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Status indicators in software engineering group projects ☆

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ABSTRACT

A segment of studies on group structure and performance in software engineering (SE) project-based learning (PjBL) have focused on roles, including studies that use Belbin team roles and studies that address problematic roles such as social loafing. The present study focuses on the status, which is basically missing in SE PjBL studies, although relating to roles. The study investigates the aspects that students identified as indicators of rising or declining status in their project groups. The status theory was utilized as the framework that motivated the research and on which the results were reflected. An inductive qualitative content analysis was applied to learning reports in which students reflected on their statuses. The indicators of rising status included technical know-how, commitment, management responsibility, and idea ownership, while also group-level attributes such as a caring atmosphere and joint responsibility. The indicators of a declining status included aspects that appear as counterparts of rising status indicators, while also more refined aspects such as no one willing to be a leader or study background. The results are concluded to provide material for educating students about intra-group relations and promoting self-regulation for fruitful collaboration in groups. The authors believe that the results also initiate further PjBL research in which status theory can be utilized.

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1. Introduction

Incentives for using group work as an educational measure are in abundance. They follow from emphases on student-centered learning (e.g. Souza et al., 2019; Pérez and Rubio, 2020), from creative problem solving being regarded as a collective activity that stresses interactions (Bach et al., 2008), and from another employability attribute of ability and willingness to work with others (Hernández-March et al., 2009). Additionally, group work may be adopted to reduce resource pressures in teaching (Burdett, 2007). In software engineering education, reports on project-based courses in which students typically work in groups form a decades-long tradition (Tomayko, 1998).

The present motivation to study SE PjBL groups includes that the literature often presents rather general reflections on constructivism and constructivist teaching as the theoretical framework of a PjBL report. The present authors think that researchers should keep adopting focused and underused theoretical frameworks to enrich the conceptual understanding of group pedagogy. To this end, the concept of status was adopted as the theoretical framework. Based on the theory of Status Characteristics and Expectations States (Berger et al., 1965), status hierarchies in groups are based on the characteristics by which social organization can occur. A simple explanation is that when a group member possesses abilities that help the group make progress toward its goals, this group member has high status. Other conceptualizations of status are introduced in the section devoted to status. The authors conjecture that asking students to explain their status sheds light on the factors that explain when an individual student can attend group work and thereby has learning possibilities in their groups. Additionally, how statuses appear in groups sheds light on a group's structure and dynamics.

The research question addressed in this study was: what aspects influence individuals' statuses in small groups in the context of SE education? Students studying on a SE project course were asked to reflect on and report the indicators of their status in learning reports at the end of the projects. Taking a qualitative approach, conventional (inductive) content analysis (Hsieh and Shannon, 2005) was applied to this textual data. The results are presented as a framework that differentiates various aspects as indicators of a low (or declining) and high (or rising) status.

Due to a lack of related studies on students' statuses in SE PjBL groups, studies on group roles and personality types were regarded as related work. The reflection here is that the concept of status is relevant for these lines of research and that part of the present contribution is introducing the status concept for these research lines to consider. The present study includes a discussion on how studies on roles and personality types could be linked with studies on status.

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Section 2 reviews conceptualizations on status. Section 3 reviews PjBL studies that have looked into students' roles or personality types in their groups, which will be returned when discussing the results. Section 4 describes the research approach and method, and the results are presented in Section 5. Discussion in Section 6 considers the results from the perspectives of status theory, teaching, and research. Section 7 summarizes the main conclusions.

2. The concept of status

The theory of status characteristics and expectations states was outlined by Berger et al. (1965) and further explained in the studies by Berger et al. (1980), and Cohen and Zhou (1991).[1] Berger et al. (1965) acknowledged previous status and expectations conceptualizations while, by noting a lack of a coherent formulation in this area, proposing this theory. The theory explains status usefully for educational ad-hoc student work groups, as it was noted to apply to "task-oriented" (Berger et al., 1965, p. 1) problem-solving groups that have a shared goal (Berger et al., 1980, pp. 478–480, 483–484). The following conceptualizations are at the core of the theory (Berger et al., 1965, 1980; Cohen and Zhou, 1991): Status characteristics refer to any characteristics according to which statuses of group members may become organized. Expectation states indicate that a particular status characteristic can have two or more states and hence serve as a source of status differentiation. A specific state imposed on a group member creates expectations of his or her performance. Status hierarchies in groups emerge based on the evaluations and beliefs about group members in light of the available status characteristics. It can be said that individuals become ranked or that their statuses become organized based on these beliefs and evaluations.

Additionally, the theory identified two kinds of status characteristics: diffuse and specific (Berger et al., 1965, 1980; Cohen and Zhou, 1991). The former referred to prior external factors that exist in social structures outside a problem-solving group and can hence influence not only one but many specific task situations. Cohen and Zhou (1991, p. 180) included a race, sex, and military rank as examples. The latter characteristics were considered more specific, with a disciplinary ability given as an example often associated with sex (Berger et al., 1980, p. 494). The status characteristics were also differentiated into external and internal characteristics based on whether a characteristic is external or internal to the group's interaction situation (e.g., Cohen and Zhou, 1991, p. 181). This seems to echo the differentiation into diffuse and specific characteristics. Cohen and Zhou (1991, p. 181) mentioned help received from a technical advisor as an example of internal (within a team) characteristics, which appears relevant for SE student project groups. Regarding research, Cohen and Zhou (1991) advocated a multi-level research lens that incorporates both internal and external characteristics.

Using the terminology of the theory, a task group can be considered "status equals" (e.g., Berger et al., 1965, p. 2) – we would see this as an obvious starting point for student groups if compared to settings in which participants have job titles, for instance. Student group members have apparently similar study backgrounds, and there can be few diffuse (or external) characteristics (cf., a junior developer vs. a senior developer) available for observation. Drawing on earlier studies by Bales (e.g., 1951), the theory (Berger et al., 1965, 1980) included that statuses developing among status equals yield a relatively stable status differentiation that begins to influence group beliefs and behaviors similar to prior status information in case of external status characteristics. Altogether the manifestation of statuses was considered situational because this was attached to the task situations of a group (e.g., Cohen and Zhou, 1991, p. 181).

The theory further explains the process of a status organization by the concepts of the path of relevance and burden of proof Berger et al. (1965, 1980), Cohen and Zhou (1991). The former indicates how relevant a particular characteristic is for processing a social situation. If the characteristic is directly relevant to the group's goals – Berger et al. (1980) gave an example of high mathematical ability in the situation that requires such ability – the path is short (Berger et al., 1980). A characteristic that indirectly influences the situation (e.g., sex) can be seen to have a longer path (Berger et al., 1980). The burden of proof refers to a situation in which status expectation defines an individual's status regardless of its relevance to the task situation. Changing the status would require proofing against this expectation (Berger et al., 1980, p. 486; Cohen and Zhou, 1991, p. 180). The burden of proof was considered relevant for both diffuse and specific characteristics (Berger et al., 1980). In the scope of the present article, we omit further details of the theory and now concentrate on other status-related literature.

Another relevant line of literature is peer acceptance. Wright et al. (1986) reported that previous research in this area had in great quantity attributed status determination to the traits possessed by a person. In this connection, the authors proposed and found support for an individual's prosocial behavior as a universal or at least locally stable correlate of high status. Additionally, their study emphasized that status determination is influenced by how an individual fits into a group, which called attention to situationality in place of personal traits alone. The study confirmed this group (mis)fit effect; for example, an aggressive child could have a low status in a group where aggression was not predominantly present but not in a group where aggressive behaviors predominated. This attraction of similarity appears to be a relevant conceptualization for higher education student groups. To develop a higher education example, we refer to Pieterse and Thompson (2010), who reported that groups with academically aligned members (similar goals, skills, and attitudes) showed little group problems such as social loafing. Additionally, the preference for similarity was reported in a study that addressed with whom students prefer to work (Strauss et al., 2011).

Bearing some resemblance with the group (mis)fit effect, Stamper and Masterson (2002) focused on perceived insider status (PIS). They conceptualized the relationship between an employee and an employer, putting that how the employer treats an individual employee causes variation in how the employee perceives their status. Organizational support and actual inclusion (e.g., how much effort an individual puts into work) were proposed to contribute to PIS. The individual's perception of being an insider or not could result in so-called organizational citizenship behavior or deviancy work behavior. The former refers to altruistic behavior, including unrewarded helping among peers, while the latter refers to behaviors detrimental to the organization's functions. The empirical part of the study supported these conceptualizations. The conclusion by Stamper and Masterson (2002) was that organizations should manage their employees' perceived insider statuses.

In the context of commercial work groups whose members value a high status, Loch et al. (2000) considered the conditions in which status competition either increases or decreases performance. Their model emphasized work culture. The culture was considered to emphasize merit or politics, and status determination was considered to echo the relative degree of these attributes. The model suggested that a merit-based culture contributes to a setting where individuals work hard. An emphasis

[1] The information on the theory in this section is often found in all three references; to guide the reader, we keep pointing to particular one(s).

on politicking instead causes waste as the individuals' resources are expended on pursuing a high position. Altogether, this study conceptualized status behaviors, which we consider relevant for SE student projects. For instance, the present study will shed light on the question of whether a high status is typically imposed on or consciously pursued by a student.

Finally, the study by Kulich et al. (2015) investigated status movement by focusing on the transition of individuals from a disadvantaged group (e.g., in light of ethnicity) to a higher-status group. The authors draw from prior research that individuals making the transition discount their previous identities. Kulich et al. (2015) instead found that an individual possessing a low-status background, now performing in a new high-status group, does not disregard their background but rather advances their identification with the new high-status group. We consider the status movement a relevant conceptualization for understanding programming-intensive student projects in which participants have to negotiate somehow their positions in groups in which members' skill levels are often observed to differ.

3. Related work

We did not find status theory in SE PjBL studies outside the first author's previous work. In the referred work, the status concept was introduced as the learning topic for students and provided a conceptual foundation for a group intervention during projects (Isomöttönen and Ritvos, 2021). The following reviews studies that have analyzed group pedagogy with the help of roles or personality types. Studies analyzing roles were considered related work because statuses relate to roles; for instance, a high status can indicate a leadership role (Brown, 1988). It should be mentioned that formally assigned roles might complicate status interpretations (Cohen and Zhou, 1991), but such assignment does not apply to the present research setting. Studies on personality types appear interesting because they potentially link with status theory. For instance, being social was a category that students reported as an indicator of status in the present study and both Myers–Briggs type indicators (MBTI) and the five-factor model (FFM), frequently used in software engineering research (Gulati et al., 2015; Barroso et al., 2017), include aspects of sociability.

Belbin (2004) defined eight roles that explained interaction types of individuals and were considered needed for successful teams. Additionally, Belbin acknowledged a specialist role, which was not similarly seen as a general role type. Rather than specifying what an individual does in a team, Belbin's eight roles explained how individuals fit into teams, as was summarized by Henry and Stevens (1999).

Researchers have been interested in Belbin's roles to analyze their effect on team performance. Henry and Stevens (1999) made use of the "Shaper" Belbin role. Belbin (2004, pp. 49, 62) clarified that the shaper refers to a driving, action-based leader, whereas another kind of leader role – "Chairman" – refers to an acknowledgment of people and knowing how to use resources. Henry and Stevens (1999) found that SE teams with a single leader (that is, a Shaper) performed better than teams with no leader or multiple leaders while noting that their experiment was limited in duration compared to an authentic project. Thomas (1999) analyzed Belbin's roles in software engineering student groups. The analysis did not show a significant difference in performance between a control cohort and an experimental cohort in which groups were formed according to Belbin roles based on the Belbin profile test. Feedback from the participants indicated that the Belbin roles helped students consider how to relate to their peers but also that the assigned roles did not appear natural. Additionally, the authors conjectured that friendships in the control cohort might have influenced the results in a way that students tolerated each other based on their history. Gutiérrez et al. (2019) analyzed different attributes as predictors of grades, including Belbin roles in teams. Role coverage was found as the third most important factor influencing grades after age and team communication. Rajendran (2005) demonstrated how to analyze the strengths and weaknesses of teams with the help of Belbin roles. Participants were issued with Belbin self-inventory, and team leaders were interviewed for further verification. The analysis looked into patterns in these data and attempted to understand teams by comparing interpretations made and Belbin's theorizations.

The study by Beranek et al. (2005) looked into informal (emergent) roles in student SE teams and discussed their findings in comparison to functional team roles proposed by Benne and Sheats (1948): group task roles, group building and maintenance roles, and individual roles. The group task roles refer to the adoption of behavior that complies with the task the group is attempting to accomplish. The building and maintenance roles refer to soft skills needed to develop and strengthen the group as a group. Individual roles are instead not geared toward cooperation but personal needs and complicate group work. Beranek et al. (2005) observed a high number of students taking a group task role (30%) or a role not available from Benne and Sheats (1948) definitions: a stereo-typed programmer who demonstrates a high technical ability but low interest in cooperation (35%). The group of students adopting a role emphasizing team building and maintenance was smaller (21%). The smallest cluster (15%) indicated individual roles. The authors concluded that more awareness of the task- and people-oriented roles in SE teams is needed and that training on soft skills should be undertaken for better team building and maintenance in groups.

