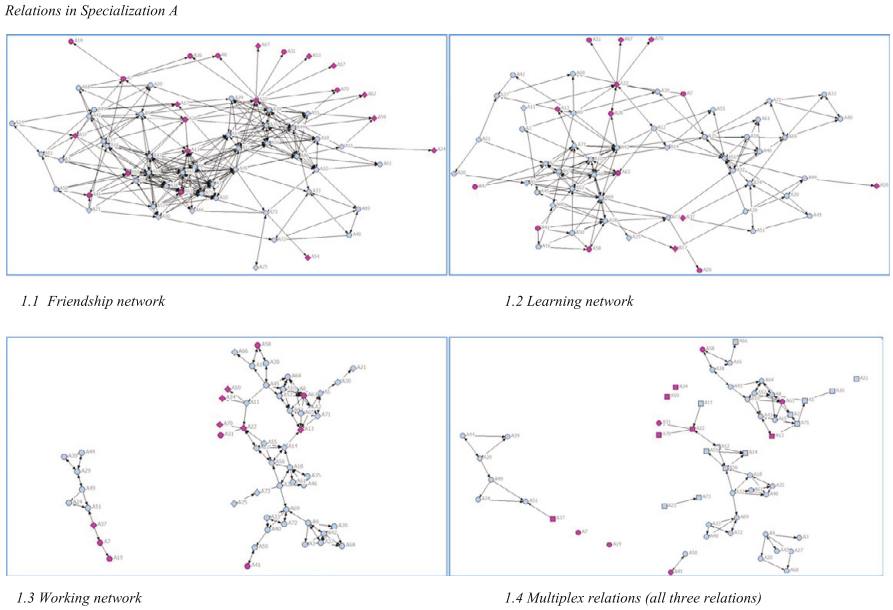

Fig. 1 Relations in Specialization A

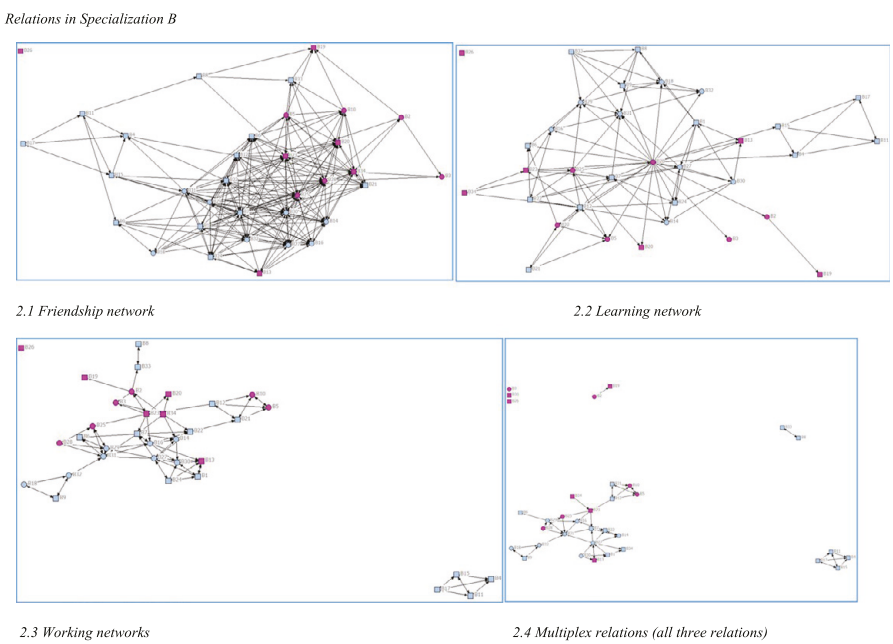

Fig. 2 Relations in Specialization B

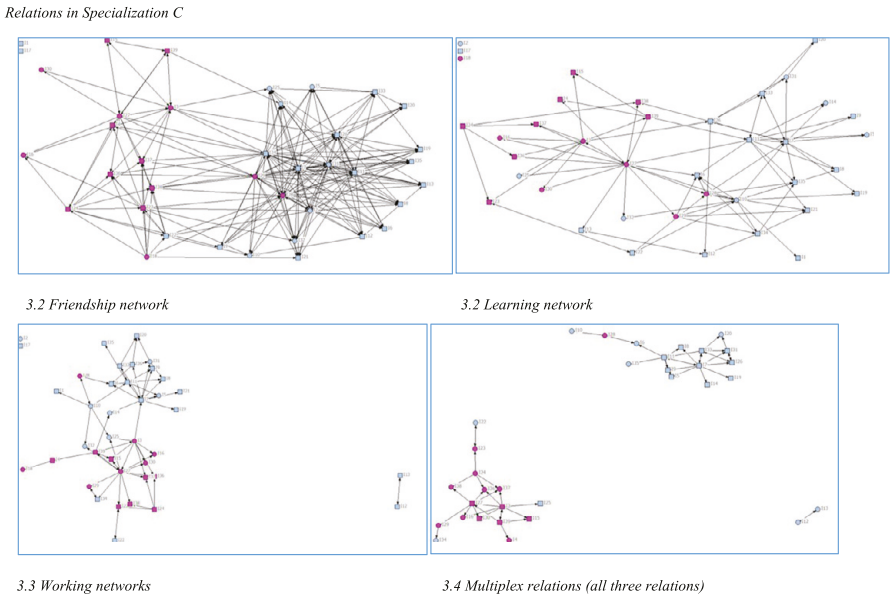

Fig. 3 Relations in Specialization C

The learning and working networks are less dense (Figs. 1, 2, 3), and students report having learned from and worked closely with a smaller number of students. In contrast, the working network (working networks in Figs. 1, 2, 3) are tightly grouped. Students form close working networks with a few students. Students they worked closely with were also marked as friends, and as a learning relation, indicating a strong prevalence of multiplex relations.

The descriptive statistics confirmed the visual analysis (Table 3). The friendship networks in all three specializations are the most connected, as they include 394, 316 and 250 ties, respectively. This confirms the picture of Specialization B as displaying a very dense friendship network (mean = 9.2) compared to A and C, which had a much looser structure (mean 6.4 and 5.3, respectively). The differences between specializations will be further discussed in the discussion section.

Students in all three networks reported more learning relations than working relations. For example, in Specialization A, students on average had 2.5 learning relations but 2.1 academic work relations. Students in B reported having more learning than academic work ties; they had more relations overall than students in A and C, with 3.6 and 3.2 learning and academic work relations per node.

As could be discerned in Figs. 1, 2, 3, there was a tendency for students to form networks based on homophily, regarding gender and language background and place of residence. Krackhardt's E-I index was calculated to measure the extent of homophily in the difference networks (Hanneman & Riddle, 2005).

Friendship Network in Specialization C and Place of Residence

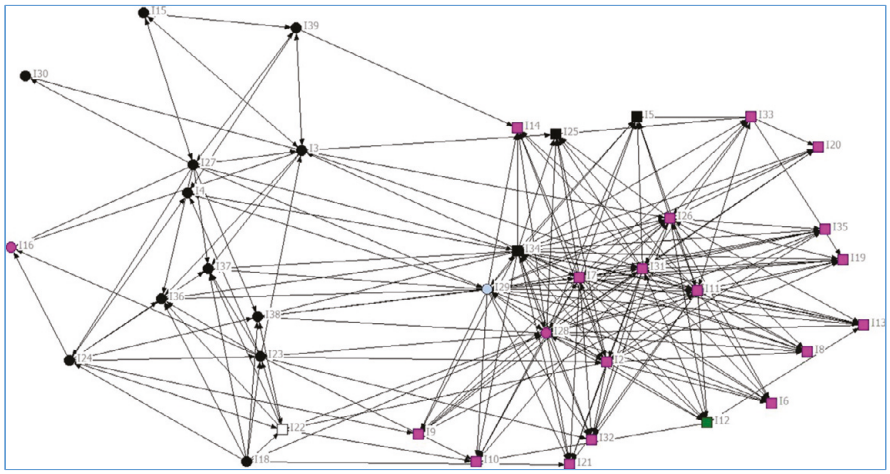

Fig. 4 Friendship Network in Specialization C and Place of Residence. *Note:* Black nodes commuted along the southwest line, whereas white, blue, and green nodes commuted in other directions. Pink nodes were residents or commuted less than 30 min

Thus, the E-I indices confirmed the impression from Figs. 1, 2, 3 (Table 4) that students seemed to prefer forming networks with students who are similar to themselves, primarily regarding gender and language background. Interestingly, but perhaps not surprisingly, the tendency for homophily becomes stronger in the learning than in the larger friendship networks, and the strongest in the working networks.

There is a strong tendency for homophily in Specialization C regarding Place of residence (Fig. 4). This means that students seemed to prefer working with students who live in the same place, and consequently who either do not commute or commute in the same direction. Thus, commuting strongly affected network formation. However, there seems to be an overlap between Place of residence and Language

Table 3 Descriptive statistics of the networks

Specialization	Network	Total # of ties	Mean # of ties	Min # of ties	Max # of ties
A	Friendship	394	5.3	1	21
	Learning	181	2.5	1	11
	Working	154	2.1	1	9
B	Friendship	316	9.2	2	21
	Learning	124	3.6	1	24
	Working	109	3.2	1	7
C	Friendship	250	6.4	3	26
	Learning	94	2.4	1	14
	Working	77	1.9	1	12

Table 4 E-I index

Specialization	Attribute	Friendship	Learning	Working
A	Language background	−0.478	−0.571	−0.597
	Gender	−0.244	−0.455	−0.701
	Social background	−0.115	−0.135	−0.130
	Place of residence	0.214	0.236	0.208
	Outcome	0.174	0.255	0.104
B	Language background	−0,272	−0,355	−0.413
	Gender	−0,076	−0.065	−0.138
	Social background	−0,325	−0.093	−0.247
	Place of residence	0.177	0.274	0.175
	Outcome	0.387	0.241	0.107
C	Language background	−0.376	−0.511	−0.662
	Gender	−0.192	−0.404	−0.403
	Social background	0.232	−0.132	0.095
	Place of residence	−0.104	−0.319	−0.584
	Outcome	0.328	0.340	0.377

background in this sample, as a large share of the immigrant students commuted from the same larger metropolitan area.

QAP analyses were performed in UNICET to assess the associations between the different networks. The Jaccard coefficient, which is more suitable than the Pearson coefficient with binary relations (Hanneman & Riddle, 2005), indicates how similar two matrices are. In the case of Specialization B, for example, the Jaccard coefficient indicates (0.332) that if students are friends, there is a 33% probability that they also work together. If students work together, they are also likely to have learned from that person (0.465/47%).

Typically, the very core of each student's network consisted of a few individuals with whom network members reported having all three relations, that is multiplex relations (Hanneman & Riddle, 2005). Relations were considered multiplex if nodes had all three possible relations (McCabe, 2016). This means that when a student works with another student, this is also someone the student is friends with and has learned from (see the Jaccard coefficients in Table 5). All coefficients are significant ($p < 0.001$), suggesting strong relationships that are unlikely to have occurred by chance (Hanneman & Riddle, 2005).

Table 5 Jaccard coefficients

Specialization	Friends/work	Friends/learn	Work/learn
A	0.369	0.373	0.450
B	0.332	0.310	0.465
C	0.258	0.269	0.527

All significant at $p < 0.001$

Table 6 Means, standard deviations, reliabilities and intercorrelations

	Mean	*SD*	1	2	3	4	5	6	7	8	9	10
1.Outcome	146.28	42.83										
2. GPA	16.91	1.99	.30**									
3. SweSAT	0.87	0.29	0.17	−0.12								
4. Language background	0.63	0.48	.44**	0.14	.34**							
5 Social background	2.24	0.72	0.02	−0.02	−0.03	.20*						
6. Time commuting (hrs)	1.81	1.40	−0.13	0.14	−.21*	−.24**	0.09					
7. Age	24.87	3.97	−0.06	−.23**	.19*	.19*	−.21*	0.02				
8. Gender	0.56	0.50	.19*	.32**	−0.09	0.08	−0.15	0.04	−0.00			
9. Work Ntw size	2.33	1.64	.45**	0.05	0.15	.39**	0.09	−0.13	−0.00	0.06		
10. Learning Ntw size	2.80	2.24	.48**	.23**	0.16	.42**	0.05	−0.07	0.01	0.08	.74**	
11. Friendship Ntw size	6.63	4.54	.45**	0.11	0.14	.29**	0.11	−0.11	−0.06	−0.00	.70**	.67**

Outcome in average credits achieved in nominal time. GPA is grade-point-average from Upper Secondary school; for gender: male = 0, female = 1; *$p < .05$; **$p < .01$; ***$p < .001$

Network Ties and Individual Performance

Table 6 displays descriptive statistics means, standard deviations, reliabilities, and zero-order correlations for variables, indicating a strong relation between Academic outcome and GPA, Language background and Work, Learning and Friendship Networks ($p < 0.01$). There is a less strong relation between Academic Outcome and Gender ($p < 0.05$). As expected, friendship, learning and work network size correlated significantly with academic outcome and with each other, however, VIF values between 2.2 and 2.8 and tolerance values between 0.36 and 0.46 indicate that there is no multicollinearity problem.

