

Supplementary Information

Forma mentis networks map how nursing and engineering students enhance their mindsets about innovation and health during professional growth

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The following Appendix contains additional figures about local changes in the forma mentis of students before and after the summer job experience.

Figure S1 - Forma mentis networks for Student 1 (nursing student) before (top) and after (bottom) the summer job experience. Negative/positive/neutral words are highlighted in red, cyan and black, respectively. Links between positive (negative) words are highlighted in cyan (red). Purple links indicate associations between positive and negative concepts.

Figure S2 - Forma mentis networks for Student 2 (nursing student) before (top) and after (bottom) the summer job experience. Negative/positive/neutral words are highlighted in red, cyan and black, respectively. Links between positive (negative) words are highlighted in cyan (red). Purple links indicate associations between positive and negative concepts.

Figure S3 - Forma mentis networks for Student 3 (nursing student) before (top) and after (bottom) the summer job experience. Negative/positive/neutral words are highlighted in red, cyan and black, respectively. Links between positive (negative) words are highlighted in cyan (red). Purple links indicate associations between positive and negative concepts.

Figure S4 - Forma mentis networks for Student 4 (engineering student) before (top) and after (bottom) the summer job experience. Negative/positive/neutral words are highlighted in red, cyan and black, respectively. Links between positive (negative) words are highlighted in cyan (red). Purple links indicate associations between positive and negative concepts.

Figure S5 - Forma mentis networks for Student 5 (engineering student) before (top) and after (bottom) the summer job experience. Negative/positive/neutral words are highlighted in red, cyan and black, respectively. Links between positive (negative) words are highlighted in cyan (red). Purple links indicate associations between positive and negative concepts.

Figure S6 - Forma mentis networks for Student 6 (engineering student) before (top) and after (bottom) the summer job experience. Negative/positive/neutral words are highlighted in red, cyan and black, respectively. Links between positive (negative) words are highlighted in cyan (red). Purple links indicate associations between positive and negative concepts.

Figure S7 - Cumulative degree distribution for the “before”, “after” and “core” forma mentis networks, as described in the main paper. The distribution $P(X)$ indicates the probability of finding a node with degree k equal to or greater than X in a given network. The degree distributions of the “before” and “after” networks are quite similar and exhibit a heavy tail.