Marshall et al. (2016) studied so-called participation patterns they had observed during their previous studies. The patterns included social loafer, diligent isolate, compliant worker, and insightful shaper, the last of which the authors noted to be similar to Belbin's Shaper role. The study analyzed participation levels based on peer review data collected from mini-projects in which students were exposed to challenges of teamwork (e.g., teams were newly formed after each step of the project). After that, team profiles were constructed using clustering. The larger goal of the study was to advance research toward identifying reoccurring team profiles that can help identify at-risk teams.

The personality type indicators that Myers and Briggs (e.g., Myers, 1980) advanced from Jung's (1981) work have been widely used for a personality type self-report inventory. These indicators comprise four dimensions (Extraversion–Introversion, Sensation–Intuition, Thinking–Feeling, and Judgement–Perception). Evaluation has shown these dimensions to be relatively independent of each other and appropriate for self-report inventory (Carlyn, 1977), while validity has also been criticized, with one prominent critique being the omission of neurosity as the feature of personality (Furnham, 1996).

Karn et al. (2007) looked into relationships between team cohesion and personality type, performance, and SE methodology. The study is based on the use of Myers–Briggs type indicators (MBTI). The main takeaways of the study included that highly cohesive teams tended to outperform teams with low cohesion. Here, cohesion refers to the closeness of relationships and attraction to other team members. One team had similar personality types (5 out of 6 students showed *intuitive thinking* preference, which the authors regarded as a typical type for engineers) and performed well throughout the project. It was yet observed that high (in effect, highest) performance was possible without the highest cohesion. The authors go on to differentiate between social and technical cohesion and conclude that teams

concentrating fully on project tasks without other kinds of social interaction can perform well due to resources being solely expended on advancing the project. Also, the authors observed that cohesion increases as the project progresses and the group members learn to know each other and that cohesion can later decrease due to the diversity in the team. In the latter case, cohesion remained higher than cohesion at the beginning of the project.

Another example of the use of personality types is the role assignment methodology in SE education projects proposed by Martínez et al. (2010). The methodology starts with identifying skills, abilities, and personality types (Myers–Briggs or some other was suggested). Additionally, students are surveyed regarding with whom they would like to and not like to work. Roles are finally assigned using Gorla's and Lam's (2004) analysis of personality types in relation to software development team roles. Along with two case experiences with the methodology, Martínez et al. (2010) generally observed non-conflicting teams and the following scenarios: group members working according to the roles for a successful project, some difficulties in how students understood the assigned roles, and conflicts regardless of the role assignment. The authors noted that conflicts could emerge when an assigned role did not match the student's preference, the student was working outside the assigned role, or a conflicting individual had to be placed in a group.

Yet another contextualization is the big five or the five-factor model (FFM) of personality; the history of this model and its naming conventions was summarized by Novikova (2013). The dimensions included in the model are Extraversion, Agreeableness, Conscientiousness, Openness, and Neuroticism (N)/Emotional Stability. This model has also been criticized. Novikova (2013) pointed to Block (2010) whose criticism included vague measurement, the atheoretical nature of the factors, and the inapplicability of FFM to studying early childhood (see more discussion in Block's study).

Acuña et al. (2009) analyzed job satisfaction among student SE teams. Their principal findings included that students scoring high on Agreeableness and Conscientiousness were most satisfied. Later, Acuña et al. (2015) found that Extraversion contributes to the quality of a software product because team communication and activities are eased. Additionally, the study confirmed that those scoring highest on Agreeableness showed the highest satisfaction. Kosti et al. (2014) analyzed the characteristics of SE students and found two clusters: those scoring high on all dimensions of FFM, characterized as intense, and those scoring low, characterized as moderate. The intense ones preferred to take responsibility for all parts of software development and preferred a softer management type of work and a team setting. The moderate ones instead preferred short contributions to the projects. Another kind of example is the study by Bell et al. (2010) on personality type and performance. These authors did not find significant correlations between FFM-based personality type and individuals' performance in an undergraduate SE team setting.

The findings in the above studies appeared attractive regarding how the students in their respective teams would become ranked and be characterized regarding their statuses. Consider, for instance, whether teams of similar MBTI personalities would concurrently have a homogeneous status ranking or whether a student with high job satisfaction, linking with a particular FFM personality dimension, would concurrently possess a high status in a team.

4. The study

The concept of status has been in real use in the present group project setting for several years as a means to promote students' understanding of how their groups develop and to give them incentives for self-regulation. As teachers, we observed that students can reflect on their experiences against this framework, which encouraged the present systematic evaluation of the student reflections. The selection of the status literature in Section 2 was based on this historical experience of the authors. For instance, as we had observed that students develop their statuses during projects, we choose to raise the reference on status movement. The present study as a whole does the actual work of contextualization for a SE group project setting, inductively analyzing students' reflections. The discussion reviews the results in reference to the status theory, and thereby analyzes status theory in the present context.

4.1. Research context

The research context is a project course provided to students who study computer science and software engineering topics as a major. A handful of science and statistics students studying CS bachelor studies as their minor have attended. Student groups are guided to review open data sets on the web and ideate an open-data software product that is useful for a real-life target group. Groups also self-select technologies (development frameworks, programming language, and development tools) by which they implement the ideated product. The course is worth 5 ECTS credits and spans 12 weeks, after which students individually reflect on their project experience in a learning report. The preferred group size is four students. The course is evaluated as pass or fail based on active participation. Each student has to report a minimum of 100 work hours.

The learning goals include group work, software process, intellectual property rights (IPR), and an ability to survive a self-selected group project that starts as an open-ended assignment and requires creativity. Weekly per-group coaching sessions support groups. The course has generally been well-received, as it helps students notice their ability to manage an authentic software project and encounter topics of professional practice (IPR and group work).

The course events are displayed on a timeline in Fig. 1. During the first week, students are given a lecture on group concepts, including roles, status, norms, and justice. Based on Brown's (1988) compilation on group processes, the concept of status is summarized to students as an idea of emergent ranking that occurs in groups. When a student has characteristics or skills that help the group make progress, the student possesses a high status (and vice versa). It is also explained to students that status can be situational because the project may come to require skills and abilities that a student with a previously low status possesses. The group concepts are introduced as reflective learning topics to promote learning and self-regulation, not as particular conditions that students must achieve or compete on for passing the course. The educational thinking here is that students should not feel that they will be judged. The preliminary review of the group concepts provides a setting for the students' final reflections in learning reports. The course is primarily a project, and a single group concept is not given detailed attention during the lecture — compare with our literature review in Section 2 with multiple sources on the concept of status.

4.2. Research approach and method

A qualitative research approach was adopted to address the question of what aspects students identified as status indicators in their groups. The approach is based on theory in that the theoretical framework on the status concept motivated the study and the research question and provided boundaries for the study. However, the analysis phase was not directed, omitting

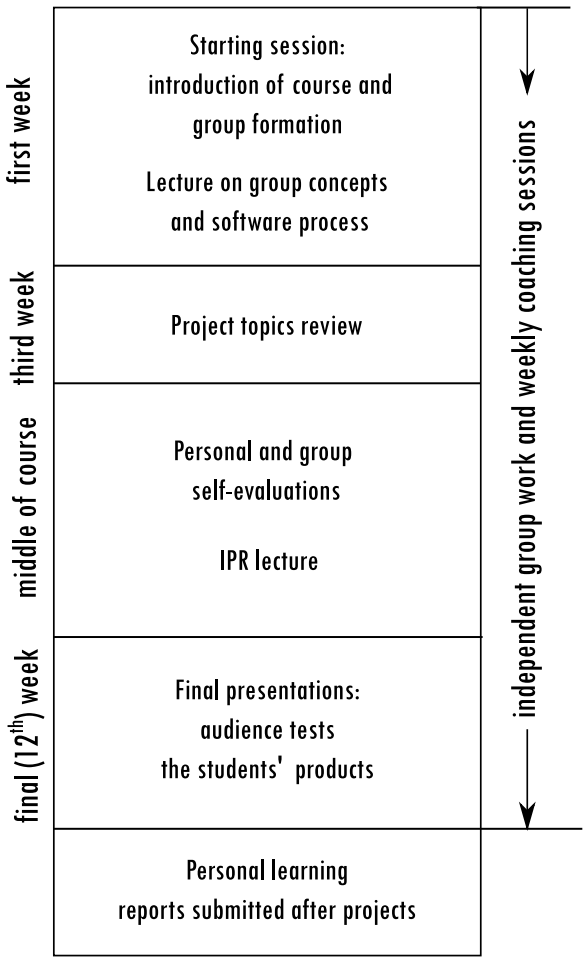

Fig. 1. Course events.

the use of any pre-defined coding scheme. We instead identified any status-related aspects broadly in the students' reflections and considered the data analytical phase conventional in the terminology of Hsieh and Shannon (2005) or inductive in the terminology of Patton (2015, p. 47).

Concerning the literature, we found studies on roles and personas but not a study that would have provided a ground for a directed study on the students' view of their statuses. This lack of informative studies is the usual argument for undertaking an inductive analysis (e.g., Hsieh and Shannon, 2005). It is also worth noting that even the scholars who appear to prefer quantitative hypothesis testing research note the value of qualitative studies performed first in particular contexts. For instance, Gast and Ledford (2014, p. 13) admitted that qualitative studies provide descriptions under natural conditions, which can inform subsequent hypothesis-testing research. The present study accordingly contextualizes status theory by focusing on how SE students reflected on it in a particular group projects setting.

4.3. Participants and data

Reporting of demographics was not included in the research consent. The general characterization of the participants is as follows. The target course is advised to be taken during the third year, while a few students have taken it during the second year. Additionally, due to the system's flexibility, students can follow their personal study plans and occasionally be fourth-year students. The prerequisite courses are CS1 and CS2. The teacher's (the first author) observation is that although the study background of the course participants is relatively homogeneous, the level of hobbyism and the level of skills studied during the prior courses indicate differences among the participants. Additionally, some participants have recently started to take a web programming MOOC course before or in parallel with the project, which has helped them adopt the programming techniques needed in their projects.

The learning reports each student wrote as the final assignment of the course were used as the data (see Fig. 1). Regarding the students' status reflections, data with opt-in research consent was available from 2015–2019. Consent to use these data for research purposes was acquired at the beginning of the annual implementations of the course. All students participating in the course during the research period gave their consent. A total of 21 groups and 79 students participated in the course, with $N = 77$ completing the course by returning the learning report. To avoid the identification of students from personal texts, which count as personal data, the authors cannot share the data but frequently include quotations for plausibility.

The writing of the learning report was guided by asking students to reflect on particular aspects in relation to their project experience, while the guideline was also that the report should be a personal reflective text. The aspects were: a student's part in the project, justice in group work, effects of group self-evaluation (added in 2016), groups roles, statuses, and norms, software process, intellectual property rights in the course, and personal learning gains. The following extract from the guideline includes how students were prompted to consider their status:

> Recap the concepts of norms, role, and *status* in the lecture slides [the concepts were shortly introduced to students at the beginning of the projects]. Of these three, in particular, the first and third are items that often emerge unconsciously in groups, so it is important to reflect on them. Please, consider how these three items occurred in your project from the beginning to the end. In particular, think of the norms you were creating, what kind of role you took or received, and *how you see your status in the group*. (Emphases added)

Interpretations of status indicators could also be made when students commented on their part in the project, software development process, project topic ideation, and management. The learning reports were three-page long at the minimum, in a few cases, a bit longer.

4.4. Procedure

The researchers were the two authors of this article. The procedure comprised the following steps:

1. The data were divided between the researchers who then made initial interpretations of their respective data sets independently. This produced initial suggestive categories documented as personal research notes.
2. It was noticed that the first step had produced different wordings for similar indications. Therefore, a shared research session in which data from two student groups from the first author's data set were categorized for developing a coherent naming convention was arranged. For clarity, the categories were decided to be coded into two main groups: the indicators of increasing or high status and the indicators of decreasing or low status.
3. The first author's data set (except the two groups already analyzed in step 2) was divided between the two researchers to develop categories with more concise language than the initial research notes. This step yielded many new categories (compared to step 2) based on visiting the research notes and original data.

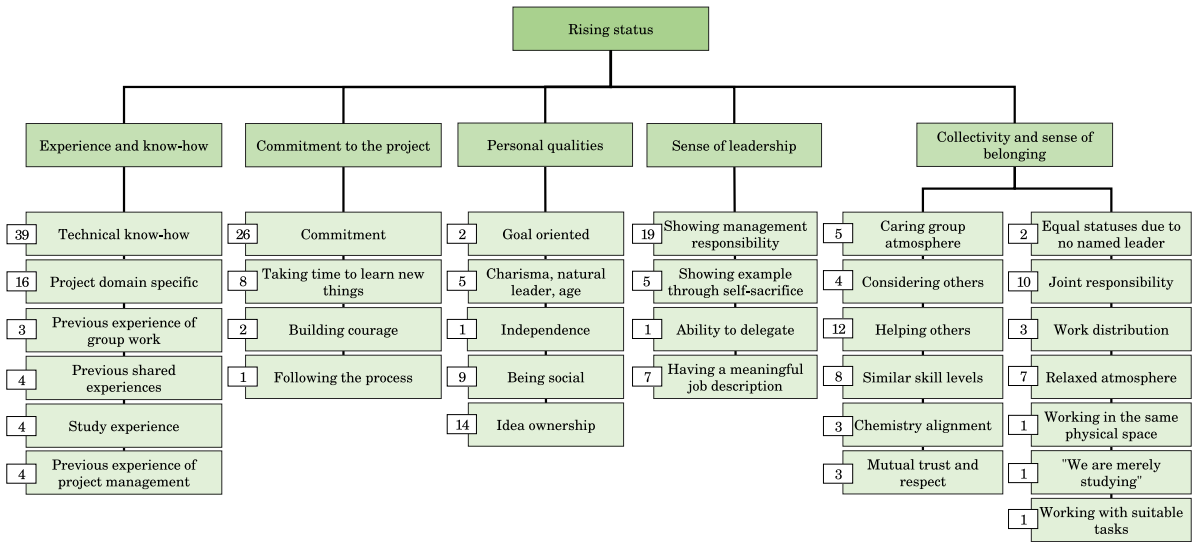

Fig. 2. A network of categories pertaining to rising status — the numbers indicate the number of participants who discussed the category.