RQ2 explored the relation between student friendship, learning and academic work network and academic outcome in this specific context (Table 6), without distinguishing between overlapping multiplex relations. Preliminary analyses indicated no violation of the assumption of multicollinearity. GPA, language background and gender were entered into Model 1, explaining 25% of the variance in academic outcome. Values for in-degree centrality of the friendship, learning and work networks were entered into Model 2 (Table 7). In Model 2, only GPA, language background and centrality in the Friendship network were significant, with language background recording a higher beta value ($beta = 0.27$, $p < 0.001$) than centrality in the Friendship network ($beta = 0.22$, $p < 0.05$) and GPA ($beta = 0.19$, $p < 0.05$). The total variance explained by Model 2 was 35%, F (5,143) = 13.94, $p < 0.001$, which means that the network variables explained an additional 11.6% of the variance in academic outcome, $R2$ change = 0.116, F change (6, 143) = 8.548, $p < 0.001$. Hence, the analysis indicated that the number of socially focused friendship relationships in a student's school-related network was positively related to that student's performance, but this was not true of the work and learning networks.

RQ 3 explored the relation between student multiplex relations and academic outcome. Due to multicollinearity issues, it was not possible to analyze the individual networks and the multiplex/uniplex networks in the same model. In Model 3 (Table 7), both centrality in the multiplex and that in the uniplex networks were significantly related to academic outcome. The multiplex network had a higher beta

Table 7 Predictors of academic outcome

	Predictors	*ß*	*F*	*df*	R^2
Model 1	GPA	4.67**	16.65***	3, 143	.25
	Language backgr	36.13***			
	Gender	7.12			
Model 2	Friendship	2.09*	13.94***	6, 143	.35
	Learning	1.64			
	Working	2.74			
Model 3	Mplex	8.01**	16.78***	5, 143	.38
	Uplex	2.69**			

Outcome in average credits achieved in nominal time. GPA is grade-point-average from Upper Secondary school; for gender: male = 0, female = 1; *$p < .05$; **$p < .01$; ***$p < .001$

value (*beta* = 0.26, $p < 0.01$) than the uniplex network (*beta* = 0.20, $p < 0.01$). The total variance explained by Model 3 was 36%, F (5, 143) = 12.78, $p < 0.001$, which means that the network variables explained an additional 11.5% of the variance in academic outcome, *R2* change = 0.115, F change (5, 143) = 8.548, $p < 0.001$.

Discussion

The relations between students' study-related learning, working and friendship networks, as well as uniplex and multiplex networks, in a cohort of business students were explored using social network analysis. In contrast to previous research, the study was carried out at a teaching-intensive university where students follow the same program for 3 years and a large share of them commute, meaning that the context differs from that of previous SNA studies.

Previous research has offered inconclusive results concerning whether centrality in learning and work networks is linked to academic success (e.g., Rienties & Tempelaar, 2018; Tómas-Miquel et al., 2016). The present study confirms that centrality in the friendship network correlates significantly and positively with academic outcome, but this is not true of centrality in the working and learning networks. This is interesting, as the students themselves perceived that the work network was central to their academic success (Fjelkner-Pihl, 2021, Manuscript in preparation).

There was a substantial overlap between the friendship, learning and working relations. On average, students developed more friendship than learning and working relations, and slightly more learning than working relations. This is in line with previous studies in Anglo-Saxon countries (e.g., Rienties et al., 2015), but in contrast to Chen et al. (2012), who found that Chinese students reported fewer friendship and more academic ties, which they suggest may be partly explained by cultural factors. Students had more uniplex friendship ties than multiplex learning and work-related ones, in line with Shah et al.'s (2017) findings concerning a cohort of MBA students.

The substantial overlap between the three independent networks means that it is difficult to determine whether the effects of the friendship network can be solely attributed to the friendship itself or what part of the effect may be depend on the work-related component (Methot et al., 2016). Thus, student multiplex and uniplex ties were explored in relation to academic outcome. The multiplex relations had a higher beta value than did the uniplex relations, which indicates that the multiplex relations contributed substantially more to academic outcome than did the uniplex ties, although both correlated significantly and positively with academic outcome. This result supports the notion that the coexistence of friendship and instrumental ties in one relation creates a synergy, which may be both richer and more useful to students than uniplex relations only. This means that students have a network of a few trusted peers in the cohort and that this *significant network* is more important than social interactions with other individuals in the wider personal network, as previous research has pointed out in relation to university faculty peers (Becher & Trowler, 2001; Roxå & Mårtensson, 2015).

Given that student multiplex networks have been largely overlooked in the literature, it is time to acknowledge that students, just like academics, have several relations simultaneously. Arguably, these combined relations affect their performance, and these relations have also proved to be more resilient in the recent emergency transition to online teaching due to the Covid-19 pandemic. Therefore, it is important to provide students with opportunities to expand their relationships, so that rich links as well as multiplex relationships grow in number. As Felten and Lambert (2020) pointed out, it is in and around the physical and virtual classroom that students have the most opportunities to build relations with peers, and curriculum development, at least in Sweden, also needs to better acknowledge the social side of education and to provide these opportunities. How this can best be done differs depending on the context, as studies have indicated that commuter students, for example, rely on fewer relations than do campus students, which also left them more resilient when teaching transitioned to online platforms (REF).

One main contribution of the present study is to show how the tendency toward homophily increases the tighter the network gets, that is, the tendency is slightly more predominant in the learning and working relations, especially for gender and language background. This is problematic, mainly as higher education institutions risk cementing the homophily if students are not presented with ample opportunities to form relations with students of different backgrounds, thus denying them opportunities for both social and intellectual development which a more diverse network could potentially present them with. Academic success is important to integration in society and on the job market. Better integration in the program and better opportunities for all students, no matter their background, to work with and learn from a wider array of peers may offer more students both the affective and instrumental support they need to achieve academic success and social success.

The tendency for homophily based on place of residence in Specialization C, but not in the other two specializations, can be explained by the substantial overlap between language background and place of residence in this specific group. In this context, immigrant students mainly commuted from the same place, whereas native students commuted from other directions or lived on or close to campus. This is in line with previous research indicating that immigrant students are less prone both to move away from their families and to take student loans than are their native counterparts (London Higher, 2019; The Swedish Council for Higher Education, 2013). One may still wonder why this tendency is less prominent in the other two specializations. In Specialization B, the share of students with an immigrant background was lower and the entire group was better integrated (Fig. 2). Specialization A was less well integrated, and there is a clear pattern indicating that students from the same place tended to form relations with each other.

Finally, one important insight is how difficult it is to counteract homophily despite conscious efforts, on the part of program teachers, to mix students of different backgrounds in work groups during the first semester. The result indicated that there is an integration problem and intersectionality issue in the cohort, as commuter students with immigrant backgrounds and native Swedish students have separate networks. Immigrant students commuted longer distances and performed less well. It may be even more important to create opportunities that enable all students

to form multiplex relations, that is, both affective and instrumental ties, that are not based on homophily. It has been argued that active measures to mix student and to help them form cross-cultural ties are important (Rienties & Nolan, 2014; Rienties et al., 2014). Despite the efforts to do so in this context, they did not seem to have any long-term effect, especially on the working and learning networks. Clearly, targeted efforts to create opportunity for students to meet and interact need to be extended beyond the first term if such efforts are to have a more long-lasting effect.

Implications for Practice

Student multiplex networks have been largely overlooked in the literature. It is time to acknowledge that students, just like academics, have several relations simultaneously. These combined relations affect their performance, and this needs to be further explored. Further research should focus on students' perception of their significant (multiplex) networks and on how they form and use these networks for academic support. This type of knowledge is important for teachers and curriculum planners, as it enables them to provide all students with opportunities to expand their social network, forming both uniplex and multiplex relations.

At the same time, the results reveal how difficult this can be. Despite teachers' efforts to mix students as much as possible in group activities during their first year, the desired reduction in homophilic tendencies during network formation was not achieved. Interventions to support the evolution of multiplex friendship/learning/working relations are clearly difficult to plan or organize, something which has implications for diversity, equity, and inclusion in the program. These implications could be further explored in future research. One implication is to continue to acknowledge the importance of the self-selected work group and to strategically and systematically work with group activities in and around the classroom to enable all students to develop additional and sustainable working and learning relations, while at the same time acknowledging the importance of the friendship network as a vital source of inspiration and information. A more systematic work at the program level would perhaps enable more students to form both emotionally supportive and academically productive relations, which could lead to a better academic outcome for more students irrespective of background.

Limitations

There are several limitations to this study, but they suggest paths for further research. First, the present study is based on self-reported relational data from 2016 and register data from 2018. The situation for today's students is surely different from that of students in 2016, especially as much teaching has now transitioned online due to the current pandemic. At the same time, current research on student networks points to the importance of student relations (Felten & Lambert, 2020), and especially to overlapping, mulitplex relations, as these have been found to be more resilient than uniplex relations (Elmer et al., 2020; REF). The present article offers insights into students' study-related social relations, and how these relations overlap to form

multiplex work-focused networks. Future research could explore how students perceive these relations, and how they are formed and maintained, not only in a classroom situation, but also online.

Second, the networks were only constructed based on self-reported measurements at one point in time, thus offering a snapshot view of student friendship, learning and working relations, which may reduce the study's validity. Students may have overstated or underestimated the number of relations in their networks. They may also have attempted to give "the correct answer" rather than their own perception of the number of relations in their network. All these biases may have led to a distortion of the data.

It must also be kept in mind that how students interpret the questions and what the different relations comprise may also differ. McCabe (2016), for example, left it to the students being interviewed to define friendship, and found great variability in the students' conceptions. Furthermore, the labels given to the relations explored differ across studies, but the relations measured may be the same. For example, the working relations explored in one module—where teachers assign students, who mainly do not know each other, to teams (e.g., Rienties & Tempelaar, 2018)—may be different from the working relations explored in the present study, where students report on peers they mostly work with or have worked with during the entire course of their studies. Hence, it must be kept in mind that networks are fluid representations, snapshots of students' perception of their friendship, learning and working relations, and must be treated as such.

At the same time, I feel the study offers a picture of how students perceive their social situation in this specific context. It reveals the complexity of the social relations in a cohort, how these relations overlap to form multiplex relations, and how these relations correlate with academic outcome. Future research could explore students' multiplex relations in greater depth, looking at how these relations are formed and maintained, and how the academic culture fostered in these networks promotes or obstructs academic integration and success.

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Declarations

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Paper III

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"Ok—I Need Help from Somewhere": 'The Educational Value of Multiplex Student Relationships in a Commuter College'

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Abstract

The present mixed-methods study provides insight into how students in higher education describe and form multiplex relationships in a cohort of students attending a commuter college, thereby improving our understanding of the complex relationships within student groups and their relation to learning. The main aim was to understand the student experience of networking with other students, particularly how commuter students perceive their academic *multiplex* relationships. Relational data were collected in a cohort of students ($n = 109$), complemented by 15 semi-structured interviews. One main finding was that students perceived that their largely homophilous multiplex relationships were central to academic achievement, but if students also had limited friendship relations these multiplex relationships could limit students' academic experience. Another finding was how orientation week and group work done during the first semester mainly supported the formation of multiplex networks but were also perceived as barriers by some students. Likewise, commuting both scaffolded network building and became a barrier, especially for students with an immigrant background. One important implication for curriculum development is that faculty cannot leave relationship building to the students alone. A strategic model is discussed that supports emerging multiplex relationships, which can lead to gains in learning, retention, and integration.