Supplementary Text S1 - Description of the Intervention Event

Supplementary Text S2 - Qualitative Feedback from Students

Supplementary Table S1 - List of Cue Words

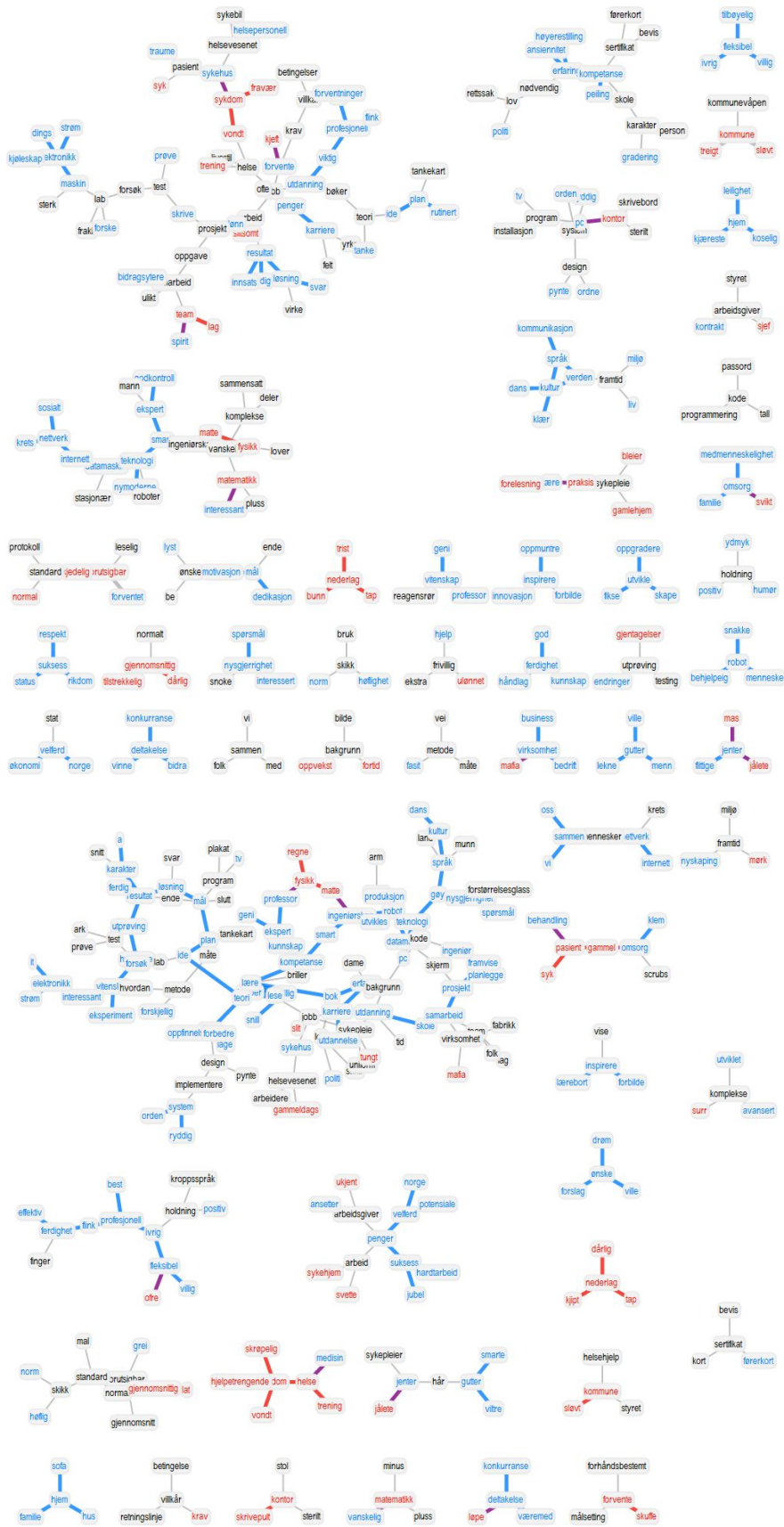


Figure S1

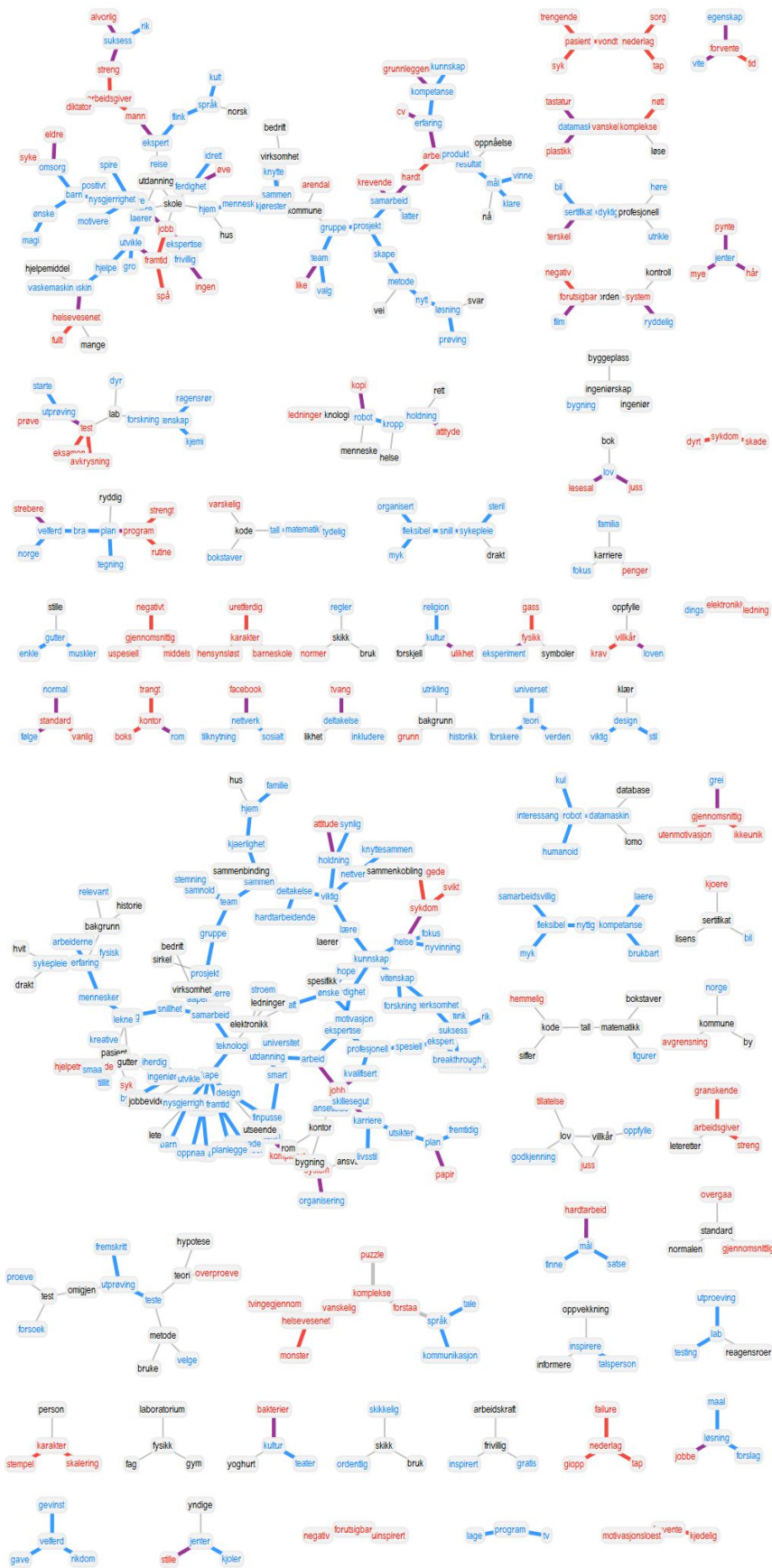


Figure S2