4. In a shared review session, several misunderstandings related to what was agreed in step 2 regarding the use of categories were observed and discussed. Explanations were developed regarding what the categories identified so far indicated.
5. The first author reworked the whole previous analysis step to correct all misunderstandings and ensure that any nuances in the data were not lost.
6. The results of the previous step were discussed to further strengthen the shared understanding of what the categories indicated.
7. The second author re-worked his part of the data with the understanding of the categories developed together. Several new categories were again found (refined from the research notes) during this step.
8. A shared session was arranged to discuss the new categories of the previous step. A few of the categories were integrated with the existing categories, while many were deemed conceptually interesting and worth reporting in their own right regardless of being only one or few in quantity.
9. The categories were grouped under higher-level categories based on similarities and differences. The second author performed an initial grouping.
10. The grouping of categories was discussed and reworked in a shared session for an agreement.

5. Results

Figs. 2 and 3 present results in two networks of categories: aspects interpreted to indicate high or rising status and aspects interpreted to indicate low or declining status, respectively. For simplicity, the terms rising and declining will be used in the remaining of the article. The high-level categories of the *Rising* network are *Experience and know-how*, *Commitment to the project*, *Personal qualities*, *Sense of leadership*, and *Collectivity and sense of belonging*. The high-level categories of the *Declining* network are *Lack of personal skill and ability*, *Lack of commitment*, *Personal qualities*, and *lack of management*. The following sections explain these high-level categories by reviewing and illustrating the lowest-level categories that were grouped under them. The categories have a level of overlap.

5.1. Rising status

5.1.1. Experience and know-how

Somewhat unsurprisingly, previous experience and know-how positively affected the individual's perceived status. The subcategories given in Fig. 2 are explained from top to bottom as follows.

Technical know-how. The situation in which students receive a high status based on higher *technical know-how* compared to others is demonstrated below.

> [Participant-112:] "I was a more experienced programmer than the others, and I knew the technologies we used. This created emergent leadership. The project did not have a named leader. However, my expertise in things led to a situation where I made many decisions, especially on technical matters, because I possessed the most knowledge and experience. [...] The high competence gave me status in the group".

This category showed up to varying degrees and was the most prominent status indicator in the data. Technical knowledge, skills, competence, or expertise are illustrative synonyms for the category.

Another illustration below refines that a student might not have wanted high status based on technical know-how. Receiving responsibility may appear to be a burden and have consequences:

> [Participant-90:] Right at the beginning, I noticed that I was the one who was asked for tasks and help and that I had to take control of the situations to advance the project. Thus, the other members gave me responsibility and some kind of a leader role. I was against this thought because in my mind no reason for this existed, and, students being equal, it felt somehow unnatural. In my opinion, this could arise from the topic of the project since it was based on my initiative. On the other hand, I wouldn't say I liked the topic at any point and would have preferred staying in the background throughout the project. I ended up avoiding leadership, which was likely to negatively influence the project's progress and contributed to the reserved atmosphere [...].

Other similar examples indicated that a skillful student could feel stressed about making important decisions alone. Yet another example, conveying the disappointment of a skillful student, is:

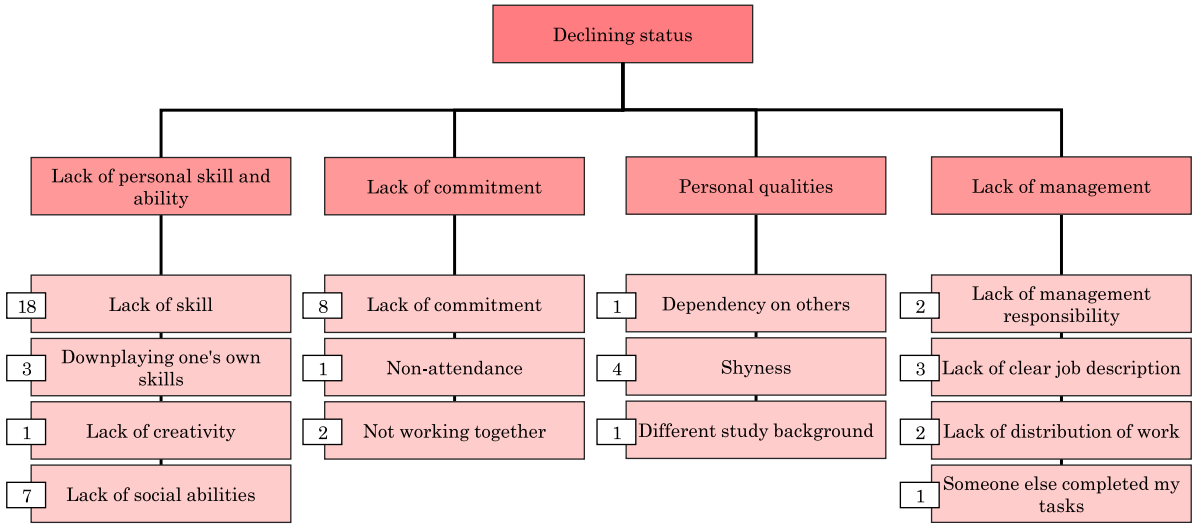

Fig. 3. A network of categories pertaining to declining status — the numbers indicate the number of participants who discussed the category.

> [Participant-100:] Well, I assume leadership was expected from me. I nevertheless attempt to actively avoid being avuncular and do not want to act as a mama or papa to others, so I was actively avoiding this. I first attempted to suggest easily approachable tasks for others but these tasks were not really seized [...]

The quotation explains that the group situation is vulnerable, depending on how group members react to the leader's acts when the leader status is imposed on a student.

Nevertheless, other students could feel comfortable with competency-based leadership, consciously starting to act as an educator, as in the case of the student cited above:

> [Participant-112:] [...] In addition to being a technical leader, I acted as a member who educates and supervises others [...] I noticed that in other groups students could be left outside the project and were not involved in coding.

These kinds of occurrences could also show frustration regarding how helpful acts were responded to.

To sum up the technical know-how, it can be said that this status situation can materialize differently in groups; attitudinal aspects can influence the group situation. This concerns both how advanced students welcome leadership and how less skillful students attend when someone or some are more or less unavoidably given a high-status position.

Project domain specific. Students begin to advance their portion of the project, become experts in their part (domain) of the development work, and therefore develop a comparable status in their group. The students can but must not have expertise in advance. That is, domain-specific (e.g., one student knowing how to work with databases) experts can be identified, or such profiles start to emerge when students are studying and working on a particular project domain. Illustrations are given below.

> [Participant-111:] "Statuses in our group were not considerably exposed and varied with situations and [project] phases. The group leader clearly had higher status in the meetings, but otherwise, the one who knew the topic under discussion the most had the highest status".

> [Participant-40:] "I feel that we were generally speaking very equal. Perhaps this is because you behave like a group of friends in a small group, and no clear roles or statuses emerge. However, of course, when speaking of a certain topic, for instance, implementing the layout or building the database, the one who knows most of it leads the conversation or takes the role of an educator or explainer. In such a situation, a single group member's status can be higher than others because the person possesses useful knowledge or skill".

Previous experience of group work. This category refers to the experience in group work gained from a working life context and is illustrated below.

> [Participant-118:] "I have several years of experience in jobs in which one works in workplace communities and in which mere completion of personal tasks is not enough but communicating and collaborating with others is required. All these attributes have surely influenced how the others in the group saw me as a colleague".

The category was based only on a few indications, presumably due to the third-year study setting. It is assumed that students with any software engineering or other work experience have also had some group work experience. However, such was not recognized as any significant status indicator in the present context.

Previous shared experiences. Another infrequent group work-related category was that students reported shared experiences from other contexts. That is, status is rising based on the prior knowledge of group members. The below is illustrative anticipation by a skillful student, concurrently suggesting that this situation can create an external-like status characteristic.

> [Participant-59:] "My status was clearly a leader. My status formed at the very beginning as I noticed our project lacked direction and decided to take control of it. My status, in the beginning, was probably influenced by my experience in programming and other web programming matters. *I also knew part of the group which was likely to impact the status formation".* (Emphasis added.)

Another example is one student having a relationship with other members through other courses with the result of being able to maintain conversation and humor in the group:

> [Participant-60:] "[Member x] was the person who appeared to have the most established programming competence and

whose opinions mattered in decision-making. On the other hand, [member x] was naturally an "easy goer" for what reason [member x] upheld humor and free conversation during working. *Or, this was due to the fact that [member x] was taking other two courses with me, for what reason I perceived it to be easy to talk with [member x] about* [technologies we used], and that [member x] was, correspondingly, discussing a lot with [member y] about a thesis writing course". (Emphasis added.)

Study experience. The amount of study experience was referred to as the status indicator. Both illustrations below refer to informal interaction as the setting for this indicator. At the same time, the latter, in particular, reveals that students identify two settings (problem-solving vs. informal interaction) for the status organization.

[Participant-54:] "I think that I was able to achieve some status and role in the group also because I have spent time at the university a little longer [compared to others] [...] For this reason, I have developed a view that group assignments appear as serious as one makes them, and that, in the end, the most important thing is that good dialog connections exist [in the group]".

[Participant-111:] "Outside advancing the tasks and problem solving, in ordinary interaction, I felt that those who were the oldest and had more studies done had the highest status".

Previous experience of project management. On some occasions, an individual's know-how was linked with previous experience in leadership. One example is the participant-112 (cited above), who continued as follows:

[Participant-112] [...] "In addition to being a technical leader, I acted as a member who educates and supervises others [...] I noticed that in other groups, students could be left outside the project and were not involved in coding. *My previous experience in leadership helped me notice this problem. Adjusting task allocation to match our skill levels and a sufficient amount of help when needed, eliminated this problem in our group. The cohesion of the group continued till the end of the project".*

Other examples were available in a less direct manner. Students referred to feeling comfortable and familiar with leadership tasks (an illustration is included in an extract from Participant-116 in a later section), while other members in the group could observe this by referring to a more advanced student. Additionally, such advanced students described professional workflows in the use of a version control system, further supporting our interpretation of project management experience. However, this category appears small in comparison with the technical know-how.

5.1.2. Commitment to the project

Commitment to the project was a significant category. It generally included effort, contribution, and the more specific categories of Taking time to learn new things, Building courage, and Following the process.

Commitment. Commitment in terms of taking the initiative, being active, and contributing to the project was an essential category for receiving a meaningful status. The following illustrates this and additionally shows that perceived status based on effort can fluctuate:

[Participant-21:] "The effort made [by a group member] appeared to influence the status most. One group member's effort did not show much during the first weeks, and tension emerged in the group toward this member. My status was quite volatile. I could first show my competence in designing UI and starting things. Rather soon, I wanted to turn to little more challenging things and a "gray" zone, so I started to write JavaScript, which I had not previously done. Studying Javascript and [therefore] the reduced concrete outcomes appeared to lower my status. Toward the end of the project, each group member's status was quite easy to see, and the contributions of each member were observable".

It seems that studying periods can lead to the perception of a lowered status compared to the periods of work that contribute to the product in an observable manner.

The following explains commitment in terms of social activity, that is, speaking and decision-making:

[Participant-20:] "The most important factor in how our roles finally developed was how actively each participated in decision making and, before anything, in presenting ideas. Although anyone's ideas or voices were not left without attention, those who speak more often will have a greater influence on the group's operation".

Furthermore, despite seeing differences in contribution, the student below acknowledged a contribution by everyone and considered this with statuses.

[Participant-104:] "Efforts of each of us, however, show in the final product, and everyone is likely to have a feeling of *being an integral part of the group*". (Emphasis added.)

This illustration can be compared to the concept of perceived insider status in Section 2. Here, it arises from sufficient participation that shows some contribution to the project. The terms insider or insiderness will be used in this sense below.

Taking time to learn new things. It was noted above that practicing new things with minor immediate outcomes may be perceived as the condition for a low status compared with advancing the project more straightforwardly. However, an important category under commitment seems to be starting to learn new things. The following demonstrates how such commitment helped a student to develop a decent status:

[participant-54:] "Perhaps I personally feel that because I did not first participate fully in what others were doing (I had no experience in IoT) I adopted a bystander role. *Later, when I decided to be active and learn things, I could take a bigger role.* The consequence was that I was able to produce new ideas and start implementing them fairly independently". (Emphasis added.)