Keywords Commuter students · Commuter college · Mixed methodology · Social network · Multiplex relations

Students generally perform better in relationship-rich environments, and the classroom is a central place for the formation of supportive relationships (Felten & Lambert, 2020). They also benefit from interaction with faculty and peers, while

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orienting themselves in courses (Esterhazy, 2019). These interactions shape the students' experience of their education, of themselves as learners, and perhaps even how they view the world (Henderson et al., 2019). Thus, it is useful to reflect on how we organize higher education in the future, particularly now in the wake of the emergency transition to online learning during the Covid-19 pandemic. As students' opportunities to interact with peers reduced drastically, face-to-face interaction with peers decreased, leading to negative effects on their self-reported well-being (e.g., Elmer et al., 2020; Wang et al., 2020/2021), but also to decreased motivation, and problems related to structuring information about courses and dealing with feedback (Warfvinge et al., 2021). Hence, it is particularly important to understand how students find support in each other as they strive to orient themselves in higher education, whether in online or face-to-face learning environments.

Students maintain various types of relationships with their peers, for example working, learning or friendship relations (e.gHommes et al., 2012, 2014; Rienties & Tempelaar, 2018; Rienties et al., 2012). Working and learning relationships provide task-related support (Rienties & Tempelaar, 2018), whereas friendship relations provide emotional support and access to information, both of which are important for academic achievement (e.g., Hommes et al., 2012). Previous research has mainly considered these types of relationships in isolation (e.g., Biancani & McFarland, 2013); this perspective, however, may be overly simplistic, as student relationships are often multi-layered, that is, multiplex in nature. A relationship is considered multiplex when, for example, students are both friends and working partners (e.g., McCabe, 2016).

How students perceive, form and maintain multiplex relationships in educational settings, especially where a large share of students commute, has been underexplored. The substantial overlap between relationships reported in previous research (e.g., Chen et al., 2012; Author, 2021; McCabe, 2016), and the importance of multiplex academic relationships discussed by McCabe (2016) and Felten and Lambert (2020), indicate the relevance of exploring student multiplex relationships further, especially given that, during the pandemic, multiplex relationships were found to be more resilient (Elmer et al., 2020). Commuter students are of specific interest because they maintain pre-college friendship relations to a greater extent and are less engaged in campus activities (Alfano & Eduljee, 2013). As their pre-college friendships offer social support, commuter students may be less inclined to form new social relations, which in turn may limit their possibility to form academically supportive relations at university.

The main aim of the present study was to try to understand how commuter college students form and perceive their multiplex relationships and the support they offer, thereby improving our understanding of the complex, intertangled relationships existing within student groups, and in addition possibly providing an alternative image of commuter students. The results and implications of the study may be of interest to management, academic developers and staff engaged in teaching, student support, or planning of higher education, as well as other researchers who study students' social relationships.

Literature Review

Because the present aim was to explore how commuter college students form and perceive their multiplex relationships and the support they offer, to provide context, the literature review will first discuss support offered by student social networks generally, and then the specific circumstances of commuter students and the barriers they may face.

Research on Student Social Networks

Students' study-related networks provide emotional and social support, but also information and cognitive processing support (Tomás-Miquel et al., 2016). Social Network Analysis (SNA) studies typically focus on groups formed during one module or semester, that is, learning communities of groups of 10–15 students formed by faculty for a specific reason (Brouwer & Jansen, 2019). In the present study, the groups (or networks) are informal peer networks formed by students themselves during two years of study.

Network studies in higher education have explored various types of relationships separately (uniplex relations), commonly student working, learning or friendship relations (e.gHommes et al., 2012, 2014; Rienties & Tempelaar, 2018; Rienties et al., 2012). The relationships studied are often described as either instrumental or expressive. Working and learning relationships are normally considered *instrumental*, in that they arise due to a work role (Methot et al., 2016) or, in this case, an assigned group. Such studies have explored with whom students communicate, both formally and informally, about task-related activities (Rienties & Tempelaar, 2018), such as how to solve an assignment or how or what to study for an examination. It is common for students to maintain fewer working and learning relationships than friendship relations (Author, 2021; Rienties & Tempelaar, 2018).

Friendship networks, on the other hand, are based on *expressive relationships* which involve passive information diffusion (Hommes et al., 2012). Expressive ties are not bound to any formal structure, such as assigned groups or learning communities in a classroom situation, instead they are based on voluntary interaction (Methot & Lepine, 2016). Rienties and Tempelaar (2018) pointed to how the information sharing that takes place in friendship relations, outside the formal work group, is important in that it helps students avoid groupthink and achieve creative solutions to group assignments.

However, students often share several types of relationships, which means that these relationships are multiplex, rather than separate independent constructs (uniplex). Multiplex relationships, being simultaneously both expressive and instrumental, are rewarding for students; they contribute intellectual engagement, inspiration, and emotional and instrumental support, all of which are success factors in college (Felten & Lambert, 2020; McCabe, 2016).

In general, students, like people in society at large (e.g., McPherson et al., 2001), tend to form friendship relations with students they perceive are like themselves (*homophily*), or have easy access to (*propinquity*), that is, with students in the same

courses or cohort/study program (e.g., Gašević et al., 2013; Hommes, et al., 2014). Likewise, in a study on social integration and social support, Wilcox et al. (2005) concluded that making compatible friends in college is important for social integration and that student living arrangements are vital for this process. In a study on students' social networks in an American university, McCabe (2016) found that students mainly met their new college friends in various communities outside class, such as fraternities or sororities, campus clubs and other activities, while also maintaining a network of old friends from home.

Commuter Students and Study-Related Relations

The students in the present study commute to a large extent, which means that the classroom and the commute itself potentially affect how students form relationships and their academic social network. There is much research focused on how commuter students are disadvantaged and face several barriers to participation. For example, previous research has indicated that commuter students are often older (25 +), come from ethnic and/or socially disadvantaged backgrounds, and are often first-generation students (e.g., Alfano & Eduljee, 2013; Newbold, 2015). Furthermore, they are less likely than non-commuter students to fully engage with their peers or feel they fit in (e.g., Pokorny et al., 2017). Commuter students are also more likely to leave campus immediately after class, and they less frequently attend social activities on campus due to other engagements, such as work or family obligations (Biddix, 2015). For this reason, it is also more difficult for them to form study-related relationships.

Commuting has further been found to have a negative impact on engagement, and time spent commuting negatively affects academic outcomes (e.g., Author, 2021; London Higher, 2019). Students from disadvantaged backgrounds are most likely to commute, whereas privileged students most often live on or close to campus (London Higher, 2019).

However, it must be noted that as more students commute, this somewhat simplified picture of commuter students as a struggling and disadvantaged group may no longer hold true. Research linking commuting to academic outcomes is inconclusive. Gianoutsos and Rosser (2014) found no difference in retention and academic standing, and other studies have further suggested that there is a substantial overlap between commuting and other factors, such as ethnicity, that explain the attainment gap (Author, 2020). In addition, a qualitative pilot project indicated that students also found commuting and living off campus advantageous. For example, they found friends during the commute and tried to use travel time effectively. They also seemed to treat studying as a full-time job, dividing their time between study (work) and leisure time for socializing with friends and family at home (Thomas, 2019).

In sum, although the situation of commuter students is complex and diverse, they do seem to face several, overlapping barriers to participation that may affect how they form and maintain multiplex study-related relationships, which in turn may affect academic outcomes. Universities could do more to counteract the barriers faced by commuter students, which is especially important as more and more

students commute. The literature commonly refers to three types of barriers: institutional, situational, and dispositional (e.g., Goto & Martin, 2009). Institutional barriers involve policies and practices of the higher education institution (e.g., Goto & Martin, 2009), such as tuition rates or the cost of course literature, access to information or inconvenient course times. Policies and practices of higher education institutions are often shaped after the needs of campus students, the image of which has remained an ideal type of what it means to be a student. These are also possible for universities to modify to better suit the needs of commuter students. Situational barriers concern the circumstances of the individual, such as health issues or availability of childcare (Patterson, 2018). Dispositional factors include the student's attitude and self-perception, self-esteem, self-efficacy, and motivation (Patterson, 2018).

Research Questions

Given the special situation of commuter students and commuter colleges, it is of interest to explore the multiplex character of student relationships in that specific setting. The overarching aim of the present study was to explore how students in a commuter college perceive and form multiplex relationships and what potential implications their experiences have for the organization and planning of the program. Use of a mixed-methods approach enabled a more contextualized analysis of the cohort in question, providing qualitative information that will allow us to better understand students' experience of the mapped relationships.

1) How do commuter college students describe their study-related multiplex relationships?
2) How do commuter college students form study-related multiplex relationships?

Study Context

This two-step study targeted a cohort of business students at a teaching-intensive university in Sweden, with about 14,000 students predominantly enrolled in teacher education, nursing, and business programs. The business program enrolls about 600 students in total, mainly at the bachelor's level. It is important to note that 70% of the students in this cohort commuted more than two hours each day and that 35% had an immigrant background, that is, they were either born abroad or both parents were born abroad (Swedish Higher Education Authority, 2019). Only 30% of the students had two parents with an academic degree. The study was part of an evaluation of the program, as faculty had previously pointed out issues with integration and completion rates. I have taught various modules in the program for the past ten years and have been intrigued by group formation patterns, and the variation in integration and completion rates among the students. I was not active in teaching or grading when the study was being conducted.

Students are divided into classes of 30–70 students that remain stable throughout the full three-year program. Most courses are compulsory, and students are required

to take them in a specific order. Thus, the context differs substantially from that of most research on student social networks where students instead have more educational choice, live on campus to a greater extent, and form relationships in dormitories, extra-curricular activities on campus or in organized learning communities.

The opportunities for forming relationships were many during the first semester. In the first week of the first semester, the Student Union arranged orientation activities, and students were given several group assignments to be performed in different group constellations. Students were purposely divided into work teams based on variation in gender, language background (native/immigrant) and place of residence (commuter/on campus), the goal being to enable them to form study-related relationships. However, after the first course, during which most of the orientation activities took place, students were mainly free to form their own groups.

Method

The present mixed-methods social network study is explorative (Cohen et al., 2007), as I attempted to gain insight into the phenomenon in focus rather than to draw general conclusions. Prior social network studies have focused on uniplex friendship, working, or learning relationships, respectively, rather than multiplex ones. Definitions of network relationships vary across studies (Rienties & Tempelaar, 2018). Arguably, the context of a commuter college in a Swedish university setting differs from the context of most prior research. This calls for an explorative interpretivist approach, which I chose, and which allowed me to focus on the participants' own descriptions of the relationships under study and how they are formed. My aim was to try to understand the phenomenon from the participants' perspective, to the extent that this is possible (Braun & Clarke, 2006).

Procedure & Analysis

Social Networks

In the first step of the study, students completed a questionnaire exploring their working, learning and friendship relations using a standard closed-network roster technique (e.g., Heliot et al., 2019; Rienties & Tempelaar, 2018). Participants answered three questions, requiring them to mark students in their respective specialization whom they "work a lot with," "are friends with" and "have learned from." The survey was distributed during a lecture. Students were informed that participation was voluntary, and that data handling would be done so as to ensure anonymity and confidentiality.

Networks were represented using Netdraw, in UCINET. Centrality measures were calculated using the software UCINET v. 6, a program developed for social network analysis (Borgatti et al., 2002). Freeman's in-degree centrality was used to measure centrality for the *working/ learning/friendship networks* (Grunspan et al., 2014).

Independent-samples t-tests were performed in SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. IBM Corp.) to test for group-level differences in number of relations. Differences were considered statistically significant if $p < 0.05$, two-tailed (Table 1).

Semi-Structured Interviews

Respondents for the semi-structured interviews were selected based on *sequential purposeful sampling* (Palinkas et al., 2015) from the 25 students who had indicated their interest in being interviewed in the initial SNA survey ($n = 109$). Fifteen students were selected based on their profiles for the sample, the aim being to reflect as well as possible the composition of the cohort regarding, gender, and background (i.e., commuter/campus students, native/immigrant background) and at the same time have an equal number of students with small, medium, and larger sized friendship networks (see Table 3).

The aim was met regarding share of commuters and spread in network size (friendship), which was important as these two aspects are the focus of the study. There was also a mix regarding academic achievement, with three students categorized as low, five as high and seven as medium achievers. The fact that there were slightly more female and native Swedish students in the sample was deemed acceptable. The small N and the uniqueness of the case preclude drawing any general conclusions, but rather offer propositions (Crouch & McKenzie, 2006) that might give valuable insights into how students form and maintain multiplex study-related relationships that may be relevant to others in similar higher education contexts.

During the interviews, the paper SNA survey was used as a discussion point to help the students focus on both structural and compositional information on their networks. Table 1 presents sample questions.

Students were informed of the aim of the interview, and that they could end the interview at any point without giving an explanation. They were further ensured confidentiality in the handling and presentation of the data. All participants signed a consent form before the interview took place, in line with ethical the university's guidelines.