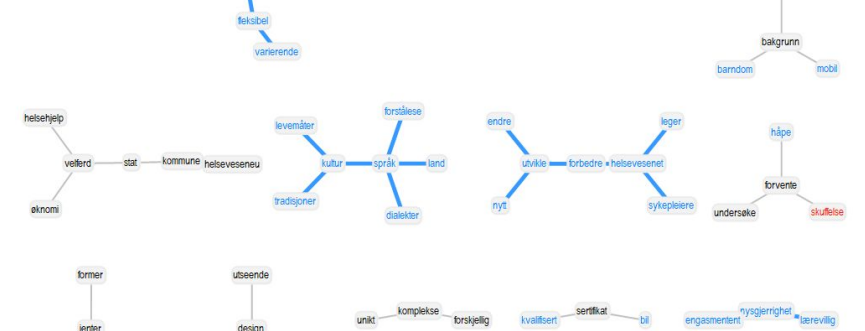
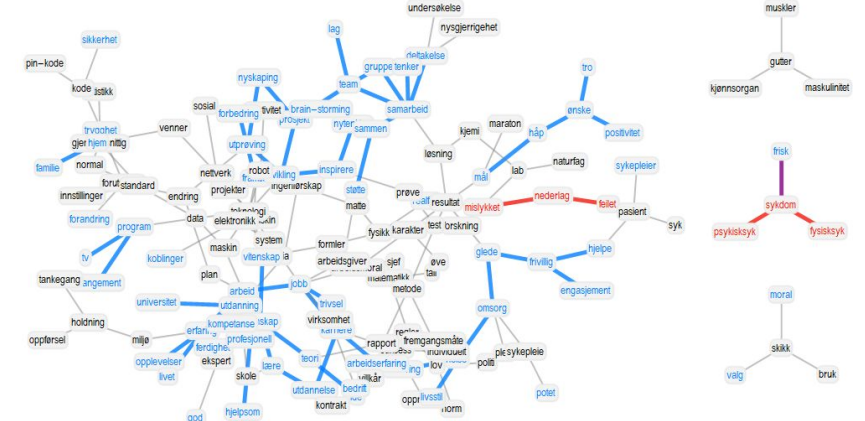
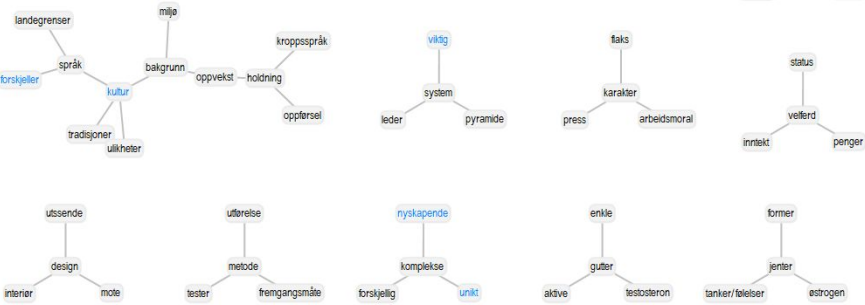
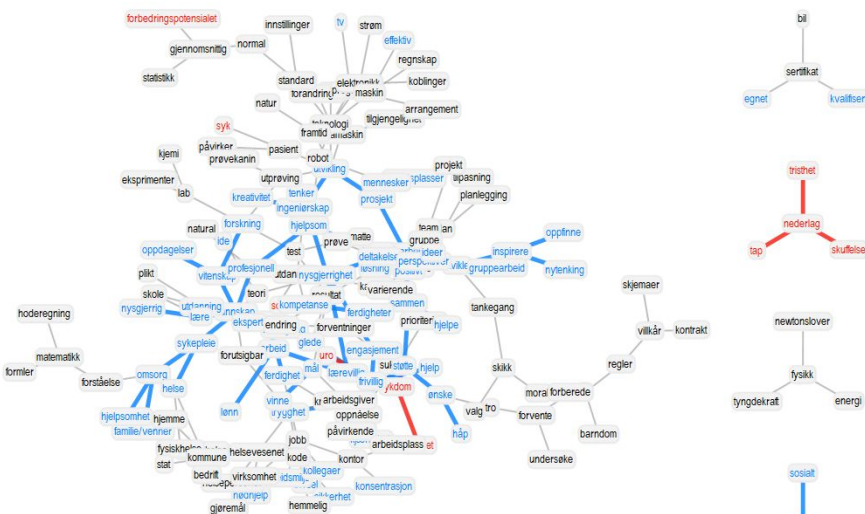