Another illustration similarly shows development toward some kind of insider role based on practicing:

[Participant-57:] "During the beginning of the project, my time was spent on learning things and marveling at the skeleton of the program [being developed in the group], when I had some kind of a learner role. After grasping something about React, and developing an understanding of the intended program and the component I was about to work on, my role perhaps changed into some kind of a *worker*. Because while doing the component I still had to learn this and that, and I tried a variety of ways as for how to best implement the component, the learner role remained in the background throughout the project". (Emphasis added.)

Here, the student added a "worker" characterization to the initially-identified and persistent "learner".

Building courage. The example below illustrates how a student acknowledging the fear of social situations developed the courage to comment on things in the group and, in our interpretation, referred to becoming an insider.

> [Participant-89:] "I fear social situations and before this course, I had attempted to avoid group work whenever possible. [...] My thought was to get used to it and use this course as desensitization. At first, in particular, working with the group felt distressing and I was constantly worried about what I said or did. At the end of the project, the situation developed into a more relaxed one and during the last part of the project I dared to comment on [things] in group meetings".

This category links with the previous one, Taking time to learn new things. For instance, Participant-12 quoted later in Section 5.2.1 noted that practicing resulted in confidence and an improved status experience.

Following the process. One student clearly recommended following a software process better, with frequent meetings, to help group members get involved in work and, in our interpretation, become insiders.

> [participant-111:] "[member x] was considerably silent compared to others in the meetings, and for this reason, it came as a surprise during the last part of the project that [member x] did not [still] know what should have been the [member x's] tasks in the project. We could have avoided this by formally reviewing what each of us was about to do next at the beginning of meetings, ensuring everyone was in the know. [...] in the future, I would prefer that a group clearly commits to some process that would be held onto. [...] This could also help prevent someone from dropping out".

5.1.3. Personal qualities

A group member's personal qualities were seen to raise their status. These qualities ranged from relatively clear qualities like *age*, *being goal oriented* and *social*, as well as *independent*, to rather ambiguous and subjective qualities such as *charisma*, and *being a natural leader*. We first present all these small categories and then the more substantive category, Idea ownership, which is presented under Personal qualities based on creativity. The last concurrently refers to leadership readily imposed on a student who provides the idea for the project.

Goal oriented. Goal orientation as a personal characteristic is illustrated in a narrative that concurrently refers to leadership:

> [Participant-93:] "Regarding roles, we did not make any formal selection of roles. However, varying roles emerged among group members during the project. On my part, if no one else stands up to lead the group work, I am usually the one who starts to oversee that everything happens on time, for instance, I keep reminding of the deadlines, take notes of what should be yet done, and so forth. I took such a role in our project. This is not anyhow a bad thing, I just find it important that someone is looking after everything is done, and if no one else volunteers, I take it. I need this kind of clarity in the work because I am, overall, such a person that I write down reminders of things for myself, and I do not trust that I would remember things after a day or two without writing them down".

Charisma, natural leader, age. These attributes are illustrated in the quotations below.

> [Participant-113:] "As I recall, we together named [member x] as a project manager. The work of the project manager included in practice, among other things, management of tasks, implementation of more challenging functionalities, and supervision in problematic situations. It could be said that [the member] was pretty much alone in charge of the project. This situation was, of course, influenced by competence acquired earlier, experience, and *charisma*". (Emphasis added.)

> [Participant-103] "[Member x] had clearly the highest status in the group, because he seemed to, so to speak, be a *natural leader* and attempted to get the project forward". (Emphasis added.)

The student, who was referred to as a natural leader, used such terminology regarding self. This self-reference was present in the same extract that included 'age:'

> [Participant-104:] "In my opinion, I was given some kind of leadership position in the group, although I did not really aspire after this. This was likely because I was most often the one who spoke first and the most. Some group members perhaps demonstrated some timidity in bringing up their opinions or views. Surely, also the fact that *I am clearly older than the rest of the group* and other *natural characteristics* influenced this status". (Emphases added.)

A quotation in also included age.

Independence. This category means that the student assigns a status to peers who are capable of advancing tasks independently:

> [Participant-109] "About statuses: I believe that [member x] had the highest status. [Member x] was clearly the most experienced in coding and typically capable of helping in one way or another when problems emerged and aware of the needed functionalities and the logic by which the application should function the most. [Member y and member z] were at the same level, and I felt they knew what they were doing, and could implement their tasks without any considerable help [...]".

This reflection arises from a comparison between one's dependency on help and the independence of others. How the quotation continues to refer to one's low status is shown in Section 5.2.3.

Being social. Social activity or ability (introvert vs. extrovert) was seen as a key status indicator. Two illustrations are included below.

> [Participant-06:] "Also the social abilities of the group members influenced the development of statuses. Those who were naturally more social took a bigger role in the meetings, and in these situations, they were also given more prestige. I felt I belonged to these persons and attempted to participate in project meetings".

> [Participant-94:] "Perhaps one of the most important tasks I had was speaking in group meetings. Often when we met, all of us did not maybe have the same picture of the project, as it [the project] changed rapidly, and one member of our group produced new functionalities quickly, which were not necessarily understood by all. By speaking, I attempted to invoke conversation about the stages the members were in with their tasks and the overall picture of the project, for instance, regarding how our architecture works. By giving talks, I could activate the most silent persons in our group, and they could express their thoughts in front of the group".

Idea ownership. The project course requires that students develop the project idea that they will implement as a group. This ideation is critical for being able to advance the project. Students who are active or creative in this sense gain status:

> [Participant-110:] "Speaking of roles, at the start of the project the roles were very much undetermined but I feel like, as I was the one who initially suggested things that we could do, and I had quite refined ideas already thought out, I gained a sort of a leadership role. I also tried to manage the work of the group. As things progressed a little and we started planning things and doing some actual coding it turned out that one of my group members had a ton more technical knowledge than me, so [this member x] slowly took over the decision-making regarding the software architecture and I kept making the decisions regarding the design and functionality of the software, this worked out well".

This example interestingly shows that a group can harmoniously have several kinds of leadership. We would characterize the student whose idea started the project as a product owner.

The following similarly shows a high-status position for a student who appears like a product owner in the group:

> [Participant-87:] "The change leader of the group was [member x], from whom we asked for approvals for all bigger change proposals, as [the member x] had the most holistic picture of our product as a whole. I remember asking him several times about the direction of our development".

The illustration below shows that when one student has a clear idea and others do not, this situation can almost unnoticed develop into one where the student with the idea receives a central position.

> [Participant-94:] "I was surprised by the pace of the project. Usually, when doing group work, I am used to projects not starting up as rapidly as now. Regarding project ideation, one member had a clear idea of the project and what it should achieve. In my opinion, we perhaps gave away to the group member too much during this ideation phase, as the project came to look like this [member] a lot. Certainly, the project was interesting, but I felt that the other group members did not mind the project being a one-person idea. Surely, I felt that the others and I only had a [rough] idea that the software product would include a map".

5.1.4. Sense of leadership

A sense of leadership within the group seemed to affect status. This category was associated with showing responsibility in managerial tasks such as task allocation, and insights in delegating tasks, which resulted in team members having meaningful job descriptions. Furthermore, leading with an example and the willingness to self-sacrifice were seen as indicators of rising status.

Showing management responsibility. This category refers to someone fulfilling a project managerial gap, being interested in how the project can make progress, and showing actions accordingly. Such a managerial intention is well worded below.

> [Participant-61:] "From my perspective, the role of [member x] was to be the de-facto project leader. The person who oversaw the job is making progress and had a strong intention that work is done properly".

Another illustration conveys that, in a group in which any explicit definition of roles was considered unnecessary, someone yet shows managerial responsibility and gains status in that sense:

> [Participant-31:] "We did not allocate roles. The need for substantive leadership did not emerge, as our project made good progress from beginning to end. However, we discussed at the beginning that if the project starts to float or other management problems emerge, someone has to take bigger responsibility. For instance, this could have concerned Scrum sprints. [Member x] nevertheless showed the most leadership, as [member-x] was in most cases looking after [the arrangement of] our forth-coming meetings".

Another illustration of concrete management actions is the allocation of tasks. Illustrations are given below.

> [Participant-51:] "During the project, our group did not have any considerably big role division because everyone did a bit of everything. I nevertheless attempted to look after that project made progress and everyone would have some pleasant work available throughout the project".

> [Participant-116:] "I see my role as some kind of supervisor concerning both working and helping. It was easy for me to participate because I was familiar with the technologies and other work. I often considered what kind of tasks/tickets are present [needed] in each phase and how to allocate them by considering the group members' interests and competencies. The role was somewhat known to me, so it was easy to grip the marker pen and give advice over my shoulder".

The last sentence concurrently indicates the category of Previous experience of project management.

Showing example through self-sacrifice. Self-sacrifice indicates a situation in which a student undertakes important unpleasant work, and this way initiates a sense of leadership in the group:

> [Participant-104:] "In part, the situation was affected by the fact that I took responsibility for advancing some perhaps unpleasant tasks, for which anyone else did not volunteer".

This category was also demonstrated in conjunction with technical know-how in a way that a student can have no other chance than working on a certain task to guarantee that project will be accomplished:

> [Participant-55:] "In practice, I was forced to take a technical leadership role because anyone else had no idea how this [part of the project] could be put together. [...] It would have been a bit interesting, so to speak, to be the fly on the wall as for how others would have survived this [part] without me".

Less direct indications were inexperienced students referring to other group members undertaking more challenging tasks.

Ability to delegate. An ability to delegate was identified in a group's perceived leader, as illustrated below.

> [Participant-113:] "A clear leader status was imposed on the leader of our group. It showed in the ability to delegate tasks and help in difficult situations. However, any power hierarchy did not exist in our group, but our performance was about collaboration".

The ability to delegate could have also been presented under Personal qualities. This characteristic appeared in conjunction with the sense of leadership (see the quotation) and was hence reported here.

Having meaningful job description. This category refers to situations in which the student perceives that there is something to do that feels like a meaningful position in the group. In some cases, the category is related to Taking time to learn new things; it was previously noted that learning new things can lead to a perceived insider position. The example below describes oneself as a mere worker while acknowledging substantive leadership roles for others.

> [Participant-48:] "Some people in our group had much more experience in programming and projects than others, so roles and statuses were noticeable almost from the start. Those people who knew more about the tools and technologies got higher status and acted as leaders in the group, and that way got more ideas pushed through. But I don't see it as a negative thing because everyone agreed with the ideas. And without someone with more experience, we would have had more problems and it would have been harder to get the project running. And after a while, those leadership roles started to disappear but statuses remained. Everyone got more responsibilities, but the leaders still had more power when it came to decisions. *I guess I can say that my role was a researcher or just a worker. I found our open data sets, a couple of useful websites, and some tools to use".*

The same student identified good statuses for all based on democratic interactions in the group:

> "Our group got along right from the beginning, had a good spirit, and our meetings were not that serious. Everyone had a chance to speak and suggest improvements without getting laughed at or hearing how awful an idea something was. So everyone had good status, and we were pretty equal. We got together to change ideas and to think about the tasks every week".

Interestingly, other very similar narratives were found, such as the one below.

> [Participant-102:] "Our group roles were a little unbalanced ([...] in a way that part of the group had more responsible roles relative to the progress of the project) because skill differences were rather big in the group, but on the other hand, the roles were good as for learning. To describe my role, I felt it to be a little like a mere worker in a workplace, not anyhow a leader position or something like that, but a part of the development process that aimed at producing a working software product. I experienced my status as fairly good, I could make proposals, and others responded to them well, in my view. I feel that this applied to the whole group because the process was in a way 'democratic' and open".

Taken together, "mere worker" is seen as a position with a decent status, although these narratives refer to other group members with more critical positions. These narratives (and the narratives by other members in these groups) indicate that these groups were democratic and not troubled by others doing less critical tasks, which may highlight a pre-condition for interpreting good status based on at least some kind of effort in the development process.

5.1.5. Collectivity and sense of belonging

The most diverse category of rising status was collectivity and a sense of belonging. This category emphasizes the working condition of a group as an important constituent in experiencing status.

Caring group atmosphere. Caring (a.k.a. collectivity) was referred to as the factor that appeared to support the group members' belonging. Thus, in our interpretation, caring contributes to individuals having meaningful positions and hence status in their group. The below describes the situation.

> [Participant-107:] "[...] Neither did I notice that anyone was left an outsider or would have dropped out of the work anyhow. It was taken care that everyone was updated about the tasks, and, in difficult situations, everyone was guided and helped forward if something did not work or there was not enough know-how. Especially toward the end of the course, when the team spirit was reaching a climax, new functionalities could be effectively added to the project and the existing ones could be refined, when the threshold for asking for help was lower".

Considering others. Compared with the previous group-level category, the present one refers more to an individual who deliberately leaves space for others to learn and participate, thereby increasing the sense of belonging in the group. An illustration of such propensity was already present in a quotation from Participant-112 in Section 5.1.1. Another student from the same group acknowledged that the leader added safety to work:

> [Participant-111:] "I think the leading member helped advance the project and brought security to working".

Yet another group member, being relieved about the granted possibility to participate at an appropriate level of challenge, noted the following:

> [Participant-113:] "I would say that, at worst, the group members' thoughts of each others' roles could vary rather considerably. My personal experience could then be entirely different, in a negative sense".

Helping others. Adding to the previous category, helping occurs in groups, which is noticed and appreciated as a possibility to participate. Skillful students notice their helping:

> [Participant-104]: "In addition, my technical competence was sufficient at least for what this project demanded, and when needed, I could also help the other members to solve potential problematic points".