The interviews were recorded and transcribed verbatim, whereafter they were analyzed using an inductive thematic approach (Braun & Clarke, 2006). The analysis was data driven, and initial codes – based on, for example, recurring words – were grouped together to generate themes. One theme was *Meeting spaces*, with subcodes such as "first group work" or "commute" (see Table 4 in Results). Identified themes were then discussed with experienced colleagues outside the project, who independently judged the themes prior to the discussions.

Results

The Networks

Visualization of the relational data provided insight into the complexity of relationship building in a cohort of students ($N = 146$; $n = 109$; response rate 75%). Students

Table 1 Sample questions from the interview guide

Category	Main questions	Sample follow-up question
Warm-up question	What does it mean to be a student?	
Network questions – with each student's Social Network questionnaire as a discussion point	Whom have you marked that you work a lot with? Whom have marked that you have learned from? Whom have you marked as friends?	Why them? How did you get to know them? Could you give examples of how you work/hang out? In what way is your relationship with them different from the guys you work a lot with?
Closing question	If you think about your school network, in what way has that network affected you, your studies/learning?	

Note. The exact wording of the questions varied depending on how the conversation with the students went.

Table 2 T-result comparing network scores between non-commuters and commuters for all, immigrant, and Swedish students

Sample	*Variable*	*Predictor*	*M (SD)*	*Range*	*t* (df)	*p*
All	Working NW	Swedish	2.82 (1.57)	0–8	5.07 (144)	0.000
		Immigrant[a]	1.50 (1.41)	0–5		
	Friendship NW	Swedish	7.62 (4.05)	0–17	3.57 (144)	0.000
		Immigrant	4.94 (4.87)	0–20		
	Learning NW	Swedish	3.52 (2.31)	0–10	5.57 (144)	0.001
		Immigrant	1.57 (1.45)	0–5		
	MPX NW	Swedish	2.03 (1.36)	0–7	5.30 (144)	0.000
		Immigrant	0.89 (1.06)	0–3		
Swedish students	Working NW	Non-commuters	2,77 (1.44)	0–5	0.59 (81)	ns
		Commuters	2.98 (1.60)	0–8		
	Friendship NW	Non-commuters	7.90 (3.34)	0–20	0.44 (81)	ns
		Commuters	7.94 (4.18)	0–17		
	Learning NW	Non-commuters	3.68 (1.96)	0–5	0.17 (81)	ns
		Commuters	3.75 (2.51)	0–10		
	MPX NW	Non-commuters	1.98 (1.14)	0–3	0.93 (81)	ns
		Commuters	2.25 (1.44)			
Immigrant students	Working NW	Non-commuters	2.86 (1.57)	0–5	-2.75 (36)	.009
		Commuters	1.42 (1.18)	0–8		
	Friendship NW	Non-commuters	9.57 (6,08)	0–20	-2.18 (36)	.036
		Commuters	5.10 (4.65)	0–17		
	Learning NW	Non-commuters	2.14 (0.90)	0–5	-0.65 (36)	ns
		Commuters	1.74 (1.57)	0–10		
	MPX NW	Non-commuters	1.00 (1.00)	0–3	-0.71 (36)	ns
		Commuters	1.03 (1.11)			

maintained several relations with other students with whom they discussed study-related issues (Fig. 1). On average, students had 7 friendship relations, had learned from 2.8 people, and worked closely with 2.4 people. Some had very large friendship networks, whereas others were highly selective and said they interacted with only a few people on a regular basis.

Students reported having multiplex relations with only a few students (2.7 relations on average). The color coding and shapes of the symbols in Fig. 1 indicate that these networks were largely based on homophily regarding gender and nationality. For example, immigrant female students (pink circles) tended to work mainly with other immigrant female students, and male Swedish students tended to work with other male Swedish students (blue squares). The multiplex and working networks were also more fragmented than the denser friendship network.

Immigrant students had significantly fewer relations than Swedish students did, on average. There were significant differences between commuters and non-commuters only among immigrant students, where commuter immigrant students had

Table 3 Demographic information on interview participants

ID**	Gender	Age	Immigrant Background	Achievement*	Interview Time (min)	Commute (hrs)	Friends NW**	Mpx NW
Stella	F	22	Native	Medium	31	2	5	1
Taylor	F	22	Immigrant	Medium	30	2	3	1
June	F	25	Native	High	42	3	4	1
Monawar	M	23	Immigrant	Low**	45	3	2	2
Ahmed	M	23	Immigrant	Low**	37	3	3	1
Lottie	F	23	Native	Medium	47	0	12	3
Frank	M	30	Native	Medium	28	0	8	5
Penny	F	24	Native	High	46	0.75	6	1
Tara	F	24	Native	High	42	2	6	1
Inez	F	22	Immigrant	Low	49	3	8	4
Jamie	M	25	Native	Medium	42	0	20	3
Carl	M	28	Native	Medium	60	0	21	3
Ed	M	28	Native	Medium	43	1.5	20	3
Mina	F	26	Native	High	43	0	24	9
Mary	F	26	Native	High	37	2	17	2

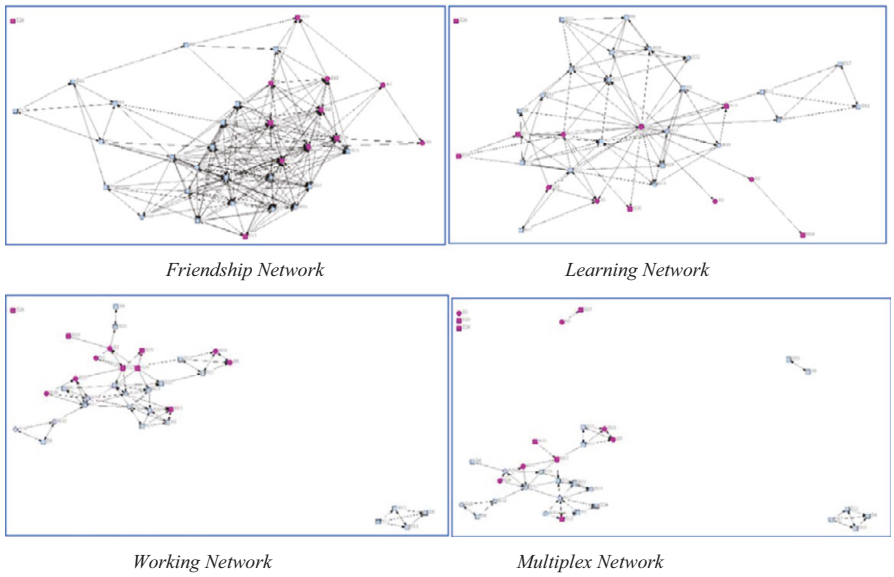
67% commuters (68%), 60% female students (56%), 73% native background (63%). Composition of cohort within parentheses. * Achievement is calculated as share of courses in which the highest grade was achieved (Pass with distinction). In this specific program, the course grades awarded are Fail, Pass and Pass with distinction. High = > 70%; Low = 10-69%; Low = < 10%, as Grade point average (GPA) is not a standard calculation in the Swedish higher education system. ** 1-2 years extra completion time. **Student names are fictive

approximately 50% fewer working and friendship relations compared to non-commuting immigrant students. There was no significant difference between commuting and non-commuting Swedish students (Table 2).

Students Interviewed

The participating students were representative of the student population in the larger cohort regarding immigrant background and time spent commuting (see Author, 2020). In Table 3, the interviewed students are divided into three groups based on number of friends. Students in the bottom category with the most friends (16+) also had larger multiplex networks overall. These were all native Swedish non-commuters who were older than 25. Students in the first category with few friends also had few multiplex relations. They also tended to commute longer distances, 2–3 h. Three out of five students in this category were immigrants, and two were struggling academically.

Two students with 6–15 friends also reported having only one multiplex relation, whereas the other students in that category had 3–5 multiplex relations. Only one



Note: Pink nodes=immigrant background; Dark blue = Swedish background; Round nodes = female; Square nodes = male students.

Fig. 1 Sample group level friendship and learning networks

student in this group had an immigrant background, and there was a mix between commuters and non-commuters.

How do Commuter College Students form Their Multiplex Networks?

The interviews revealed that the students' multiplex relations were central to them, and it was there their main learning and work took place. Visualization of the networks also indicated a close overlap mainly between the multiplex and working networks, but also the learning network (Fig. 1).

Students pointed to four main ways in which they had gotten to know students they formed multiplex relations with: group work in the first semester, orientation week, old friends from high school, and fellow commuter students (Table 4).

Mary was a high-performing and well-connected student with 17 peers in her friendship network, but only two multiplex relations. She reported the two ways in which she met her two multiplex relations. *L is the one I've known since the first day […] we were placed together in the two first assignments."* and "*A, we met on the train*." She also explained how students formed friendship ties during *orientation week*: "I *was there […] yes, sense of community and such. We became pretty close those who were there."*

Inez also talked about how she met one of her friends when they commuted to class. They later formed a multiplex network of four immigrant girls who all

Table 4 Theme "Meeting spaces." Subthemes and examples

Subthemes	Examples of meaning units
First group work & from commuting	It was them I got to know first. In the first and second course. For example, J lived in X [city] too. We got to know each other on the train. […] then it was S who was friends with W, so we started hanging out. (Inez)
First group work & old acquaintances	I mainly hang out with Jamie, and G. […]. I knew R a bit from before. He and I come from the same place, and he was going out with the sister of a friend of mine. Then we ended up in the same group in the first course and G was also in that group. (Frank)
From high school, propinquity	M and I, we went to the same high school as S. We usually work at home, or we also sit in building X. We study in X [city] as we all live in X. […]. (Monawar)
Orientation week	I have to say that orientation week is important to go to. It's no joke. /…/ I feel as if not that many have quit because all my friends are still here, but I think that many, those who didn't participate /…/ they were directly a bit on the outside. (Penny)

commuted from the same area. She explained how that made it easier to meet up and study together without having to commute to school:

> [When we talk on the train] it's not that often about that [school]. It's when something has been difficult, then we can sit and discuss. When we had computer lab it was good to discuss, 'did you understand this in this way' and talk about it so that you could do it correctly later.

Here, Inez explained how she used the commute mainly as a social space but also a workspace, which was an experience she shared with other interviewed commuter students.

Another way students formed multiplex relations was with people they already knew from high school. Stella explained "*I knew her from the start and then it's easy to stick together*." Taylor had a similar experience:

> In the beginning then I stayed with S and then you saw during the first month how groups were formed and then I was not in those groups. It was safe, as you saw others who didn't know anyone.

Old friendships created safe havens, but then seemed to prevent students from connecting with other students later. The two immigrant male students in the sample told a similar tale. They found it difficult to get to know other students. According to Monawar, it was especially difficult to hang out with Swedish students; he said, "*you know orientation week is not for us*." He referred to how some students with an immigrant background refrain from participating for religious or cultural reasons, or simply because they feel they do not belong. Typically, the student union runs orientation week, which involves games and other social activities, but also partying and alcohol consumption. None of the immigrant students in the sample had participated in orientation week.

All students in the sample mentioned the random assignment to groups for the group assignments during the first semester, like Jamie who concluded that "they ended up in the same group." Many related that this was how they had met their multiplex relationships. Carl explained:

> It was the first [group] work /…/ and then we were just put together /…/ and then this girl also thought it was important so we said, we will fix this /…/ and we have worked together ever since.

Even those students who had a bad experience of group work during the first semester found it important to at least have someone to sit with when they came to class, although they did not remain friends afterwards.

With Whom do Students Form Multiplex Relationships?

The interviewed students found the multiplex networks central, as it was here the actual academic work was done. Students learned the ropes from their multiplex relationships; they learned how to study and to write better.

When students talked about why they formed multiplex relationships with certain people, they said they felt similar to them in some respect, that is, had the same level of ambition, worked in the same way, or complemented each other. In line with previous research, the students formed networks based on homophily (e.g., Rienties & Tempelaar, 2018). Tara, for example, said she first got to know a group of girls during orientation week; she explained:

> I don't know if it's age-related. She's older, we're both older. All the people I hang out with are the same age. I don't know if that's why… We didn't know each other [from before].

Similarly, other students said they worked closely only with other commuters or only with other locals. Their stories indicated that their networks were based on both *homophily* and *propinquity*.

The results showed that student multiplex networks were highly divided by native background and gender (Author, 2020), which means that social homophily was a very strong determinant of the formation of multiplex relationships. This was evident despite the efforts made by the program to mix students randomly in groups during the first semester so that they could forge friendships. Monawar found it difficult to hang out with Swedish students. Jamie camouflaged the sensitive issue and said: "There is a clear divide between those who commute and people [from here]." The quotation indicated the strength of homophily and the resulting divide between immigrant and Swedish students, disguised by the fact that a large share of immigrant students were commuters.