Figure S3

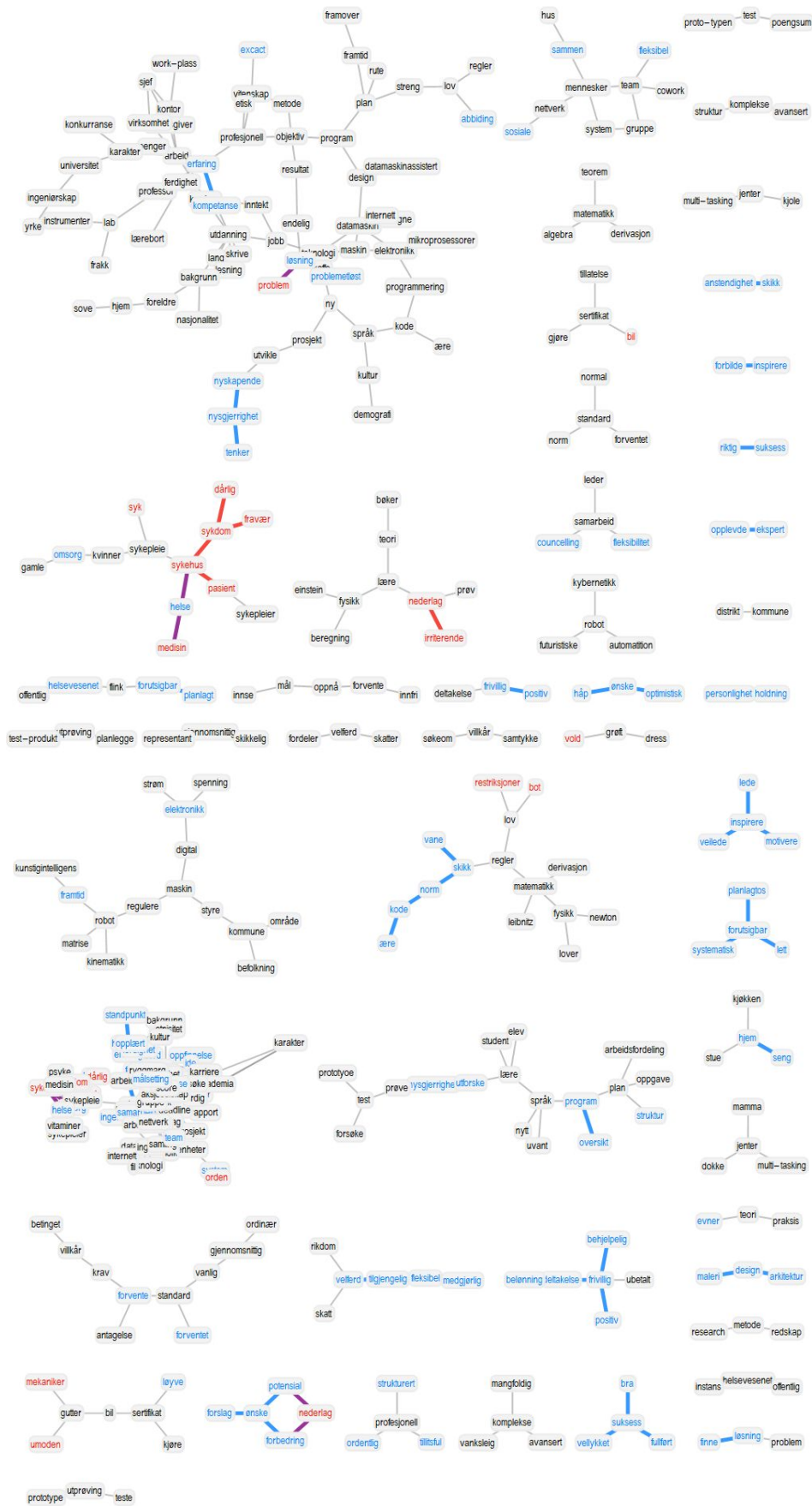


Figure S4

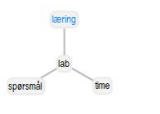
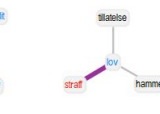
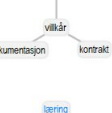
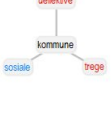
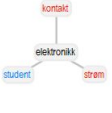