Additionally, the help received from skillful students could be highly appreciated:

> [Participant-117:] "However, hats off to the maestros of the group, who sacrificed their own time to give personal lessons, which opened up the used languages, techniques, and the structure of the project".

Similar skill levels. Similar skill levels are considered to provide a starting point where no one dominates, and the group operates as status equals. Below, the student favorably refers to this situation.

> [Participant-99:] "All group members had a fairly similar starting point, except for members *x* and y, having completed web programming. In my opinion, this equal starting point affected group dynamics a lot, which remained very fluent throughout the course. In my view, no one stood out as the leader or a dominant participant but everyone performed at pretty much the same level".

Chemistry alignment. In a group where alignment is experienced regarding what kind of personas are working together, a setting in which everyone is accepted as a group member is enhanced.

> [Participant-97:] "A mutual understanding developed that work must be done diligently and the schedule must be followed, and all of the time should be spent effectively. I however noticed rather quickly that all members were on the same wavelength and understood each other's humor well. Someone being late was always noted but the atmosphere remained sympathetic and restful".

This category, and also the previous one, appear to refer to the attraction of similarity discussed in Section 2.

Mutual trust and respect. The below illustrates a situation in which the student trusts that everyone is taking care of their tasks. The perception of status equals is present instead of one student acting as a leader. The situation appears to link with everyone being committed to their duties.

> [Participant-105:] "For myself, I mostly prefer to work on my task and suggest something if necessary but I didn't really prefer the 1 "leader" role of keeping everything in check since I saw that we all clearly could keep our to-do:s in deadlines so it was really nice to not really worry about it and have some trust in your team members so that's why I developed this sense of trust and not worry about what the others are doing but just keep faith in them. Like I believed they could do I did my best too in my area".

Mutual respect is reported in conjunction with a group appearing as status equals, although the student acknowledges that levels of statuses can fluctuate by project domain-specific expertise:

> [participant96:] "Also the status was usually rather similar for all. Everyone seemed to appreciate each other equally a lot. At times, it could be noticed that if someone knew some area of programming better, this member guided the situation forward at that moment, and others followed the will of that member. This is, of course, just natural".

Equal statuses due to no named leader. This category marks a perception of equal (or decent) statuses when no named leader is apparent in the group. The situation is such that a skillful and active student unavoidably receives high status but attempts to avoid leader identification. The high status of a skillful student is apparent in the narrative of another group member:

> [Participant-88:] "Clearly, some kind of respect arose toward our, could I say, indirect leader, [member x], as [member x] did not run out of ideas for GUI and its implementation. [Member x] received a kind of a, at least in my opinion, if one can say, chief coder title, [a situation] in which others observe in astonishment, when [member x] writes code".

However, another group member can conclude equal statuses in the group given that no clear leader is explicated.

> [Participant-91:] "My role included mainly that I at times ensured the project progress, and reminded of and proposed meetings if necessary. [...] Although I attempted to arrange things during the project, I think I was not a so-called group leader. In my view, there was no clear leader at any stage during the project, but everyone was on the same line".

This altogether appears like a hasty or accidental justification of equal statuses based on no leader identification in the group, given that the active skillful student is stressed as an essential group member in the texts. Moreover, the personal managerial attempts (see the last quotation) may mask crediting another student.

Joint responsibility. Joint responsibility refers to a situation in which group members appear to have meaningful roles and consider that, regardless of potential skill differences, everyone is taking responsibility for the project. This is qualitatively a different point compared to the previous category because here, all members, for instance, participate in communication about project progress, and the perception of equal statuses is increased and can be interpreted without contradictions:

> [Participant-14:] "In reality, I don't believe that *anyone would have had more responsibility than someone else*, but such a perception emerges because some have more experience than you do. [...] *Generally as a group we had a habit of informing others when we got a functionality working or encountered problems*". (Emphases added.)

Work distribution. Agreements on how work is divided were considered in conjunction with roles and statuses. When the principle was that everyone selects tasks based on their interests, the perception of everyone obtaining a role in the project (cf. being an insider) was enhanced. The first example explains how a meaningful role was achieved but concurrently discusses a problem in that project domain-specific previous competencies can dictate work division with the result of neglected possibilities to learn new:

> [Participant-108:] " We also agreed that everyone is allowed to implement the personally most preferred part at a given moment. Surely this had to be negotiated a little for all parts of the project to be completed. [...] In practice, my role became taking care of the backend and the communication between the backend and the client. In this case, the status is likely [based on] the experience. However, I do not value this kind of role division too much because dividing the work based on experience can take away the possibility to learn new from someone else if someone is interested in that [area of the project]. This can lead to a situation where certain things automatically become the task of an inner circle. It's never too late to learn something new".

Another example suggests that interest-based work division provided roles easily for the group members:

> [Participant-21:] "We started to review APIs. Finally, one group member proposed a topic that we selected as our project. When we started to work on the project, a project manager role emerged rather quickly, concerning the member who proposed the topic based on [this member's] professionalism and vision. Anyway, my role as one who created a group atmosphere remained almost throughout the project. *Other members also received a clear role mainly and exactly based on tasks. It was easy to divide the tasks based on personal interests*". (Emphasis added.)

Relaxed atmosphere. A relaxed and open group atmosphere was considered a positive influence on the group members' statuses. The following narrative is an apt illustration:

> [Participant-43:] "Related to our group members' statuses: because anyone's status did not get to float in high clouds, and no one was considered an information bank, a good level of justice remained in our group from the start. All of us were given, little based on expertise, a certain weekly project [goal], which each completed. We always asked the group member: "is this and this task okay for you, when this other person and this other person are doing these [other tasks] in the meanwhile", and seldom anyone objected. Sometimes it happened that because someone else was considered a little more proficient for the task, we decided to save time and give the task to that someone else based on a collective decision. This was fair because there was always room for negotiation and objection, which occurred from time to time".

The same student also pointed to the humor and its value in the group, which helped our interpretation. Furthermore, this example appears to link justice with the open group atmosphere.

Working in the same physical space. The possibility of being an insider was linked with spending time in the shared project room, as in the example below.

> [Participant-100:] "And that indeed, that part of the group was to some extent working on other exercises and else in the office [the project room], so concerning those who did not do so, this [lack of being in the same space] likely contributed to the feeling of being an outsider".

"We were merely studying". A kind of compensation was seen in otherwise potentially very low status because the project remains educational work:

> [Participant-113:] "Although the course is a study environment for learning, demands of working life are brought out in coffee table conversations. If this was purely a working life project, I would understandably not add any value to the group with my current competence but instead would be in the way".

Working with suitable tasks. This category indicates that student finds tasks that match their current skill level, and this condition contributes to the sense of belonging. The quotation from the same Participant-113 (see above) shows strong insecurity based on previously acknowledged challenges with learning to program.

> [Participant-113:] My role was clear before the course, but it caused a lot of pre-course stress. I had programming experience mainly regarding the use of different utility programs. The bigger course assignment of CS2 had been difficult to grasp, so registering for [this project] course had a high threshold. Before the course, my biggest concern was group performance and unequal treatment, in which working according to your skill level would be difficult. In practice, this meant how I would be treated.

Later, the student describes the role received as an apprentice while indicating an experience of being part of the project.

> "The roles in my group remained fairly the same up to the end of the project. I experienced myself as some kind of apprentice who got a chance to practice one's skill at the level of personal competence. Although my tasks were considerably simple, I felt that I was an important part of the whole".

This insider status with a sense of belonging is possible in conjunction with group members providing help and considering those with lower skill levels (see the other subcategories in the present section).

5.2. Declining status

5.2.1. Lack of personal skill and ability

Lack of skill. Lack of skill was the most frequent explanation for a declining status. It is rather self-explanatory and appears the opposite of the technical know-how in Section 5.1.1. In addition to "skill", we could speak of experience, competence, and know-how. The illustrations below provide further explanation.

> [Participant-50:] "The group felt like a typical student group in which everyone wanted to get the project completed, and the norms appeared accordingly. Everyone was polite toward each other, and we greeted each other if we came across somewhere during the course. I nevertheless experienced my status, the intragroup prestige, to be rather low because of my inexperience. For this reason, I mostly listened to explanations about Javascript and product structure from [member *x* and member y]. Later, when I felt that I understood more of the technical side of the project, I started to propose some small development ideas".

> [Participant-12:] "At the beginning of the project, I experienced my status to be the lowest in the group. This was because I had not much experience or competence in web development. When I got to implement the tasks of my area of the project by myself, and gained confidence a little, I felt that my status changed".

It is noteworthy that, in both of these examples, a student experiences an increase in their status after gradually gaining know-how.

Downplaying one's own skills. A perception of lack of skill can be based on downplaying one's own skills. The below shows how a student pre-sets one's status low until evidence indicates otherwise.

> [Participant-107:] Right at the beginning of the course, I admittedly set my own status rather low in my mind, as I had no experience in programming outside the [previous] studies, which [the status] however formed into a more positive one when I noticed that I could keep up with the project and that I contributed to its progress effectively".

Another example shows that unnecessary downplaying is identified by peers:

> [Participant-88:] "Regarding [member x], I noticed that [this member] held back and played down one's own skills. [Member x] did not disclose them at any stage, and [member x] also put down [member x's] own work, but [member x's] skills could be observed although, [member x] did not necessarily want to bring this out. What a pity, as I would have liked to know [member x's] level and what [member x] could do for real".

Lack of creativity. The ideation part of the course makes some students notice a lack of the needed aptitude: creativity. They notice this issue along with writing about their position in the group:

> [Participant-57:] "Most of my effort went on implementing the actual graphs, but when we ideated together and considered potential [project] topics, I could not come up with any sensible or particularly interesting idea, no matter how hard I tried. The same pattern occurred several times during the project; for instance, during the end part, when we focused on the product appearance and my opinion was asked regarding color choices, my replies were like 'both are just fine' ".

Lack of social abilities. This category refers to being introverted or having a low social ability, aspects that are acknowledged in the same example below.

> [Participant-05:] "Because [member x] and [member y] were more experienced, they had fairly high statuses in our group. I experience my status to be somewhat lower due to the small amount of actual, perceptible, fruitful work. *The other reason for my low status is my introverted character and the bit limited social skills*". (Emphasis added.)

5.2.2. Lack of commitment

Lack of commitment. This category is the counterpart of Commitment, thus indicating inactivity in participation. A quotation that explained both commitment and lack of commitment as a status correlate was already included in Section 5.1.2. The lack of commitment is clearly present in the student's observation below.

> [Participant–18:] "In practice, it was first difficult to divide tasks to others because they did not show up at the office [the project room] and they had no experience, for instance, with GitHub".

Non-attendance. Absences due to personal reasons such as health can occur and give rise to perceptions of lowered status:

> [Participant-106:] "At the beginning of the course, I set my status rather low, as it seemed that the rest of the group were more advanced in their skill levels. *In addition, I was sick for quite a long time, and I felt that I could not keep up with the others.* After sickliness, I got going, and at the end of the course, I felt that I was at an equal level compared to others". (Emphasis added.)

Not working together. We see in the data that groups observe better progress when they work or start to work together, which indirectly communicates that not working together can complicate group being a group and identification of statuses. Such a positive narrative is the following:

> [Participant-93:] "Our project topic was very interesting, motivating me to work on it. It was really nice that *all group members were willing to work together* – I am very satisfied with the group members' contributions to completing this application". (Emphasis added.)

In another related narrative, a student generally refers to an educational environment as one in which a group does not constantly work together and which therefore complicates the emergence and identification of statuses:

> [Participant-25:] "It is difficult to determine the statuses in these kinds of group assignments, in which you do not work eight hours per day in the same space but about six hours per week".

This example of six hours of shared work is, in effect, quite a good amount of time spent together weekly, yet this challenge with status identification is noted.

5.2.3. Personal qualities

Dependency on others. This category is apparently related to skill levels, but here the viewpoint is more of an incapability to perform in a self-directed manner. One's dependency on others may become apparent to the student as the student compares oneself with other team members:

> [Participant-109:] "[...] [member *x* and member y] were at the same level, and I felt that they knew what they were doing and that they could implement their tasks without any considerable help. My status was the lowest because I often appeared to be stuck in something and ask for help or be unaware of what functionalities the drawing should include, so I had to ask quite a lot about things".

Shyness. By this category, we refer to students appearing shy or feeling insecure. The feelings of insecurity were already demonstrated in the Building courage and Downplaying one's own skill sections. Another illustration is:

> [Participant-88:] "For my part, I feel that using my personal humor, I could relax and open the group members who were, at least in my opinion, a bit introverted".

Shyness was also pointed out as the situation during the beginning part of the project, which could indicate a slow start and, in our interpretation, complicate seeing any status organization.

Different study background. Over the years, a few course participants have been studying CS as their minor, which has caused status-related speculation. In the example below, such a student had a kind of a "burden of proof" that was discussed in Section 2.

> [Participant-19:] "[Member x] was the only one in the group who was not a CS major, an aspect that could have also created confrontations or doubts about [member x's] competence, but the courses completed (e.g., the notorious advanced part of functional programming) was enough to convince us about [member x's] abilities".

5.2.4. Lack of management

Lack of management responsibility. This category refers to a situation in which no one is taking a leadership position regarding project management, and the group lacks such a high-status actor. As hinted in the quotation below, a student can observe this to influence the project's progress.