Another reason students chose to continue working together was that they found they "*worked in a similar way*." Stella elaborated:

> We know how we work best together. […]. We're very much alike. We both work the same way. Both like to plan, to be done with things a few days before deadline and avoid stress. We work alike

What Stella focused on in the quotation was rather the *work process*, or how they planned and organized the group work. Several of the students were *process oriented* and said that they wanted to do work in time and avoid stress, mentioning how important having the same attitude was to avoiding conflict with their co-worker.

Students also formed multiplex academic relationships with other students for a more goal-oriented reason: They chose other students they perceived had the *same level of ambition* as themselves. Ed was both process and goal oriented, and he described why he preferred working within his multiplex network:

> We've worked in other groups along the way, but then we haven't been satisfied with how things worked or the level of ambition. You know, good planning and that things get done, and if there's a problem you ask each other.

It is worth noting here that the interviews took place during the fifth semester. Thus, all students were high achieving in the sense that they had been allowed to continue to the final year. However, several of them barely passed examinations, whereas others in the sample had high grades. In addition, there was some difference in the number of credits they had earned. It is evident that the level of ambition differed, from barely pass to the highest grade. Despite these differences, the same explanation regarding level of ambition was used by both high- and low-achieving students alike.

Although students said they formed networks based on similarities, they also frequently described how they had multiplex academic relationships with students because they complemented each other. These students were conscious of how they drew on each other's strengths. For example, June, Inez, Ahmed, Carl, Ed and Tara all mentioned how they benefitted from working with their multiplex relationships because they *contributed different things*. Carl described how he had gotten to know Lottie:

> If anything, I'm good at taking responsibility and there was this girl in the group, I don't know why, but who also thought it was important. […] She's academic and knows how to write and I'm more mathematical, and we've studied together since then and that's why we do well. I've learned how to write in a way I didn't know was possible […] and I've taught her how to study for exams.

In this quotation, Carl noted a similar level of ambition, but also how their collective strengths helped them achieve their goals, even indicating that he felt he would never have been able to achieve the same result without what he had learned from her.

Tara elaborated on the same topic:

> They give me what I need so to speak. […] L is more like me, in a way and we both want to get things done fast, thoroughly, it should be on time, it must be planned and if you don't understand you find out why. […] Sometimes you want something else, and Penny and I are a bit more opposites, but we complement each other pretty well. What she doesn't think of, I think of and vice versa.

Penny said she had actively befriended Tara. She realized she needed help with structure, study skills and motivation to succeed. Penny was aware that she contributed language skills and creativity. June, likewise, worked closely with a girl who constantly failed exams on the first, and even second try. However, she was a much better writer, according to June, and when they worked together on group assignments their collective strengths enabled them to achieve the highest grade most of the time. Students referred to how they liked working closely with their multiplex network because they trusted each other. A high level of trust is one key aspect of multiplex relationships. Ed, for example, explained how "*There is high trust and that I think is important when you work together and a high level of ambition.*"

Discussion & Implications

The present study's contributions to the literature are insights into how students describe and form multiplex relationships; the study also improves our understanding of the complex relationships within student groups at a commuter college. The findings showed that having multiplex ties helps students thrive socially and academically (McCabe, 2016). For this reason, it is important to understand how students find support in each other when they are striving to orient themselves in higher education, whether in online or face-to-face learning environments. The case presented is also an example how a mixed-methods social network study can provide pedagogical insights that are valuable when designing a study program.

One overarching theme in the students' accounts of their study-related networks is how the networks help them remain engaged in their studies; this is in line with previous research (e.g., Thomas, 2012). Students described how the different relationships provided different kinds of support, all of which built engagement in different ways. They reported that the friendship network made coming to school fun and provided access to information, both of which are important to academic achievement (e.g., Hommes et al., 2012). In line with McCabe's (2016) findings, students indicated that the multiplex relationships were central to their academic success, as such relationships provided both task-related and emotional support (e.g., Rienties & Tempelaar, 2018). Students in the same network were "in the same boat," "understood each other," and having their support contributed the most to learning and engagement.

The interviewed students had a small number of multiplex relations, 1–2 peers whom they trusted and could rely on in their studies; this pattern is consistent with that found in the cohort as a whole (Author, 2021). Previous research has shown that commuter students have a smaller number of friendship and multiplex relations (e.g., Author et al., 2021) than students who live on or close to campus. There is inconclusive evidence regarding the importance of the working network to academic outcomes, whereas research has provided consistent evidence showing the importance of the friendship network to successful academic outcomes (e.g., Hommes et al., 2012; Thomas, 2012; Tomás-Miquel et al., 2016). In the present cohort, there

were no significant differences in network size between Swedish commuter and non-commuter students, whereas immigrant commuter students had fewer friendship and working relations than did immigrant students who did not commute. In the cohort, immigrant commuter students earned fewer credits in nominal time than did Swedish commuter students (REF: Author, 2021).

Embeddedness in a larger friendship group is important, as students then have access to a larger pool of relationships for information, meaning there are more people with whom they can potentially develop multiplex relationships. Students with limited friendship relations both lack access to information and have limited opportunities to form multiplex relationships. This means that they are potentially locked into their limited network early in the program. A sense of regret could be detected in interviews with the students with limited networks: Taylor, Monawar and Ahmed. According to Taylor"new *gangs were created, and I was outside*," and for Monawar, "*the second year was difficult*" because he knew only one other student in the class. Taylor struggled and was unsure of the relevance of getting an education, and both Ahmed and Monawar dropped out during the second year. This shows how having a very limited multiplex network and few friendship relations may ultimately impact academic achievement and students' epistemological development. Intragroup (friendship) relations, provide access to expertise and critical reflection, which have been positively associated with academic performance (Gašević et al., 2013) and creativity (Tomás-Miquel et al., 2016).

One finding from the study is important for the program in question: This is the fact that the very factors that enabled participation for many students were perceived as barriers by other, less well-integrated students. The research has revealed various barriers to participation, such as institutional, situational, and dispositional barriers (e.g., Goto & Martin, 2009). One institutional barrier all interviewed students mentioned was orientation week, which excluded shy students or immigrant students who chose not to participate for religious or cultural reasons. Shyness and lack of social and study skills were dispositional barriers mentioned by both Swedish and immigrant students. Old friends from high school and commuting were situational barriers, mainly for immigrant students, who preferred to study with other immigrant students in their hometown. One implication for the program in question is that orientation week, which was important for relationship building among Swedish students, may need to be modified. The organization of activities cannot be left to the student union alone, but faculty need to work strategically to make the student union orientation week activities more inclusive, and in this specific context, less focused on partying and alcohol consumption. One immigrant student had thought about it and suggested: "*It's not for us /…/ why not play football, we all love football*."

The present results offer a complex picture of commuter students and of commuting as a barrier to participation. Previous literature has pointed out that commuter students are less likely to fully engage with their peers (e.g., Pokorny et al., 2017) or to participate in campus activities after class (Biddix, 2015). Some of the commuter students had limited networks and some struggled academically, but the commute was generally not seen as something negative. Some Swedish commuter students in the study, such as Ed and Mary, had just as many relationships, and Swedish commuter students succeeded in their studies to the same extent as their non-commuting counterparts (Author, 2020,

2021). This is in line with Gianoutsos and Rosser (2014), who found no difference in retention and academic standing between commuters and non-commuters.

In contrast, the commute was seen as a barrier mainly for the immigrant students, whose decision not to participate in full may have depended on several overlapping barriers. This finding is corroborated by previous studies of the same cohort regarding background factors and self-assessed preparedness, which have shown that immigrant students who commuted longer also earned fewer credits (e.g., Author, 2021; London Higher, 2019). Thus, commuting created an extra barrier primarily for immigrant students, who also mentioned having difficulties forming academically supportive relationships. The problem could partly be linked to a wider integration problem detected in this specific program, which is may well be similar to the situation for programs in other higher education contexts. Students talked about *commuters* and *non-commuters*, and how it was difficult to cooperate. Sometimes they added "apart from X, who is one of us." In many cases, what they described was a divide based on ethnicity, rather than on commuting.

The quantitative analysis of the network data confirmed this view, indicating that most of the multiplex networks were homophilous regarding gender and ethnicity, revealing a division between ethnic Swedes and students with an immigrant background (see Author, 2021). In the interviews, Swedish students felt immigrant commuters preferred staying in their hometown to study and did not want to take part in social activities outside the classroom, such as orientation week, corroborating the picture of commuter students in previous literature (e.g., Pokorny et al., 2017). The immigrant commuter students also partly confirmed this view; they preferred studying in their hometowns with other commuter students but went to campus when necessary. They further explained how they formed multiplex relationships mainly with other immigrant students who lived in the same town. Students talked about how they, for example, were "the same age" or had the same "background," referring to how they had grown up in the same place. There is consistent evidence showing that students form homophilous networks, that is, they prefer forming relationships with peers similar to themselves regarding, for example, gender, race/ethnicity, socioeconomic background or age, and cultural preferences (e.g., Rienties & Tempelaar, 2018; Rienties et al., 2015) as well as academic performance (e.g., Gašević et al., 2013).

Students form relationships based on preference or opportunity (e.g., Hommes et al., 2012). One opportunity for forming relationships that students mentioned was group work during the first semester, which has previously been found to be a strong predictor of relationships that students develop into friendships, at least temporarily (Rienties & Nolan, 2014). Other meeting places mentioned were orientation week activities and the commute to school. The friendships that lasted and developed into constructive and long-lasting multiplex relationships were those that "worked out," in the sense that students found both the emotional and instrumental support needed for their studies. They spoke of how they continued working together because they "worked in the same way" or had the "same level of ambition," which is in line with how students tend to form relationships with other students who perform at the same level (e.g., Gašević et al.,

2013). Students who chose not to participate in orientation week, or for whom group work during the first semester did not work out, remained on the periphery of the cohort. They eventually formed a few friendship and multiplex relations, as students are less open to forming new relationships after the first year (e.g., Mamas, 2018).

A strong tendency toward homophily in student networks could have negative effects on students' knowledge development. According to Curşeu and Pluut (2013), less diversity in groups leads to fewer chances for students to learn from or be motivated by each other. Students benefit from diversity, as it results in greater complexity of the collective knowledge in the group. Students also benefit from working with more motivated peers who contribute drive and organization. At the same time, greater disparity has a negative effect on teamwork processes and interpersonal interaction. Students were aware of both the benefits of collaboration with others, as pointed out in other studies (e.g., Mamas, 2018), and the drawbacks, which is why they preferred working with their multiplex relationships, especially on high-stakes assignments; in this context, high-stakes mean the assignments were decisive for their course grade.

In sum, both strong multiplex and weaker friendship relations are important to academic outcomes (Rienties & Tempelaar, 2018), and the interviews clearly indicate that students who performed less well did not have the same access to valuable information that their better-connected peers did. These students also spoke with regret about not knowing many people and hardly knowing the names of people in the class. In the target program, students are strategically mixed during the first semester, but are thereafter either free to choose their own groups or directed to work with certain others, depending on the preference of the teacher in question. In the interviews, students reported preferring to decide for themselves, wanting to work with people they can trust. Arguably, it is important to let them do this, especially when the tasks are complex, and their course grade is at stake.

One possible suggestion for the program in question is to organize activities in and around the classroom that enable students to form stable and rewarding multiplex relationships. On the other hand, the program should develop a model for group work that gives students the choice to work with multiplex relationships to the extent possible, while also offering them ample opportunity to get input from other peers with a more diverse background. This could be achieved if faculty were to engage more strategically in group formation and group work throughout the program.

During the first year, it is important to assign students to groups, as this allows all students to form constructive strong ties and important weak ties within the cohort. Group work and group processes must then be closely monitored to mitigate negative stereotyping and team conflict (Curşeu & Pluut, 2013). The further the students come in their studies, gradually forming multiplex relationships, the more they should be able to self-select, especially for more complex group assignments or for their final bachelor's thesis. At the same time, to mitigate the negative effects of homophily on knowledge development and creativity, and increase access to information, students should be given ample opportunities to

work together on low-stakes assignments in class or to discuss questions related to their high-stakes assignments with representatives from other groups.

Limitations

The present study has several limitations. First, it is based on interviews from 2016. The situation for today's students is surely different, especially as teaching has now partly transitioned to being online. At the same time, current research on student networks has revealed the importance of student relationships (Felten & Lambert, 2020), especially overlapping, multiplex relationships (Elmer et al., 2020; REF). Second, it must be kept in mind that the generalizability of the present findings is limited, as this is only a case study involving a single round of data collection, and a limited number of participants. However, there might be valuable implications for other educational contexts. Like all in-depth interpretive studies, potential avenues are highlighted for comparable situations, such as distant learning universities and the effects of pandemic lockdowns.