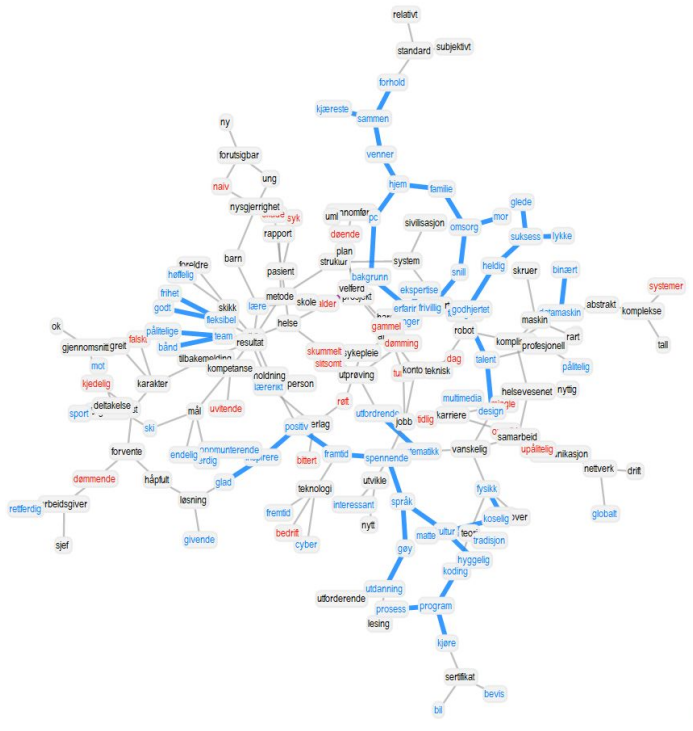
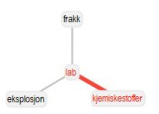
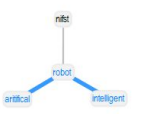
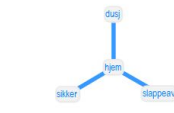
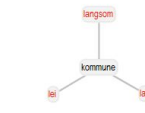
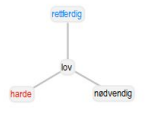