> [Participant-30:] "Normally, in these kinds of group assignments, someone has been found to be the one who has a leading role. In our group, I nevertheless did not identify a single leader, but decisions about project progress were made through discussion. All are surely not equally eager to express their opinions, which in certain situations showed in what direction the project started to move".

The same student did not acknowledge any bigger status differences in the group. Hence, the quotation hints that status equals in the sense of management can indicate inadequate management. A student from another group describes the situation more directly:

> [Participant-26:] "If we analyze the development of statuses, we may raise the problem of no one being a leader during the project. No one actually stood up to take a leader role, which [someone taking a leader role] would maybe typically occur during projects. Still, everyone worked as isolated persons and independent agents without proper cohesion. If a clear leader type had emerged right at the beginning, one who would have taken control over the project, named the tasks, and taken care of meetings, the project might have progressed more steadily".

Lack of clear job description. It is unclear whether each student finds a substantial task by which to advance the project. The destiny of no clear job description appears accidental due to a lack of management. The work can simply start in a way that important tasks become assigned to certain students while one student can lack a meaningful job. This category was raised directly or could be read indirectly. Below is an explicit note on the size of the group in reference to the project structure.

> [Participant-25:] "Due to the structure of the project, the group of four was too big, because then one [of us] was left with the task of backing up others instead of having one's own subarea to work with".

Other, indirect examples describe a kind of middle-man position in which a student did this and that but did not have any substantive area to work with. One such example is the previously cited Participant-94, who observed a quick (unnoticed) start of the project (see quotation in Section 5.1.3) and identified oneself as the communicator within the group (see quotation in Section 5.1.3).

Lack of distribution of work. The lack of attention to work distribution, complicating individuals' learning possibilities, was present in the first quotation in . This appears to indirectly communicate a situation where, for instance, weaker students are left with unimportant work, meaning that their statuses remain low. Although the other example below is from one student's reflection on the topic of justice, it reveals this situation of a lack of proper work distribution and the group members' statuses.

> [Participant-66:] "The very first problem with justice was in the work distribution. I developed a view that [member x] lacked tasks quite early in the project. That half of the team is allocated with appearance-related, music-related, and other similar tasks when the important parts of the project are yet to be implemented tells quite a lot about the level of planning".

Someone else completed my tasks. Lack of management regarding who is doing a task can lead to one student losing their work because another student did it. The student losing the job perceives a status hierarchy:

> [Participant-27:] "Initially, roles did not yet show in work distribution, and group members chose tasks freely to advance the project. During this stage, the most difficult thing was to sketch equally allocated work for everyone so that everyone would have about the same amount of work. Part of this was resolved when jobs were divided among two people. I personally chose to focus on map things, [but] when I was thinking of what was wrong in my code, [member x] said [member x] had added the map to the project already. I took this as something that advanced the project, but I suppose that from then on, I considered [member x] a better programmer than I. A similar thing happened with [member y]; after that, I regarded [member y] as a better programmer. To my eye, the valuation of [members *x* and y] thus increased regarding programming".

This category appears to be the opposite of Considering others in .

5.3. Patterns of leadership from case examples

We complement the analysis by pointing out how different kinds of leadership (co)existed. Leadership is associated with high status (Brown, 1988), and we believe that the below informs teaching and further research.

First, we observed cases where one student is both a strong project leader and a technical leader. Regarding our categorization, one person is creating a sense of leadership and demonstrating strong technical know-how. This case is evidenced in the previously included quotation from Participant-112 in Sections 5.1.1.

Second, we observed that management-related sense of leadership and technical leadership could be identified in different persons. The example below shows the remaining two members as mere programmers.

> [Participant-77:] "As for roles and statuses, member *x* and member *y* appeared to take a bit more leadership-like positions, member *y* being some kind of information provider and also a commander of the group (cf. the sense of leadership). [Member x] in turn was a mentor, because [member x] had the most knowledge and skill regarding programming, in particular in Python. [Member x] was thus asked for help, if something did not work, and mostly guided the project toward a direction that was the most sensible solution. I and [member z] were basic coders who did the work commanded. Yet, our roles were not absolute, so that I and [member z] would not have had a word to anything, but [instead] everyone's ideas were heard and taken into account in an equal manner".

Our data shows that when these two leaderships co-exist, the technical know-how is more crucial: the student with critical technical know-how is referred to as the group's leader.

Thirdly, we identified cases in which three kinds of leadership co-existed. The third was the idea owner, the group member who guides what is being developed. The example is from the student who could not identify any considerable imbalance in statuses while noting the following emergent roles:

> [Participant-52:] "The more abstract roles in our group were established as well, [member x] being mostly a kind of visionary and foreman, as the project got started from [member x's] idea. I found my role to be some kind of challenger, who tried to induce different perspectives and to some extent mold the ideas of [member x]. [Member y] was strongly an implementer and later an adviser, as he had tinkered the most, for instance, around wireless connections. [Member z] in turn acted as the most active information provider and the one who kept the people updated".

This narrative points to a technical adviser (cf. technical know-how as the status indicator), an information officer who takes care of situation awareness in the project (cf. sense of leadership), and an overseer regarding the vision of the project (cf. idea ownership). The fourth role here is a challenger. We compared this case with another case in which the idea for the project came from one student, but the idea-owning-based status was not stressed as a leadership (managerial and technical leaders were identified). In the example from Participant-52 above, the idea-owning (the kind of a product owner role) was important for the project not only from the beginning to get the project started but for a more extended period.

6. Discussion

6.1. Reflections in context of status theory

It can be observed that many of the items in the rising status categorization (Fig. 2) have counterparts in the declining status categorization (Fig. 3). A clear example is *Independence* vs *Dependency on others*. However, many available associations were not forced into the analysis or the naming of the categories. For instance, the results include *Idea ownership* and *Lack of creativity* in place of only creativity with multiple states. The purpose was to report the categories evocatively, which conveys students' reflections in context. Another example of such an indirect association is *Someone else completed my tasks* vs. *Considering others*. The analysis in the present form demonstrates the stated interest in the inductive approach, with the theory providing the overall lens for the study.

Another key observation is that the categories can be viewed as (1) individual relative to the group, (2) person-related, or (3) group-level. The influence of an individual's *Experience and know-how* is arguably relative to the newly formed group, while, for instance, *Charisma* or *Natural leader* appears to be more inherent

qualities. Examples of group-level categories are *Caring atmosphere* and *Chemistry alignment*. The literature included in Section 2 supports the idea of group-level attributes, e,g., the studies on the attraction of similarity and the studies on perceived insider status. It is acknowledged that the group-level characteristics link with the individuals' qualities, but the students' reflections yet appear at the level of a group. Taken together, it seems valuable to combine different fields of status-related literature into a framework when group projects are studied.

It was observed that students may have known each other from previous course settings, which can mean that prior knowledge of a group member (reputation) acts as an external characteristic (see Section 5.1.1). This rarely occurred, however. How students provided their reflections (see the included quotations of the results section) instead suggests that information of statuses develops in the interactions of newly formed groups. From this point of view, a student group first appears as a group of status equals with hardly any external characteristics available for statuses to become organized. It may thus be helpful to use the above kind of classification (see the previous paragraph) in place of considering the effect of internal vs. external characteristics in a student project context. It should be noted that a grouping strategy may influence how students' reputations affect the situation. The strategy in the present course was that students of a group had not previously worked together.

Technical know-how was the most frequent category, and students' reflections hint that it was a more critical status characteristic than another frequent category, *Showing management responsibility*. This interpretation matches the status theory, in which internal status characteristics relate to the task situation demands. These small-group projects require a group to develop a software prototype that is publicly presented at the end of the course—*Technical know-how* is crucial for the groups. Although it is later noted that the summative information is suggestive, the most prominent categories do underline what is critical in these student projects: the top three subcategories of the rising status were *Technical know-how*, *Commitment*, and *Showing management responsibility*. Perhaps it can be said that the present kind of inductive analysis discloses critical success factors in a given context.

Based on the results, perceived insider status (PIS) (see Section 2) is a highly explanatory concept for groups that perform in a decent manner, where each member makes at least some contribution to the project. In such cases, lower-skill students can experience a worker status, although they admit to being learners throughout the project. Some critical discussion can be developed here. Students' reflections hint that the situation can lack authenticity compared with working life (see), on which the present authors agree. Part of the group becoming teachers for the other indicates that the project's goals may have to be downgraded, and work can become a pretense for both the teachers and those who are taught. This is further supported by the justice-based analysis of the same data in another study (Kokkoniemi and Isomöttönen, 2020): when injustice is experienced, the situation is cognitively coped with by comparing it with other settings. That is, capable students include notes concerning whether their group experience would be acceptable in working life and tolerate the current imbalances in work (and statuses) because of the educational context. On the other hand, the optimistic view of this setting is that a group in which members develop the feeling of insiderness is likely to provide more empowering than discouraging experiences. Additionally, many educators might opine that ability and willingness to teach others is a needed graduate attribute in software engineering.

It is easier to interpret a comfortable situation in homogeneous groups regarding skills, work attitudes, and personalities. This showed up in the reflections in which a good working attitude was agreed on (see Section 5.1.5), and it was liked that the group started from a similar skill level and no one was dominating (see Section 5.1.5). We would say that equal statuses in this sense (based on similarity) can indicate better authenticity than a considerable imbalance in statuses, although perceived insiderness can be achieved in the latter case. We have observed groups in which members, starting from a similar level, make a shared effort to learn new technologies during the project; we believe this provides students with a realistic experience although they spend resources on learning.

The results also warrant considerations on status movement raised in Section 2. Students perceived that they developed their statuses when they first built the courage to participate or decided to address the learning curve ahead (see Section 5.1.2). In a sense, a process of status movement was initiated toward a more self-directed practitioner. On the one hand, it seems that the authentic small-group project usefully invites – if not to some extent forces – one to self-study or "fill the gap" when personal know-how is low regarding what participation demands. On the other hand, one might wonder why the status movement occurs (is faced) during a third-year project course but not earlier. It seems important to understand students' status perceptions in a historical context regarding how they see themselves during their first years of study. Do they begin to see themselves as insiders of the field? What their participation in first CS courses implies on this continuum? Do the highly populated first CS courses invite or support one to fill a gap in know-how when such is acknowledged, or do they continue to mark potential differences in the feelings of insiderness? Do the potential differences in CS experience before university studies continue to exist and define what will be experienced later, during project courses? The importance of these questions should be considered in connection to *Technical know-how* being the dominant category, an observation conveying that differences in know-how often exist and are influential in how students define themselves and others. The authors find the status theory to be an appropriate framework for the proposed historical analysis.

6.2. Comparison with studies on roles and personality types

In the results section, terms such as "worker", "mere programmer", "challenger", and "idea owner" were used. These sound like roles and appear to bear some status, perceived insiderness at the least. Additionally, some passages referred to being social in a significant way. Comparing these indications with the role definitions in the literature seems possible. For instance, the challenger sounds similar to "evaluator-critic", the idea-owner sounds similar to "initiator-contributor", and being social (see the quotation from Participant-94 in) sounds similar to 'gate-keeper and expediter' in the functional roles scheme by Benne and Sheats (1948, pp. 31–32). The worker or mere programmer may, in turn, correspond with a "team worker" and a "specialist" in Belbin's scheme. However, the authors believe that asking students to reflect on their statuses yielded insights that differ from role definitions. An example is *Taking time to learn new things*, which appears more like a behavioral measure to become an insider than a role definition.

Beranek et al. (2005) noted that group building and maintenance in the functional roles scheme should receive more attention in student groups. In our study, *Being social* was a noticed category after the three topping categories (*Technical know-how*, *Showing management responsibility*, and *Commitment*) among the rising status indicators, and attributes such as caring and helping were clearly present. In our reflection, the situation calls for more analysis because it is likely to be much easier to notice

technical competence as a high-status indicator than sociability in programming-intensive projects. As we note later, increasing students' awareness of differing status indicators might result in a better view of the relative importance of the indicators.

The three leaderships (Section 5.3) are considered as follows. It was raised in Section 3 that a single-leader scenario was considered better compared with no or multiple leaders when the leader type in question was Shaper in the Belbin's scheme (Henry and Stevens, 1999). This suggests that analyzing the kinds of leadership (Section 5.3) in relation to Belbin roles might help understand the conditions under which several leaderships can live in harmony. Additionally, Benne and Sheats (1948) favorably referred to joint responsibility across member roles while also advancing that roles are helpful when it is understood which roles are needed in a particular context and the stages of work therein. In this light, the three leaders could be seen as taking joint responsibility. They arise from what the students' projects require; hardly ever the students reported that any leadership role was an explicit decision made in a group. On the other hand, when similar skill levels were observed in a group, the situation of no one dominating was a preferred one in our data. Perhaps the data also here echoes what Benne and Sheats (1948) noted: the concept of leadership as "multilaterally shared responsibility" (p. 30). With the help of these remarks from Benne and Sheats (1948), it is concluded that, in the present context, it is important to be aware of and welcome useful leadership roles, which are likely to come with high status, but yet understand them as something that supports joint responsibility, and not a power hierarchy.