A third limitation is that the sample of interviewed students is limited to students in their third year, thus the perspective of less successful dropouts is missing. It would be valuable to explore how these students experienced their multiplex relationships. Finally, students were not asked to indicate strength of tie in the initial survey, and this limitation in the data makes it difficult to fully explore the complex, multiplex relationships.

At the same time, the study offers a rare glimpse into students' understanding of their relationships and networks, which may be valuable to faculty at both the program and module level in various educational settings. A discussion about how to strategically work with student group constellations to foster both weak and strong ties may lead to improvements in learning, retention, and integration.

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Paper IV

Articles

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"It has worked well despite the circumstances" – a study on student social relations and well-being during the pandemic

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Students' possibilities to interact with peers have reduced drastically during the emergency transition to online teaching due to the Covid-19 pandemic. Students report on decreased motivation and other study related issues; hence, there is a need to better understand the effects of decreased interaction. The aim of the present exploratory study was to document changes in student networks, in relation to perceptions of connectedness, study outcome and well-being in two different settings. An ad hoc online survey (n = 97) was distributed among students from one research-intensive and one teaching-intensive university where many students commute. Results showed that student social networks defoliated from the outside-in and left students with an inner circle of students they shared multiplex relations with. Students who had lost more working and multiplex relations also reported a decline in well-being. The main contribution of this study is the visualization of how networks became fragmented, and how the experience of this differed depending on type of study context. These findings may have implications for a post-Covid organisation of higher education.

Keywords: word, social relations, well-being, commuter students, academic outcome, higher education, multiplex relations, epistemological development

INTRODUCTION

In this article we focus on how the pandemic has affected students' opportunities to interact with other students and combine graphical representations of students' networks on cohort level with individual students' descriptions of how they perceived the situation during and before the pandemic. The aim is to provide another piece in the puzzle for academic teachers, academic leaders, and others on what we can learn from the pandemic experience.

Students' possibilities to interact with peers have reduced drastically during the emergency transition to online teaching due to the pandemic. According to one study, face to face interaction with peers has decreased with 88% (Gothenburg University, 2020). Subsequent negative effects on students' well-being have been reported (Elmer et al., 2020; Husky et al., 2020; Savage et al., 2020; Wang et al., 2020/2021). Furthermore, students report on decreased motivation, and problems related to structuring information about courses and dealing with feedback (Warfvinge et al., 2021). It is against the backdrop of such findings, that this study investigates effects on students' study related networks.

Students' study related networks are important for their learning (e.g., Eggens et al., 2007; Fjelkner-Pihl, 2021; McCabe, 2016). It has been emphasized that students tend to rely on

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"a myriad of emerging interactions and relations that will shape how students may or may not learn" (Esterhazy, 2019, p. 73), fulfilling a formative function for students (Hattie, 2008; William, 2011). The "social environment is understood to have an important role in shaping experiences of learners and simultaneously providing a mechanism to test and evaluate new ideas, which may then result in modified or new conceptions of the world" (Henderson et al., 2019, p. 21). In sum, university students generally perform better in relationship-rich environments (Felten & Lambert, 2020), where they meet and interact with a multitude of other students. Therefore, it is possible to hypothesize together with Jeffrey and Bauer (2020), that what some students experience as problematic with online courses during the time of Covid-19, is that previously dense interactions, foremost with peers, become less dense and thereby less informative. However, the students' experiences may vary depending on study context. For example, students in a university where a majority of students commute may have experienced the transition in a different way than students who study in an environment where many students live close to the university.

Thus, the present explorative study contributes with an exploration of how the Covid-19 pandemic has affected student study related networks in two different types of universities, in relation to the students' perception of connectedness and study outcome. The aim is to add to a growing knowledge of effects of the pandemic on higher education, in this case on decreased interaction among students and self-reported effects on study outcome. The text also offers a discussion on possible implications for the planning and organization of courses during online conditions like the pandemic experience.

Student social relations and online teaching

To better understand what it means to be an online student during the pandemic, it can be useful to turn to pre-pandemic research into online teaching. For example, in an elaborated study in an online environment, Theobald et al. (2018) explored the link between study outcome and disciplined study strategies. Results indicate that study discipline more than teaching format (e.g., online) explains the variation in study results. In addition, attempts have been made to positively support student interaction also in online courses, that is to increase the experience of social presence (Oh et al., 2018). Weidlich & Bastiaens (2019) added applications supporting interaction to the learning platformed used to increase a sense of connection and community and thereby enhancing the study outcome. However, the result "suggests that socio-emotional perceptions regarding the learning environment and of peers do not actually impact learning" (Weidlich & Bastiaens, 2019, p. 12). Consequently, even though some research suggests that social presence and dense interaction with others are important for study results, other research suggests a more complicated relationship between social interaction during courses and study outcome.

Thus, even though study discipline comes across as crucial, it is unclear how interaction with others influence study outcome. It might be that different students rely on networks in different ways, something that may explain the variation in the literature (for example Elmer et al., 2020; Warfvinge et al., 2021). In this study we will include a sample of commuter students to see whether they are affected by the pandemic in the same way as campus students. Previous studies have found that commuting often has a negative impact on engagement and that students who commute often take less part in social life at the university (London Higher, 2019; Yorke & Longden, 2008), but whether the pandemic has negatively affected their experience has not yet been researched.

Student social relations in and around the classroom

Network studies in higher education have explored various types of relations, commonly student working, learning or friendship relations (e.g., Hommes et al., 2014; Rienties & Tempelaar, 2018). Students' study-related networks provide emotional and social support, but also information and cognitive processing support (Thomás-Miquel et al., 2016). Relations studied are often described as either intrumental or expressive. Student working relations (*instrumental*) explore with whom students communicate about task-related activities (Rienties & Tempelaar, 2018), such as how to solve an assignment, whereas friendship relations (*expressive*) are not bound to any formal structure (e.g., work relations), such as an assigned group, but on voluntary interaction (Methot et al., 2016).

Social relations among students are often based on homophily (e.g., Fjelkner-Pihl, 2021), the tendency to prefer forming relations with others you perceive as similar regarding socioeconomic background, age, cultural preferences, or ethnicity. This could potentially lead to less interaction with others who think differently, that is, being less disturbed in their own thinking, something that potentially could undermine long-term epistemological development (O'Donovan, 2017; Perry, 1988).

Students often share several types of relations, and these multiplex relations are rewarding for students as they are both expressive and instrumental at the same time as they contribute with both emotional and instrumental support, as well as intellectual engagement and inspiration (Fjelkner-Pihl, 2021; McCabe, 2016). Elmer et al. (2020) have shown that if students shared two types of relations (interaction, friendship, informational, or emotional support) the relations were more likely to be maintained during the pandemic. However, the relations explored were part of an open network (e.g., Tómas-Miquel et al., 2016), that is students could name any ten relations of their choice. In contrast, the present study specifically explores student study related relations within a given cohort, a so-called closed network, that is the relations that are formed and maintained in and around the classroom and thereby arguably closer to study-tasks. The result of such a study may contribute with insights important for teachers, the organization, and the execution of future post-pandemic higher education.

A further issue addressed here concerned whether students in a research-intensive university report a different experience during the pandemic than do students in a teaching-intensive university, where a large share of students commute. Thus, it is probable that there are differences in experiences between these groups.

Questions in focus are:

(1) What are the effects of the Covid-19 pandemic on students' study related networks in two types of universities?
(2) How do students describe the effects of the Covid-19 pandemic on their social network in relations to study outcome and cooperation with other students?

METHOD

Study site

The present study was carried out in two cohorts of students from a research-intensive technical university, Lund University's Faculty of Engineering (LTH), and one cohort of business students from a teaching-intensive university, Kristianstad University (HKR). Lund university is one of the oldest and largest research universities in the country, with over 40,000 students.

Kristianstad university is a younger, regional university focusing mainly on undergraduate education. It has approximately 15,000 students. The composition of enrolled students differs between the universities. Students at HKR more often come from non-academic backgrounds, they have relatively lower grade point average (GPA) from upper secondary school and lower mean SweSAT scores. They are also more likely to commute longer distances.

Sample, procedure and ethical considerations

Students were in the middle of their third year; thus, they had presumably formed both friendship and working relations within their respective programs. Relational data was collected via an online survey distributed via e-mail in late fall 2020. 97 out of 319 students responded to the survey leading to a 30% response rate. The completion time was about 10 minutes.

Students were approached during an online lecture and were informed about the purpose of the survey, the procedure and that participation was voluntary. Students were further ensured confidentiality in the handling and presentation of data, in line with ethical guidelines of the university (Lund University, 2021). Even though two of the authors were affiliated to two of the programs, none of them were actively engaged in teaching at the time of the survey.

Networks

The first part of the survey explored working, and friendship relations maintained prior to Covid-19, while students still studied on campus, and after the transition to online teaching. A closed network, roster recollection method (e.g., Rienties & Templaar, 2018; Tómas-Miquel et al., 2016) was used, that is, students were asked to select the students they were friends with from a list of names of all the students registered in their present program course.

Students were first presented with two conditions. They were asked to reflect on their study situation in early spring 2020, before teaching was shifted to online due to Covid-19, and then mark whom "you frequently cooperate with when you study," and whom "you socialize/are friends with." After that they were asked to reflect upon their study situation right now (during online teaching) and then mark students they socialize with or frequently cooperate with.

Students were also asked to reflect upon two open questions regarding if and how their study related network had changed due to the transition from campus to online teaching, and if and how that transition had affected their study outcome.

Demographic predictors

Demographic predictors in the present study included gender and whether student commuted. Students reported on *place of residence* both prior to and after the transition (Q2 and Q4). Previous research has shown that these factors affect academic outcome (e.g., Krause et al., 2005; Thomas, 2019). Responses were then collapsed into a dummy variable (1 = non-commuter; 2 = commuter). Students who lived in the city where their university was located were considered non-commuters.

Analysis

Freeman's out-degree centrality was used to measure centrality for the *working* and *friendship networks* (Grunspan et al., 2014). The out-degree measures the number of outgoing ties indicating how influential actors are in the network and how many others they can exchange information with (Hanneman & Riddle, 2005). The analysis of friendship and working networks in program A at LTH was carried out in UCINET and networks were visualized in NetDraw (Borgatti et al., 2002). The higher response rate in that cohort was maybe due to that one of the

authors had taught parts of a course in that cohort earlier in the fall semester 2020. That author did not handle the collection or analysis of the data. It could also be due to the high number of female students in the group, or the fact that they felt the focus of the survey was important to them.

The answers collected through the open questions were analyzed and coded. First all three authors coded student answers regarding study outcome, cooperation with other students and well-being as either *worse, same, or better*. The coding was then compared and modified, before used in the statistical analysis. Vague answers were coded as missing. The open answers were thematically coded by two authors individually, then discussed and refined before arriving at the results presented here.

In the statistical analyses, *Dependent-samples t-test* were used to test for group level difference in network size under the two conditions pre-Covid campus teaching and during Covid-19 online teaching. *Independent-samples t-tests* were used to test for group level differences in networks and self-reported well-being, cooperation, and study outcome between student groups. Student descriptions of their well-being and cooperation with other students were coded as qualitative variables: Worse = 1, Same/better = 2. A *Chi-square tests for independence* was used to explore the relationship between these qualitative variables. Finally, *a One-way between-groups analysis of variance* (ANOVA) was conducted to explore the impact of difference in number of relations on self-reported study outcome. Qualitative responses regarding study outcome were coded as a qualitative variable with three categories (worse/same/better).

Differences were considered statistically significant if $p < 0.05$, two-tailed. SPSS (IBM Corp. Released 2016. IBM SPSS Statistics for Windows, Version 24.0. IBM Corp.) was used for all analyses.

RESULT

The result section is divided in four parts: 1) presentation of the sample, 2) group level analysis of how the emergency transition has affected students' study related networks, 3) statistical analysis of the network data, and finally 4) the themes emerging from students' answerers to the open questions.

The sample

The total sample ($n = 97$) consists of responses from three different study programs as displayed in *Table 1*. 59% of the participants were females and 33% commuted to school. One major difference between the two schools that was thought to impact students' school related networks and the experience of the transition to online teaching was the share of students who commuted to school. 68% of the participants from HKR commuted as compared to 9 and 4% respectively in the two programs from LTH. We can also note that LTH in this study is considered a research-intensive university, while HKR is considered a teaching-intensive university.