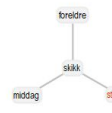
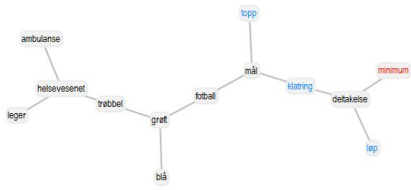
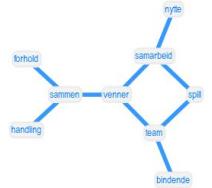
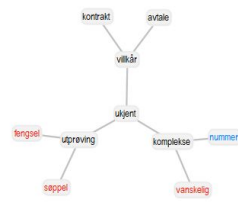
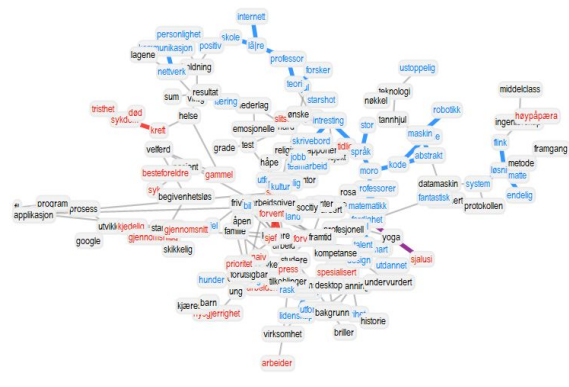
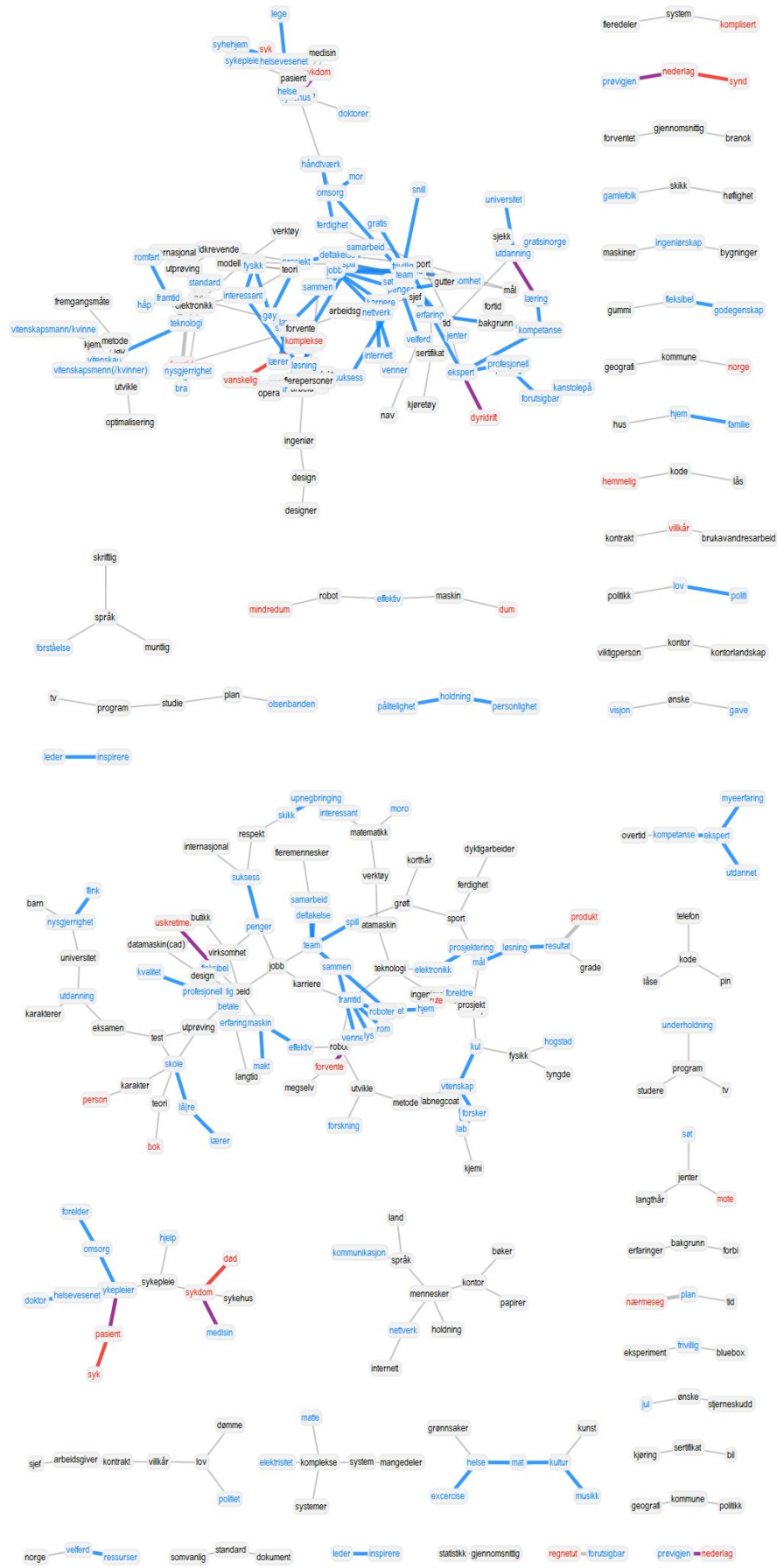