The results raised personal qualities as status indicators, including *Idea ownership* (creativity), *Goal-oriented*, *Charisma*, and *Natural leader*. This raises the question of whether students are destined to receive specific roles and statuses based on their personalities. The idea ownership or creativity is interesting to analyze in relation to Openness to experience, which represents fantasy and ideas in Big Five. In effect, Monteiro et al. (2016) have reported from a SE setting that individual attitudes influence creative behavior and that personality plays a role in this linkage. The reported goal orientation may have something to do with Conscientiousness which represents order and dutifulness in Big Five. *Helping others*, which we presented under *Collectivity and sense of belonging*, might find a home as a personal quality if we compare it with Agreeableness, a tendency for altruism. See a summary of Big Five dimensions in Novikova (2013). Charisma and natural leader appearance have been studied in connection to leadership. For instance, Hoogh et al. (2005) summarized that such connections had been found but the linkage and how strong it is varied. They reported on the effect of context, i.e., that its features might activate personality-based charismatic leadership in different ways. For instance, Openness to experience-dimension was observed to correlate positively with charismatic leadership only in a dynamic work context. In this connection, it can be speculated that how skill differences in the present student group setting are responded to might explain that in some cases fruitful leadership, with the leader helping and considering others, emerges, and that this development might be anchored to the leader's personality type.

Altogether, comparing statuses and their indicators with personality type might shed light on the extent to which group dynamics are either destined or accidental in temporary student groups. In the present setting, the roles and statuses are allowed to emerge (they are not guided), which explains the discussed interest in the students' personality-based destiny. Relatedly, it seems very interesting that Benne and Sheats (1948, p. 33) acknowledged (long ago) the tension of what role-taking is possible for individuals given their personality types and considered this an important research agenda. In the study by Martínez et al. (2010), part of the students experienced the role assigned by help of MBTI personality information as incorrect, perhaps indicating that finding roles based on personality is challenging.

6.3. Implications for teaching

Some of the categories are likely to appear more common to the SE field than others, in particular the technical know-how. However, the present authors see human factors as an integral part of software engineering and related education, and from that perspective, an analysis of the categories regarding their disciplinary relevance is considered unnecessary. In the authors' view, the categorizations as a whole inform teaching in SE student projects.

A key implication for teaching is using the present results as teaching and learning material. This statement aligns with what for instance Glaser (1978) noted regarding the value of inductively developed grounded theories. He emphasized that practitioners, having been informed by inductively developed theorizations, are more prepared to encounter their daily practice (Glaser, 1978, pp. 13–14). Although the present study does not outline a theory, the result categorizations are inductively developed conceptual schemes. In the present case, the practitioners are the teachers and students of group project settings. A few examples are developed as follows.

First, the observed leadership patterns (Section 5.3) suggest that leadership positions of different natures are available to group members. Educating students with this information and even encouraging such role-taking might help groups to become status equals and also resolve the situation of one student with high technical know-how attempting to avoid a single leader – alone responsible for the project – destiny. As was discussed above, this is not to encourage a power hierarchy but joint responsibility. An interesting question is if the remaining positions (e.g., the mere programmer or challenger in our data examples) are seen as equally important membership.

Second, the authors find it essential that the promising effects of collectivity are explained to the students regarding how individuals can become insiders of a group (Section 5.1.5). The authors have previously focused on individual-related examples of status characteristics when introducing the status concept, whereas the present results encourage a broader perspective.

Third, the results evidence that an initial perceived low status due to lack of experience and skill can be developed if one builds courage and decides to tackle the learning curve. It seems educationally valuable to "pass forward" this information from these students to new project groups to encourage attitudes by which challenges are addressed, not escaped.

Finally, differing social abilities should receive attention in connection to a software process. One student recommended that groups commit to following a software process to ensure everyone is involved in the project. Hence, the use of a software process can be motivated as a tool by which group members can become insiders, a tool by which students can perhaps sensitively manage differing social abilities in their group.

Another implication is that the results support similarity as a grouping strategy. This showed in cases where similar skill levels were preferred as the setting for equal statuses. Another example is the reported chemistry based on similar personalities in a group. These effects of similarity align with the findings and considerations reported by Pieterse and Thompson (2010). Perhaps the similarity principle could be added to the current grouping strategy, which was that students of a group have not previously worked together. However, differing grouping strategies tend to each have pros and cons (Fincher et al., 2001). With the similarity

principle, one could imagine it targets weaker student groups in the setting where project results are publicly presented. This might be compensated by focusing project presentations both on the learning gains and product in place of a strong emphasis on the product.

Taken together, we do not argue that teachers should simply suggest to students that their statuses should become equal during a short-term project. The above rather exemplifies teaching topics and actions for supporting the development of sufficiently comparable statuses, that is, students' experiences of insiderness. Informing students as suggested can be complemented with follow-up reflection activities, all attempting to support students' self-regulation toward participatory group work. Additionally, particular teaching settings, e.g., bigger courses where teachers cannot correspond much with the groups, could benefit from diagnosing group situations by status-based inventories (cf., the first two future research suggestions below). This might help in identifying the groups whose group development requires support.

6.4. Implications for research

The discussion above warrants at least the following future work:

- It is conjectured that differences in technical know-how are easy to observe in software development-intensive projects. For this reason, future work should inform students of the varying status indicators and study how they would rank the indicators based on their lived group experience.
- For a group-level analysis, students should also be asked to rank their group members along with the differing status indicators (e.g., *Commitment*, *Technical know-how*, *Showing management responsibility*, and *Being social*). This would reveal potential differences in the students' perceptions. Additionally, the authors recommend this conduct as an intervention in the middle of a project course to prompt students' awareness of their group dynamics and educate them about group work. The status concept was used as the motivating concept for a group intervention exercise earlier (Isomöttönen and Ritvos, 2021), but the present results allow a more detailed use of the concept.
- How students' histories influence their status during authentic group projects should be explored. Research should examine if students progress toward being insiders of the field or, for reasons such as continued challenges with programming self-efficacy, remain outsiders.
- Regarding roles, a small group setting (e.g., a group of 3–5 students) should be analyzed for greater clarity regarding if optimal roles would be available for successful group work. A competing question is if the roles and statuses should be kept unguided and educational efforts focused on intervening groups' working conditions.
- An interesting question is if students' personality type influences their status. Are students with certain personalities destined to have a particular role and status in their project? Given that research has shown relationships between personality type and software product quality or team members' satisfaction levels (Acuña et al., 2015), the proposed future work could also look at whether personality type influences which status indicators students value the most.
- Finally, it would be interesting to know if students consider a teacher-led review of the present status indicators (e.g., at the beginning of the course) sound education about group work.

6.5. Trustworthiness of the study

The study's trustworthiness is reviewed through the attributes of credibility, dependability, and transferability known from the work by Lincoln and Guba (1985). The term trustworthiness captures the idea that one should achieve research results that the field considers plausible and worth attention (Lincoln and Guba, 1985, p. 290).

Credibility in qualitative (naturalistic) research corresponds with internal validity in (conventional) quantitative research (Lincoln and Guba, 1985, p. 296). Credibility calls for correctly interpreted categories that capture the phenomenon under study while cautioning against interpretations that fail to talk to practitioners whom the research concerns (Lincoln and Guba, 1985, p. 296). Prolonged engagement, building trust, member checking, referential adequacy, peer debriefing, and negative case analysis can increase credibility (Lincoln and Guba, 1985, p. 301).

A worry about credibility is mitigated because the first author, as the course teacher, knows the context through prolonged exposure (action researchers refer to a similar aspect when emphasizing that the research group should stay the same (Melrose, 2001)). The second author implements PjBL courses and is therefore aware of PjBL group phenomena through teaching. Additionally, the reviews between the authors during the research procedure corrected misinterpretations of the research notes arising from the setting in which only the first author had a direct relationship with the context. In conjunction with the prolonged engagement, Lincoln and Guba cautioned against personal distortions finding their way into interpretations (Lincoln and Guba, 1985, p. 302). To emphasize students' perspectives, the status theory section was written after completing the analysis, which counteracted the possibility that the authors would have had status theory actively in their minds with the consequence of directed analysis. The authors agreed at a general level that status is viewed as a determinant in which characteristics of an individual or a group influence what kind of positions students possess in their groups.

Furthermore, it is important to note that no incentives for why students would have commented on their status in a biased way are identified. The course was evaluated as pass or fail, and passing did not depend on the demonstration of high status. Additionally, the status concept was introduced as a measure to understand group work and reflective writing in learning reports was encouraged. We believe that a potential bias is worth considering if a similar study is performed in a project setting with individually given grades. It is also worth noting that consent was received from all course participants; the data do not represent only those students, for instance, who experienced a high personal status and would therefore be willing to respond to a research invitation.

Trust was built during yearly courses. The teacher-as-researcher personally communicated to each student group that using the learning reports as data indicates a possibility for research-based development of teaching and that the learning reports are utilized only on the condition of students' opt-in decisions. Furthermore, many of the aspects documented in the results have emerged in weekly coaching sessions and mid-course group self-evaluation sessions during the eight-year history of the course. For instance, the group self-evaluation session in the middle of the course prompts students to analyze their group situation with the help of group concepts, including status (Isomöttönen and Ritvos, 2021). This means that the first author who has yearly read the students' learning reports in a teacher role also knows about participants' status reflections through interaction. That is, a kind of member checking has informally occurred over the years of the study.

Referential adequacy indicates raw data being archived for testing the researchers' interpretations (Lincoln and Guba, 1985,

p. 313–314). In the present case, the authors did not archive the data publicly, as this would have increased the identifiability of the participants. With personal course assignments as data, in which students analyze the dynamics of their groups, the authors argue that such publicity would limit the number of students providing consent and influence the nature of the data. It is important to note that the present inductive content analysis remained close to the data, and illustrative quotations were included to convince the reader.

The authors did not find it relevant to conduct an external peer briefing outside the research group because the other analyst was not a teacher in the target course and provided an external analytical lens throughout the data analytical phase. Neither the negative case analysis appeared to need attention because the analysis was equally targeted at the aspects that either increased or decreased students' statuses. As shown in our results, the same or similar aspect could cause an increase or a decrease.

Dependability corresponds with reliability in quantitative research (Lincoln and Guba, 1985, p. 299). An action for addressing dependability is a step-wise process in which work is divided and becomes replicated (Lincoln and Guba, 1985, p. 317; Guba, 1981). The authors took turns in the data analysis procedure and arranged shared sessions to agree on the categories after all steps in which the analysis was advanced. It should be further noted that the more one conceptualizes data, the more the attribute of theoretical sensitivity (ability to conceptualize) begins to play a role in the analysis and validity, as with the inductive grounded theory method (Glaser, 1978). The conventional content analysis used here was not geared toward integrative theory development (Hsieh and Shannon, 2005) and the ability to abstract integrative hypotheses is not considered further.

Relating to credibility and dependability, a challenge with the data was that it was not always clear which category was indicated. For example, it was occasionally difficult to interpret if taking the initiative in the project concerned project topic ideation or project management. Here, a validity threat mostly related to the quantification of the categories is acknowledged. However, the authors believe that the quantification of the categories was worth reporting because this at least approximates the aspects that dominated the students' reflections: some status indicators were clearly more frequently reported than others. Altogether, the authors believe that the results originating from $N = 77$ students usefully documented qualitatively different aspects across the data set regardless of occasional difficulties in interpretation.

Transferability corresponds with external validity in quantitative research and indicates how research results apply to other settings (Lincoln and Guba, 1985, p. 297). Lincoln and Guba (1985, p. 298) stated that transferability is less of a concern for the original investigators than for those who attempt to use the results. The critical action that researchers can take is to document their research setting, as this helps others analyze the applicability of the results (Lincoln and Guba, 1985, p. 298). The present research setting was described in Section 4. Concerning the transferability, the authors conjecture that the dominance of specific categories, such as that of the student's technical know-how, is due to student groups being software development groups. It is acknowledged that categories and their distribution could vary with the form of PjBL and the educational-cultural setting. Projects' varying forms and design attributes were documented in taxonomic works (see Clear et al., 2001; Fincher et al., 2001; Burge and Gannod, 2009). As for culture, for instance, individuality versus collectivity, differentially emphasized between cultures, was found to influence students' perceptions of group-based activities in a comparative study (McLeay and Wesson, 2014).

6.6. Limitations

The limitations include that the results were drawn from a single course setting. The research should be advanced to other student SE projects, including different cultural settings. Another limitation is the lack of per-group analyses. These were omitted because students could focus their status considerations more on their group members or themselves or anonymously refer to others; because data were personal texts, how students addressed status varied. A directed data collection measure, in which each group member is prompted to analyze the whole group based on the same indicators, is needed for group-level analyses and was proposed for future research. However, the present data turned out to be rich for the analysis of status indicators, which arguably shows in the high number of low-level categories.

7. Conclusion

This study documented multiple status indicators identified by students. The results were discussed with several sources of status theory, based on which it is concluded that several branches of status-related literature appear useful for SE PjBL research and teaching. The results call attention to both individual and group-level characteristics for understanding individuals' statuses in educational groups. Status as a research lens yielded considerations of group situations that, the authors believe, can complement the studies focused on roles and personality. This lens should also be integrated with research on roles and the effects of personality. Furthermore, the results inform directed studies for understanding differences within and between groups. At the same time, an exciting aspect is the observed status movement of weaker students and the discussed need for historical analysis of how students develop as insiders of their field. Regarding teaching, the status indicators provide learning material for analyzing group development: why specific roles bearing certain statuses emerge in groups. When the results are shared with students at the start of the projects, it is hoped that self-regulation can be encouraged for collaborations that yield status positions in which learning becomes possible for all group members. Additionally, teachers can adopt the results for designing research-based group interventions implemented during group projects.