Table 1. Sample characteristics

	LTH		**HKR**	
	Program A	**Program B**	**Program C**	**All**
Number of respondents	33	22	42	97
Female students (%)	61	55	59	59
Commuters (%)	9	4	68	33

How study related networks were impacted by the pandemic: working, friendship, and multiplex relations

Due to sufficient response rate in program A (70%) the entire network was analyzed (Rienties & Tempelaar, 2018) in Ucinet (Borgatti et al., 2002) to illustrate the changes in study related networks due to the transition. The network data is presented in Table 2 and the networks are visualized in Figure 1.

Overall in program A, students lost more than 50% of their study related relations, and as much as 57% of their multiplex relations, that is students they both cooperated and socialized with. In figure 1 the networks to the left depict student friendship, working and multiplex networks pre-Covid, when teaching took place on campus. The networks to the right depict the same relations after the transition to online teaching.

Table 2. Descriptive statistics of friendship and study networks in program A, prior to and during the pandemic

	Pre-Covid-19 Campus teaching		**During pandemic Online teaching**		
Network	**∑ ties**	***M* (*SD*)**	**∑ ties**	***M* (*SD*)**	**Loss (%)**
Friendship	472	14.3 (9.99)	227	6.9 (6.91)	52
Working	215	6.5 (5.39)	103	3.1 (1.76)	52
Multiplex	186	4.0 (0.28)	79	1.7 (0.19)	57

In line with previous research, students generally have more friendship relations overall than work relations (e.g., Fjelkner-Pihl, 2021; Rienties & Tempelaar, 2018). Pre-Covid, the friendship network (A in Figure 1) consisted of a total of 472 friendship ties, and had one very dense cluster to the right in the figure consisting of about a third of the students. Two thirds of the students are more peripheral, but still had ties with the dense cluster. Only one isolate is visible. After the transition to online teaching, the network became more fragmented. There are now five isolates and four clusters, where one is more dense. The working network (B in Figure 1) had a total of 215 ties or 55% less ties than the friendship network. Also here, the transition to online teaching resulted in an even more fragmented network. Interestingly, there are no isolates, or students with no relations, in the working network, meaning that students still cooperated with a few other students, but did not always socialize with these.

The multiplex network largely mirror the working network, but is even more fragmented after the transition. Students only socialized and worked with those they share strong ties with, more peripheral ties were not maintained. Generally, this picture was strengthened by student responses to the open ended questions in the survey.

Changes in student social relations due to Covid-19 and the transition to online teaching

The above case visualized the loss of relations in one specific cohort of students. The further analysis of all responses in the study confirms the detailed study of program A that students experienced a loss of relations in all three network types, and that the number of relations maintained differed between the two universities (Table 3).

A paired sample t-test, testing the pre-Covid and Online condition for the different networks indicated significant differences in both universities, although the loss in actual numbers was larger at LTH, where students overall had more relations than did students at HKR in this sample.

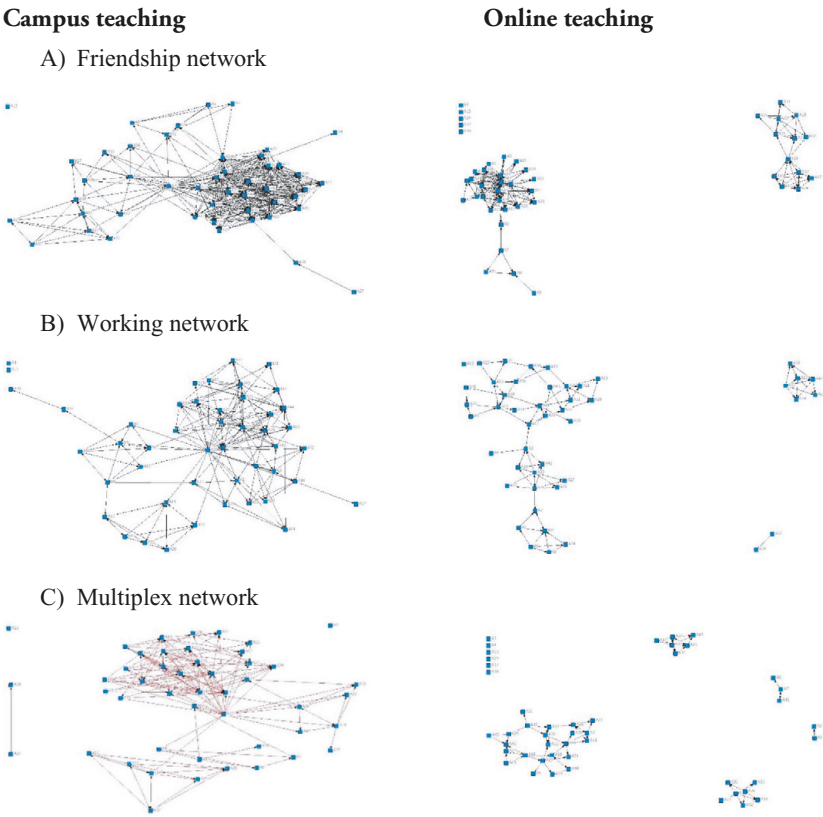

Figure 1. Student social networks in group A: pre-Covid-19 campus teaching vs. online teaching

Note: The networks to the left depict student relations prior to Covid-19 and the networks to the right relations that remained after the transfer to online teaching. A relation is considered multiplex when a student both cooperate and socialize with another node (red ties in C above).

Table 3. Changes in study related networks at HKR and LTH prior to the pandemic and after the transition to online teaching

		Pre-Covid		Online		Paired sample t-test		
		M	***SD***	***M***	***SD***	***t***	***df***	***p***
LTH	Friends NW	16.17	15.26	8.60	9.87	6.28	54	<.001
	Work NW	7.09	5.49	4.04	3.31	5.63	54	<.001
	MPX NW	5.98	5.11	3.25	3.11	5.62	54	<.001
HKR	Friends NW	3.21	3.12	2.29	2.83	3.40	41	<.002
	Work NW	4.90	3.51	3.81	2.98	3.51	41	<.001
	MPX NW	2.74	2.66	1.86	2.30	3.11	41	<.003

Further analyses indicated significant differences in the number of relations students maintained between LTH and HKR, and between non-commuter and commuter students, both prior to the outbreak of Covid-19 and after the transition to online teaching (Table 4).

Table 4. T-result comparing networks under the two conditions pre-Covid-19 campus teaching vs. online teaching

Variable	School	*M* (*SD*)	Median	Range	*t* (*df*)	*p*
Working NW Pre-Covid	LTH	7.09 (5.49)	6	0–27	2.38 (92.4)	<.019
	HKR	4.90 (3.51)	4	0–13		
Friendship NW Pre-Covid	LTH	16.16 (15.26)	18	0–71	6.13 (59.8)	<.001
	HKR	3.21 (3.11)	2	0–11		
MPX NW Pre-Covid	LTH	5.98 (3.25)	5	0–24	4.05 (85.0)	<.001
	HKR	2.74 (1.86)	1.5	0–11		
Working NW Online	LTH	4.04 (3.32)	3	0–15	0.35 (95)	ns
	HKR	3.81 (2.98)	3	0–13		
Friendship NW Online	LTH	8.60 (9.86)	5	0–48	4.51 (65.4)	<.001
	HKR	2.29 (2.85)	1	0–11		
MPX NW Online	LTH	3.25 (3.11)	3	0–11	2.54 (94.9)	<.016
	HKR	1.86 (2.30)	1	0–11		
Working NW Pre-Covid	Non-commuters	7.22 (5.08)	6	0–27	3.78 (89.1)	<.001
	Commuters	3.97 (3.24)	3	0–12		
Friendship NW Pre-Covid	Non-commuters	14.24 (14.68)	8	0–71	5.73 (80.7)	<.001
	Commuters	3.06 (3.97)	2	0–20		
MPX NW Pre-Covid	Non-commuters	5.78 (4.82)	5	0–24	5.01 (94.9)	<.001
	Commuters	2.12 (2.37)	1.5	0–9		
Working NW Online	Non-commuters	4.40 (3.47)	4	0–15	2.43 (89.5)	<.017
	Commuters	3.00 (2.17)	2	0–7		
Friendship NW Online	Non-commuters	7.91 (9.33)	5	0–48	5.08 (76.8)	<.001
	Commuters	1.72 (2.16)	1	0–7		
MPX NW Online	Non-commuters	3.32 (3.13)	3	0–11	4.37 (94.8)	<.001
	Commuters	1.28 (1.46)	1	0–5		

Overall, students at LTH had a higher mean number of both friendship and working relations, both prior to Covid-19 and after the transition to online education. However, the variation was quite high, especially at LTH, where there was a wide range in number of friendship ties (0–71) and higher standard deviations than at HKR.

T-test results indicated significant differences between the mean number of *friendship relations* between LTH and HKR ($p < .001$) both before and *after the transition* to online education ($p < .001$). This was also the case with the working relations on campus ($p < .019$), but after the transition to online teaching that difference had even out and there was no longer any significant difference between the two schools.

Regarding difference in relations between commuter and non-commuter students, there were significant differences between the mean number of *friendship relations on campus* between non-commuter and commuter students ($p < .001$), and *after the transition* to online education ($p < .001$). This was also the case regarding *working relations on campus* ($p < .004$) and *after the transition to online education*, although the difference had evened out slightly ($p < .023$). Overall, non-commuter students had both more friendship and working relations than did students who commuted. As could be expected, the difference between commuters and non-commuters working network was evened out after the transition to online teaching, and as restrictions limited personal interaction.

Association between background variables and reports of well-being and cooperation

Chi-square tests were used to explore if there is an association between variables such as gender, school and commuting with reported well-being and cooperation with other students. 95 out of 97 students responded to the open-ended questions. A larger share of students at LTH (44%) compared to 29% at HKR felt worse (Table 5).

Regarding cooperation with other students, there was a tendency for association for gender and cooperation, as a larger share of male students (73 %) found that the cooperation with other students was worse when teaching took place online than when it took place on campus as compared to 55% of the female students. The result was marginally significant with a p-value of .072, confirming a trend seen in a previous study of Course Experience Questionnaire results at LTH from spring term in 2020 (Warfvinge et al., 2021).

Table 5. Crosstabulation of gender, school, and commuting, with well-being/cooperation with other students

	Males n (%)	**Females n (%)**	X^2	**LTH n (%)**	**HKR n (%)**	X^2	**Non-commuter n (%)**	**Commuter n (%)**	X^2
Well-being									
Worse	12 (33)	18 (38)	.218	18 (44)	12 (29)	2.11	21 (40)	9 (29)	1.084
Same/better	24 (77)	29 (62)		23 (56)	30 (71)		31 (60)	22 (71)	
Cooperation									
Worse	29 (73)	30 (55)	**3.17***	35 (66)	24 (57)	0.79	41 (65)	18 (56)	.703
Same/better	11 (27)	25 (45)		18 (34)	18 (43)		22 (35)	14 (44)	

Note: * *p-value:* .072; student descriptions of their well-being and cooperation with other students were coded as qualitative variables as: Worse = 1, Same/better = 2.

Association between background variables and the change in number of friendship and working relations after the transition from campus to online teaching

Independent sample t-tests indicated that there were significant differences in scores between the two schools regarding changes in the *working network*, and in the *friendship networks*. This was also the case regarding the scores for non-commuters and commuters, which is to be expected since there was a substantial overlap between school and commuting. 68% of students from the HKR were commuters, whereas only 7% from LTH. The pattern was the same for the multiplex network. Overall, students from LTH, and non-commuters, experienced the greatest changes in their networks due to Covid-19 and the change from campus to online teaching (Table 6).

Table 6. Association between background variables and change in networks relations

	Variable	*M* (*SD*)	*t* (*df*)	*p*
Diff Working NW	LTH	3.05 (4.03)	3.13 (83.6)	<.002
	HKR	1.10 (2.02)		
Diff Friendship NW	LTH	7.56 (8.94)	5.37 (59.4)	<.001
	HKR	0.92 (1.77)		
Diff MPX NW	LTH	2.73 (3.60)	3.29 (84.24)	<.001
	HKR	0.88 (1.84)		
Diff Working NW	Non-commuters	2.81 (4.03)	3.12 (94.5)	<.002
	Commuters	0.97 (2.01)		
Diff Friendship NW	Non-commuters	6.34 (8.42)	4.05 (94.2)	<.001
	Commuters	1.34 (3.70)		
Diff MPX NW	Non-commuters	2.46 (3.50)	3.13 (94.5)	<.002
	Commuters	0.84 (1.59)		

Association between change in the working and friendship networks and reports of well-being and cooperation

Independent-sample t-test was conducted to explore association between mean change in working and friendship relations and reports of well-being and cooperation (Table 7). Overall, the mean loss of relations for students who indicated they felt worse, or that the cooperation between students was worse when teaching was conducted online, was larger than the mean loss for students who reported that well-being or cooperation was the same or better.