Figure S5



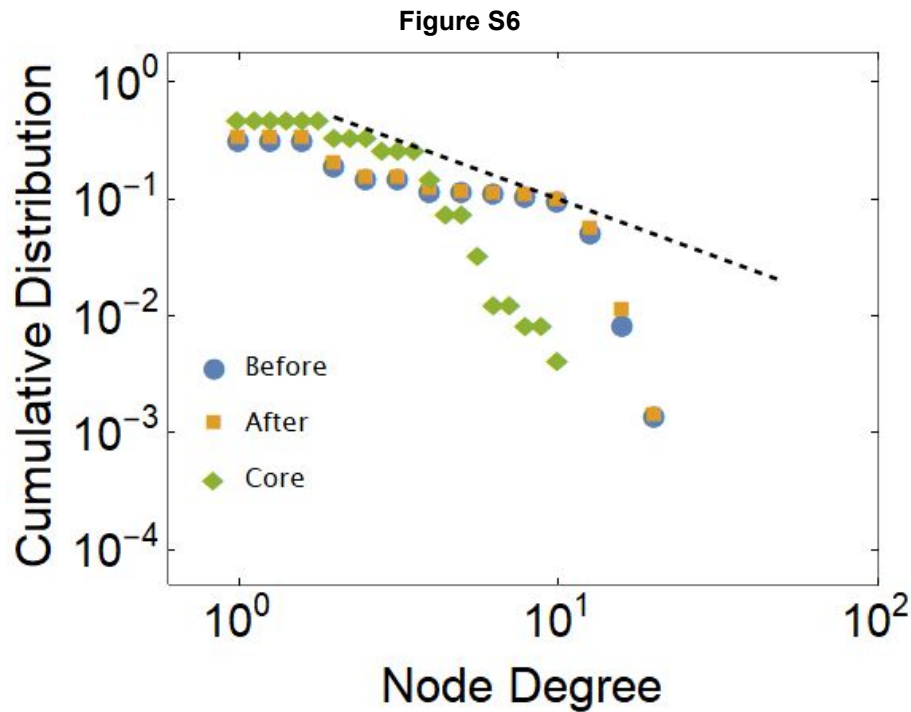


Figure S7

Supplementary Text S1 - Description of the Intervention Event

All the participants to the current study took part in a summer job experience taking place at i4Helse, University of Agder, Norway, from June to August 2019. i4Helse is an innovation hub aiming at facilitating and accelerating implementation of health and welfare solutions of tomorrow. One of its key missions is competence building in the upcoming generation of professionals in health and homecare, as well as in specialized healthcare provision, technological design and practical use of emerging technologies in the domain. Involvement of the University of Agder in the operation of i4Helse provides those synergies - of non-STEM and STEM skills students, whose forma mentis are explored, for the purposes of further application of the results for acceleration of synergic cooperation processes at i4Helse. The process of making the students to cooperate for building a “homecare assistant” robot began in spring 2019, in collaboration between i4Helse and a student-driven startup Young Industrial Innovators, was supported by the Mechatronic Innovation Lab, with tight involvement of municipal professionals, knowledgeable in so-called Early Identification of Life-threatening Conditions (Tidlig Identifisering av Livstruende Tilstander, or TILT, in Norwegian). The students came from the Faculty of Technology and Natural Sciences and Faculty of Health and Sports, including interns at Mechatronics Innovation Lab and the Center for Artificial Intelligence Research, University of Agder, Norway. The students completed a task relative to designing and assembling a mobile assisting TILT robot. Supervised by a municipal employee with practical knowledge in TILT and a couple of STEM professionals, the selected students in health and homecare and students in programming, engineering and robotics cooperated over the whole summer in order to fulfill this task. The students used equipment such as raspberry pi embedded data systems, with ports to connect with cameras, microphones for voice and language recognition, screens, sensors, bluetooth, mechanic sphygmomanometers, and robotic platforms for physical following human in movement. Research on changes in the forma mentis in students was conducted by Complex Science Consulting during short research stayings at the beginning and at the end of the summer job experience.

Supplementary Text S2 - Qualitative Feedback from Students

After the completion of the second cognitive experiment, at the end of their summer job experience, students were invited to provide feedback about their overall experience. Feedback sessions were held right after the completion of the cognitive experiment but without providing preliminary results to students. Feedback was provided through a guided dialogue, under the supervision of the first author. Students were asked to answer simple questions in the following order:

1. Do you think you achieved the main aims of the summer job experience?
2. Are you happy about the outcomes of the summer job?
3. What was your role in achieving these outcomes?
4. Which were the best and the worst elements of the summer job?
5. Which were the most useful skills that you acquired during this experience?

All the students considered the summer job a success in terms of achieving the aim of constructing an e-health robot. At the same time, all the students enjoyed the summer job event and provided positive feedback about it. Engineering students declared their involvement mostly in terms of practical tasks, related to the assembly of the robot and to its programming. Nursing students identified themselves as providing feedback to engineering students about the necessary features of a robotic assistant, based on their own personal nursing training. Nursing students did not actively code but followed the progress of engineering students, instead. Five out of six students indicated “communication” and “teamwork” as the key and most appreciated elements of the summer job experience. All students confirmed individually the roles of nursing and engineering students and the relevance of multidisciplinary interactions for progressing, especially in the last few weeks of work. Four students highlighted the last weeks as “hectic” and “very busy”. Despite the resulting stress, students expressed their satisfaction in completing the project on time. The most useful skill acquired during the summer job resulted being the capability of effectively discussing ideas across different backgrounds, enjoying personal interactions and collaborative working for professional growth. One engineering student and two nursing students also expressed their desire to improve their technical skills related to coding and programming after seeing the outcomes of the summer job.

Supplementary Table S1 - List of cue words

arbeid	erfaring	ekspert	lov
utdanning	omsorg	datamaskin	ferdighet
ingeniørskap	fysikk	sykepleie	suksess
matematikk	teknologi	helse	vitenskap
nederlag	system	inspirere	utvikle
pasient	prosjekt	plan	resultat
forutsigbar	karriere	sykdom	gjennomsnittig
karakter	helsevesenet	nysgjerrighet	program
skikk	frivillig	ønske	utprøving
fleksibel	elektronikk	lære	sertifikat
kommune	hjem	jobb	arbeidsgiver
profesjonell	kode	villkår	standard
språk	kontor	holdning	maskin
robot	lab	løsning	test
nettverk	velferd	deltakelse	team
samarbeid	sammen	bakgrunn	teori
design	forvente	framtid	metode
virksomhet	kultur	komplekse	kompetanse
mål	gutter	jenter	