CRediT authorship contribution statement

Ville Isomöttönen: Conceptualization, Methodology, Investigation, Writing – original draft, Writing – review & editing. **Toni Taipalus:** Methodology, Investigation, Visualization, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

The data that has been used is confidential.

References

Acuña, S.T., Gómez, M.N., Hannay, J.E., Juristo, N., Pfahl, D., 2015. Are team personality and climate related to satisfaction and software quality? Aggregating results from a twice replicated experiment. Inf. Softw. Technol. 57, 141–156. http://dx.doi.org/10.1016/j.infsof.2014.09.002.

Acuña, S.T., Gómez, M., Juristo, N., 2009. How do personality, team processes and task characteristics relate to job satisfaction and software quality? Inf. Softw. Technol. 51 (3), 627–639. http://dx.doi.org/10.1016/j.infsof.2008.08.006.

Bach, L., Cohendet, P., Pénin, J., Simon, L., 2008. IPR and "open creativity": The cases of videogames and of the music industry. In: DIME – the Creative Industries and Intellectual Property. London Conference.

Bales, R.F., 1951. Interaction Process Analysis: A Method for the Study of Small Groups. Addison-Wesley Press, Cambridge, Mass.

Barroso, A.S., Madureira, J.S., Soares, M.S., do Nascimento, R.P., 2017. Influence of human personality in software engineering-a systematic literature review. In: International Conference on Enterprise Information Systems. SCITEPRESS, pp. 53–62. http://dx.doi.org/10.5220/0006292000530062.

Belbin, R.M., 2004. Management Teams: Why They Succeed or Fail, second ed. Elsevier Butterworth Heinemann, Oxford, UK, First edition 1981.

Bell, D., Hall, T., Hannay, J.E., Pfahl, D., Acuna, S.T., 2010. Software engineering group work: Personality, patterns and performance. In: Proceedings of the 2010 Special Interest Group on Management Information System's 48th Annual Conference on Computer Personnel Research on Computer Personnel Research. In: SIGMIS-CPR '10, ACM, New York, NY, pp. 43–47. http://dx.doi.org/10.1145/1796900.1796921.

Benne, K.D., Sheats, P., 1948. Functional roles of group members. J. Soc. Issues 4 (2), 41–49. http://dx.doi.org/10.1111/j.1540-4560.1949.tb02106.x.

Beranek, G., Zuser, W., Grechenig, T., 2005. Functional group roles in software engineering teams. In: Proceedings of the 2005 Workshop on Human and Social Factors of Software Engineering. ACM, New York, NY, pp. 1–7. http://dx.doi.org/10.1145/1083106.1083108.

Berger, J., Cohen, B.P., Zelditch, M.J., 1965. Status characteristics and expectation states. Technical Report, Stanford Sociology Technical Reports and Working Papers, 1961-1993.

Berger, J., Rosenholtz, S.J., Zelditch Jr., M., 1980. Status organizing processes. Annu. Rev. Sociol. 6 (1), 479–508. http://dx.doi.org/10.1146/annurev.so.06.080180.002403.

Block, J., 2010. The five-factor framing of personality and beyond: Some ruminations. Psychol. Inq. 21 (1), 2–25. http://dx.doi.org/10.1080/10478401003596626.

Brown, R., 1988. Dynamics Within and Between Groups. Basil Blackwell, Oxford, UK.

Burdett, J., 2007. Degrees of separation—Balancing intervention and independence in group work assignments. The Australian Educational Researcher 34 (1), 55–71. http://dx.doi.org/10.1007/BF03216850.

Burge, J., Gannod, G., 2009. Dimensions for categorizing capstone projects. In: Software Engineering Education and Training. Proceedings. 22nd Conference on. IEEE Computer Society, Los Alamitos, CA, pp. 166–173. http://dx.doi.org/10.1109/CSEET.2009.37.

Carlyn, M., 1977. An assessment of the myers-briggs type indicator. J. Personal. Assess. 41 (5), 461–473. http://dx.doi.org/10.1207/s15327752jpa4105_2.

Clear, T., Goldweber, M., Young, F.H., Leidig, P.M., Scott, K., 2001. Resources for instructors of capstone courses in computing. In: ITiCSE-WGR '01: Working Group Reports from ITiCSE on Innovation and Technology in Computer Science Education. ACM, New York, NY, pp. 93–113. http://dx.doi.org/10.1145/572139.572179.

Cohen, B.P., Zhou, X., 1991. Status processes in enduring work groups. Am. Sociol. Rev. 56 (2), 179–188. http://dx.doi.org/10.2307/2095778.

Fincher, S., Petre, M., Clark, M. (Eds.), 2001. Computer Science Project Work: Principles and Pragmatics. Springer-Verlag, London.

Furnham, A., 1996. The big five versus the big four: The relationship between the myers-briggs type indicator (MBTI) and NEO-PI five factor model of personality. Personality Individ. Differ. 21 (2), 303–307. http://dx.doi.org/10.1016/0191-8869(96)00033-5.

Gast, D.L., Ledford, J.R., 2014. Applied research in education and behavioral sciences. In: Gast, D.L., Ledford, J.R. (Eds.), Single Case Research Methodolgy, second ed. Routledge, New York, NY, pp. 1–18.

Glaser, B.G., 1978. Theoretical Sensitivity: Advances in the Methodology of Grounded Theory. Sociology Press, San Francisco, CA.

Gorla, N., Lam, Y.W., 2004. Who should work with whom? Building effective software project teams. Commun. ACM 47 (6), 79–82. http://dx.doi.org/10.1145/990680.990684.

Guba, E.G., 1981. Criteria for assessing the trustworthiness of naturalistic inquiries. ECTJ 29 (2), 75–91. http://dx.doi.org/10.1007/BF02766777.

Gulati, J., Bhardwaj, P., Suri, B., 2015. Comparative study of personality models in software engineering. In: Proceedings of the Third International Symposium on Women in Computing and Informatics - WCI '15. ACM, New York, NY, http://dx.doi.org/10.1145/2791405.2791445.

Gutiérrez, L., Flores, V., Keith, B., Quelopana, A., 2019. Using the belbin method and models for predicting the academic performance of engineering students. Comput. Appl. Eng. Educ. 27 (2), 500–509. http://dx.doi.org/10.1002/cae.22092.

Henry, S.M., Stevens, K.T., 1999. Using belbin's leadership role to improve team effectiveness: An empirical investigation. J. Syst. Softw. 44 (3), 241–250. http://dx.doi.org/10.1016/S0164-1212(98)10060-2.

Hernández-March, J., Martín del Peso, M., Leguey, S., 2009. Graduates' skills and higher education: The employers' perspective. Tert. Educ. Manag. 15 (1), 1–16. http://dx.doi.org/10.1080/13583880802699978.

Hoogh, A.H.B.D., Hartog, D.N.D., Koopman, P.L., 2005. Linking the big five-factors of personality to charismatic and transactional leadership; perceived dynamic work environment as a moderator. J. Organ. Behav. 26 (7), 839–865. http://dx.doi.org/10.1002/job.344.

Hsieh, H.-F., Shannon, S.E., 2005. Three approaches to qualitative content analysis. Qual. Health Res. 15 (9), 1277–1288. http://dx.doi.org/10.1177/1049732305276687.

Isomöttönen, V., Ritvos, E., 2021. Digging into group establishment: Intervention design and evaluation. J. Syst. Softw. 178, 110974. http://dx.doi.org/10.1016/j.jss.2021.110974.

Jung, C.G., 1981. The Collected Works of C. G. Jung. Pscyhological Types. Vol. 6, Routledge & Kegan Paul, London and Henley.

Karn, J.S., Syed-Abdullah, S., Cowling, A.J., Holcombe, M., 2007. A study into the effects of personality type and methodology on cohesion in software engineering teams. Behav. Inf. Technol. 26 (2), 99–111. http://dx.doi.org/10.1080/01449290500102110.

Kokkoniemi, M., Isomöttönen, V., 2020. Project education and adams' theory of equity. In: Frontiers in Education Conference. FIE, IEEE, pp. 1–5. http://dx.doi.org/10.1109/FIE44824.2020.9274126.

Kosti, M.V., Feldt, R., Angelis, L., 2014. Personality, emotional intelligence and work preferences in software engineering: An empirical study. Inf. Softw. Technol. 56 (8), 973–990. http://dx.doi.org/10.1016/j.infsof.2014.03.004.

Kulich, C., Lorenzi-Cioldi, F., Iacoviello, V., 2015. Moving across status lines: Low concern for the ingroup and group identification. J. Soc. Issues 71 (3), 453–475. http://dx.doi.org/10.1111/josi.12123.

Lincoln, Y.S., Guba, E.G., 1985. Naturalistic Inquiry. Sage Publications, Newbury Park, CA.

Loch, C.H., Huberman, B.A., Stout, S., 2000. Status competition and performance in work groups. J. Econ. Behav. Organ. 43 (1), 35–55. http://dx.doi.org/10.1016/S0167-2681(00)00107-4.

Marshall, L., Pieterse, V., Thompson, L., Venter, D.M., 2016. Exploration of participation in student software engineering teams. ACM Trans. Comput. Educ. 16 (2), 1–38. http://dx.doi.org/10.1145/2791396.

Martínez, L.G., Licea, G., Rodríguez-Díaz, A., Castro, J.R., 2010. Experiences in software engineering courses using psychometrics with RAMSET. In: Proceedings of the Fifteenth Annual Conference on Innovation and Technology in Computer Science Education. ACM, New York, NY, pp. 244–248. http://dx.doi.org/10.1145/1822090.1822159.

McLeay, F., Wesson, D., 2014. Chinese versus UK marketing students' perceptions of peer feedback and peer assessment. Int. J. Manag. Educ. 12 (2), 142–150. http://dx.doi.org/10.1016/j.ijme.2014.03.005.

Melrose, M.J., 2001. Maximazing the rigor of action research: Why would you want to? How could you? Field Methods 13 (2), 160–180. http://dx.doi.org/10.1177/1525822X0101300203.

Monteiro, C.V.F., da Silva, F.Q.B., Capretz, L.F., 2016. The innovative behaviour of software engineers. In: Proceedings of the 10th ACM/IEEE International Symposium on Empirical Software Engineering and Measurement. ACM, New York, NY, http://dx.doi.org/10.1145/2961111.2962589.

Myers, I.B., Myers, P.B., 1980. Gifts Differing. CPP, Mountain View, CA.

Novikova, I.A., 2013. Big five (the five-factor model and the five-factor theory). In: Keith, K.D. (Ed.), The Encyclopedia of Cross-Cultural Psychology, first ed. Wiley-Blackwell, Hoboken, New Jersey, pp. 136–138. http://dx.doi.org/10.1002/9781118339893.wbeccp054.

Patton, M.Q., 2015. Qualitative Research & Evaluation Methods: Integrating Theory and Practice, fourth ed. Sage, Los Angeles, CA.

Pérez, B., Rubio, Á.L., 2020. A project-based learning approach for enhancing learning skills and motivation in software engineering. In: Proceedings of the 51st ACM Technical Symposium on Computer Science Education. pp. 309–315. http://dx.doi.org/10.1145/3328778.3366891.

Pieterse, V., Thompson, L., 2010. Academic alignment to reduce the presence of 'social loafers' and 'diligent isolates' in student teams. Teach. High. Educ. 15 (4), 355–367. http://dx.doi.org/10.1080/13562517.2010.493346.

Rajendran, M., 2005. Analysis of team effectiveness in software development teams working on hardware and software environments using belbin self-perception inventory. J. Manag. Dev. 24 (8), 738–753. http://dx.doi.org/10.1108/02621710510613753.

Souza, M., Moreira, R., Figueiredo, E., 2019. Students perception on the use of project-based learning in software engineering education. In: Proceedings of

the XXXIII Brazilian Symposium on Software Engineering. ACM, New York, NY, pp. 537–546. http://dx.doi.org/10.1145/3350768.3352457.

Stamper, C.L., Masterson, S.S., 2002. Insider or outsider? How employee perceptions of insider status affect their work behavior. J. Organ. Behav.: Int. J. Ind., Occup. Organ. Psychol. Behav. 23 (8), 875–894. http://dx.doi.org/10.1002/job.175.

Strauss, P., Alice, U., Young, S., 2011. 'I know the type of people I work well with': Student anxiety in multicultural group projects. Stud. Higher Educ. 36 (7), 815–829. http://dx.doi.org/10.1080/03075079.2010.488720.

Thomas, R.N., 1999. Group dynamics and software engineering. In: Object Oriented Programming Systems Languages and Applications: Educators' Symposium. ACM.

Tomayko, J.E., 1998. Forging a discipline: An outline history of software engineering education. Ann. Softw. Eng. 6 (1), 3–18. http://dx.doi.org/10.1023/A:1018953214201.

Wright, J.C., Giammarino, M., Parad, H.W., 1986. Social status in small groups: Individual–group similarity and the social "misfit". J. Personal. Soc. Psychol. 50 (3), 523. http://dx.doi.org/10.1037/0022-3514.50.3.523.