Regarding *well-being,* there was significant difference in the mean change in the *working networks* for students who reported a decline in well-being and students who reported no change or improvement in well-being. Likewise, there was a significant difference in the mean change in *multiplex network* relations, where students who reported a decline in well-being on average lost 3.59 multiplex relations as compared to 0.93 for the group *same or better*. Overall, the result indicated that students who reported a decline in well-being had lost more work and multiplex relations on average.

Table 7. Association between change in number of networks relations, and well-being and cooperation

			M	*SD*	*t* (*df*)	*p*
Well-being	Diff Working NW	Worse	3.33	4.57	2.26	<.05
		Same or better	1.57	2.55		
	Diff Friendship NW	Worse	6.43	8.30	1.668	ns
		Same/better	3.55	7.13		
	Diff MPX NW	Worse	3.59	4.43	2.577	<.01
		Same or better	0.93	1.94		
Cooperation	Diff Working NW	Worse	2.44	4.03	0.751	ns
		Same or better	1.89	3.83		
	Diff Friendship NW	Worse	5.12	7.72	0.798	ns
		Same or better	3.83	7.44		
	Diff MPX NW	Worse	1.93	2.91	0.023	ns
		Same or better	1.92	3.48		

There was no significant difference in the mean change in the *friendship networks* between the two groups, which seems to indicate a relative importance of the work and multiplex relations for well-being.

Regarding *cooperation,* there was no significant difference in the result, although students who reported that cooperation was worse than before due to Covid-19 had lost slightly more work and friendship relations than had students who reported that cooperation was the same or better.

Association between change in the working and friendship networks and outcome

A one-way between-groups analysis of variance was conducted to explore the impact of difference in number of relations on self-reported study outcome. Participants were divided into three groups based on their responses to how they thought the transition to online teaching had affected study outcome (worse/same/better). There was no statistically significant difference between groups, although overall students who reported they did less well had also lost more relations on average (Table 8).

However, when the scores of the two groups non-commuters and commuters were compared significant differences were found for commuters and differences in the multiplex and work networks at the $p < .05$ level in the LOT scores for the three groups. Commuter students who reported they did worse regarding study outcome during the pandemic had lost more relations in their multiplex networks.

Table 8. Association between change in number of networks relations and self-reported study outcome

		Study outcome	***M***	***SD***	***F* (*df*)**	***p***
All	Diff Working NW	Worse	2.67	3.18	.46	ns
		Same	2.33	4.18		
		Better	1.54	1.76		
	Diff Friendship NW	Worse	6.50	7.86	1.16	ns
		Same	4.48	8.15		
		Better	2.85	5.71		
	Diff MPX NW	Worse	2.70	2.77	1.72	ns
		Same	1.96	3.71		
		Better	.77	1.17		
Commuters	Diff Working NW	Worse	2.30	2.83	4.36 (2, 26)	<.023
		Same	.21	.97		
		Better	.20	.45		
	Diff Friendship NW	Worse	1.30	2.06	1.66	ns
		Same	.43	.85		
		Better	4.00	8.94		
	Diff MPX NW	Worse	1.90	2.02	5.50 (2, 26)	<0.01
		Same	.36	.842		
		Better	-.20	.45		

(Continued)

Table 8. (Continued)

		Study outcome	*M*	*SD*	*F* (*df*)	*p*
Non-commuters	Diff Working NW	Worse	2.85	3.34	.18	ns
		Same	3.25	4.62		
		Better	2.38	1.77		
	Diff Friendship NW	Worse	9.10	8.42	2.03	ns
		Same	6.25	9.24		
		Better	2.13	2.95		
	Diff MPX NW	Worse	3.10	3.04	.65	ns
		Same	2.66	4.25		
		Better	1.38	1.06		

Students who reported they had the same outcome as before the pandemic had only lost on average 0.4 relations. Post-hoc comparisons using the Bonferroni test indicated that mean scores for students who did worse was significantly different from students who did the same or better.

Student responses to open-ended questions

This part reports on findings from the thematic analysis of responses to the open-ended questions in the survey, which were included with the aim to shed further light on certain aspects of the quantitative findings, such as the loss of peripheral relations and supportive formative feedback and problem solving that took place in and around the classroom.

30% reported that the transition had had a negative impact on their study outcome. At the same time a majority of students indicated that 48% of the students in this sample did not find that the transition to online teaching had had a substantial effect on their study outcome, and for some (15%) the transition had even led to better study result. Reasons pointed out were the ability to plan their time better and more time to study due to less social interaction and less time spent commuting (Table 9). Regarding their study outcome, students reflected on how they could now study at their own pace, they did not have to spend time socializing, and maybe also the format of the examination or the grading had changed making it easier to pass. They also pointed out that they had kept a small but supportive network which had aided them in their studies.

Table 9. Student responses regarding improved study outcome

I do better. I think because I do not have to commute which gives me more time, but also because the group I study with are good at making sure that we spend enough time. If I did not study via Zoom with my group my results would have deteriorated. (A6)
As I have started to study more on my own, I have to say it goes better compared to when I studied with others. Now I focus more on school and less on socializing with others. (C41)

For some, and especially for the commuter students (C41) the interaction with their innermost circle continued almost as usual, and they simply met using digital tools such as Zoom or communicated frequently via different social media (Table 10).

Table 10. Student responses regarding studying using digital tools

But luckily one have used Zoom a lot in the groups and helped each other. Zoom has not only been used for lectures. Group dynamics has been great so that is why there has been no obstacles/difference apart from that we do not meet IRL. (C15)
Zoom is really a very good and useful tool. […] Of course, I miss the social bit […] but me and my friends still have some contact via social media and Zoom from time to time. (C27)

At the same time responses indicated a sense of loss, or sadness in missing the interaction in and around the classroom as 60% of the students reported that the interaction between students had deteriorated. They kept their innermost circle of students they worked closely with but did not interact at all with more peripheral peers, indicating that it is foremost the peripheral study related relationships that are were dropped; thus, the personal network was defoliated from outside in, as students now only interacted with a small core group of peers. Many further expressed how they missed getting other perspectives on things as they only or mostly communicated with the same small number of peers (Table 11).

Table 11. Student responses regarding defoliation of study related networks

Those I studied the most with I have continued studying with. Those that I studied less with have completely vanished which is sad. However, the relationship with the students I study with have gone from being just superficial study mates to actually develop into real friendship during this time. (A44)
Before you could bump into people in class in school. Now the circle of friends is more limited, and I never meet new people. I socialize a lot with old friends and seldom get new perspectives on things as you are so isolated. As most social events where you could previously meet acquaintances were cancelled you have had no possibility to come close to any new [people]. (B21)

Students further pointed to the informal activity that goes on in and around the classroom, that is, the constant sharing of what goes on in a course, what is required of different assignments and what the course literature is really saying. This flow of formative feedback was hard to maintain or recreate in an online environment (Table 12). This experience was more frequent among campus respondents compared to commuter students.

Table 12. Student responses regarding lack of information and formative feedback

The biggest difference is not meeting the teacher physically. […] which for some reason has led to insecurity and being unsure of assignments, demands and deadlines. Maybe it is so that discussions about these issues are brought up more often in a physical classroom than in a digital one, thanks to the dynamics between students in the physical environment. (C42)
Then you bumped into people on campus and often asked someone who sat close to you. Then you could realize that you were on the same level/had gotten as far and then you continued together. (A26)
I think the online teaching could be developed to reach out to more students. Personally, I learn better in a classroom and [when] I have the possibility to ask questions and another possibility to dialogue with the teacher. (C4)

DISCUSSION

In our sample students reported a loss of ties sometimes as high as 50%, as they moved into online teaching during the pandemic. This is consistent with other reports (e.g., Elmer et al. 2020). The main contribution of this study is the documentation of changes in networks in

more detail, and the visualisation of how networks are fragmented as they defoliate, or shrink from the outside in. As could be expected, weak ties are lost before strong ties. The most stable and resilient ties are those that are multiplex, that is consisting of individuals that are both friends *and* study partners. In this study, students report that the working network is the most important network for both well-being and outcome of studies, which is consistent with other studies (Fjelkner-Pihl, 2021), but in contrasts to yet other studies claiming that centrality in friendship networks is the most important factor in relation to study outcome (e.g., Rienties & Tempelaar, 2018).

Student from both universities reported on missing the informal interaction that went on in and around the classroom, although their experiences of social interaction differed depending on if they commuted or not. According to research on feedback (Esterhazy, 2019; Henderson et al., 2019), interaction with many students near the study situation is important for students to understand content, instructions, and the overall meaning of courses. The question remains, interaction with how many? In this study, commuter students had smaller networks both before and during the pandemic than did non-commuters without generally reporting a decline in results or well-being. This observation opens for a possibility that even though learning and well-being is linked to interactions with others, different groups may have different needs.

Research on effects from the pandemic in a campus environment has shown that students during the pandemic struggled to orient themselves in courses and to find motivation to study (Warfvinge et al., 2021). Such signals surface also in our material. Pre-pandemic research into online teaching (Theobald et al., 2018; Weidlich & Bastiaens, 2019) emphasize study strategies and study discipline over opportunities to engage in a multitude of interactions. Overall, this leads to a conclusion that some students need the group and the myriad of interactions (Esterhazy, 2019) more than others, while some students rely on an already developed study discipline and their already existing working network.

Arguably and possibly not surprisingly, it is those students who struggle with their studies that are hit the hardest by the pandemic, especially those that have not been able to form functioning study groups before the pandemic. Since this sample consisted of students already into their third year, it is possible to foresee that more students would struggle if they had to start their studies under pandemic-like online conditions without sufficient support for social interaction, discussion groups, and group work in the online environment. In such a situation students must rely even more heavily on already constructed study strategies and those who lack such strategies would suffer difficulties.

Student networks became more fragmented after the emergency transition to online teaching. Figure 1 illustrates what this looks like on the cohort-level. Fragmentation increased dramatically. Since we know that study networks are formed by individuals who are similar to each other (Fjelkner-Pihl, 2021), thus following the principle of social homophily (McPherson et al., 2001), the pandemic may have led to a relative increase of social homophily. This type of fragmentation, besides from making it even harder for individuals to find others to work with, makes it more unlikely that students will interact with fellow students who think differently from themselves, something that several respondents pointed out in the open-ended answers. Even though short-term negative effects from increased partitioning in student cohorts have been validated (Rientes & Templaar, 2018), research on long-term effects from increased social homophily is lacking. However, it has been established that students benefit from interacting with other perspectives, not only provided by the teacher (O'Donovan, 2015; Perry, 1988).

Finally, responses from our sample indicate that different students react differently to the online teaching during the pandemic. Commuters, for example, report doing well with a smaller working network as they maintain much of their social relations from before studying (e.g., Pokhorny et al., 2017; Thomas, 2019). LTH students, on the other hand, most of whom have chosen to study at a campus-institution, report both a decline in well-being and a loss of opportunities to interact with to them new students during the pandemic. Thus, post-pandemic planning for how to organize higher education should consider these and similar findings implying that one size does not fit all. The LTH students in our study both seek social presence from others and report being dependent on it, while students in the other end of the spectrum, the commuters, report doing well with less interaction and appeared more content with the changes made during the pandemic.

Furthermore, we argue that the fragmentation of cohorts and thereby a potential relative stronger dominance of social homophily is something that deserves attention, especially longitudinally. There is a risk that good study strategies and functioning working networks may maintain study efficiency short term despite increased cohort fragmentation, but also that they may hide a long-term negative effect on students' epistemological development. Considering the ethos of academia where personal and epistemological development are important, highlighting this risk might be the most important contribution from this study.

LIMITATIONS

The pandemic provided an opportunity to investigate effects on students' networks and to reflect on the meaning of these changes. An obvious limitation with this study is its ad hoc explorative nature. More stable conditions would possibly have allowed a more robust design. Second, the study is based solely on self-reported data which may reduce the validity of the study. Students may have over- or underestimated their relations, for various reasons, which may lead to a distortion of the data. At the same time, the study offers a snapshot view of student networks in two different settings during the Covid-19 pandemic, and how these were differently affected due to the context. This is an important insight as we now move on and discuss how to organize higher education in the future.

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