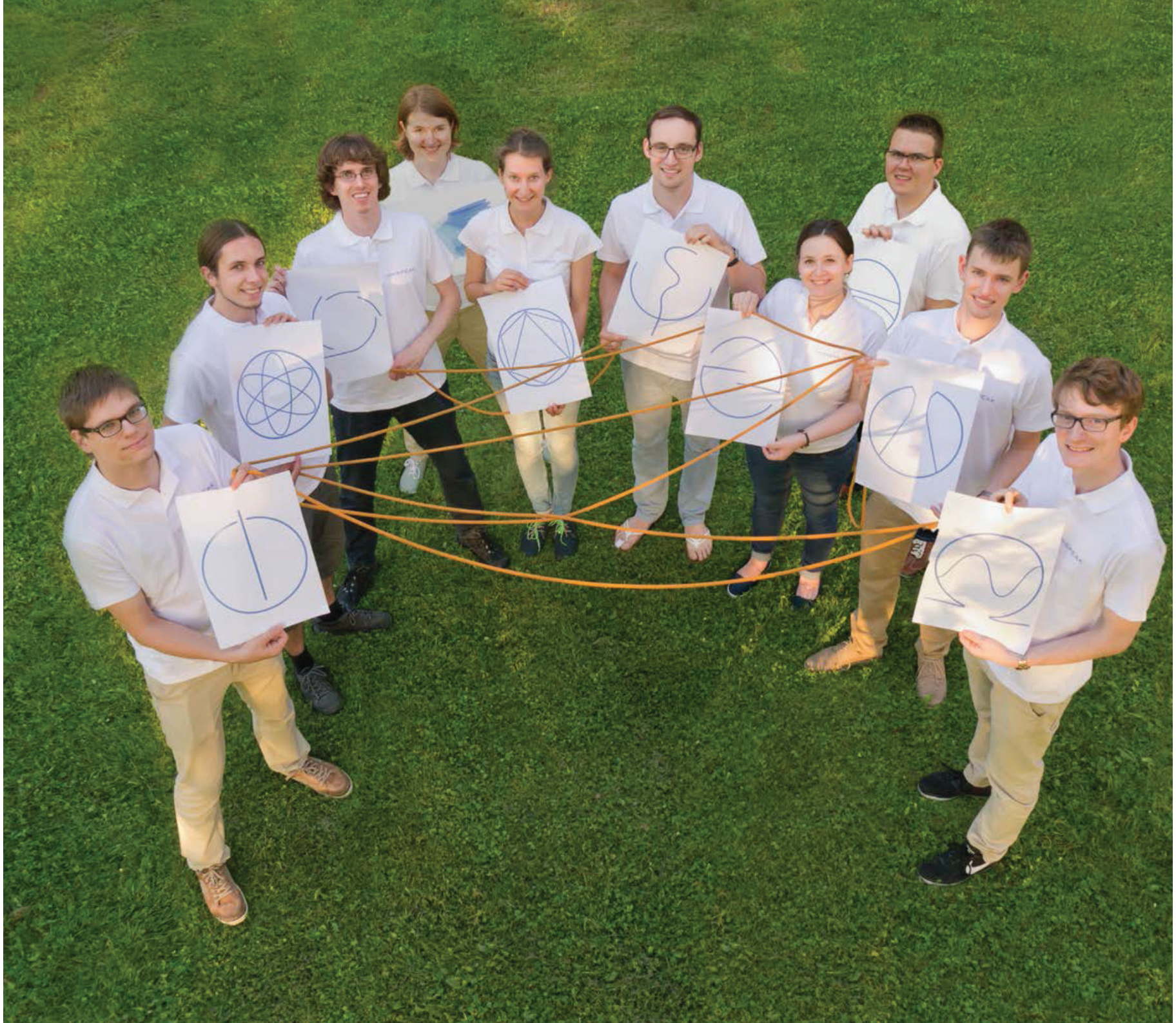

Project Report **uniSPEAK**

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Turns out it wouldn't. Still too poorly defined, and, perhaps more significantly, we were suddenly facing the daunting task of investigating the way professional researchers interact – as a student project.

So a setback it was – but this notion of examining interdisciplinary communication, once kindled, was not easily quenched. In fact, this quandary spawned our most iconic symbol: the Faculty Wheel of Fortune, bedecked with the logos of all TUM faculties (see page 63). In springing the question of their faculty symbol on unsuspecting students passing by at the city campus, we tried to find out about connections between different research fields, considering the results to be a rough first indicator.

Thus our ideas matured – and finally, our thoughts turned to that other thing universities do besides research: educating students. Why? If the goal is to improve interdisciplinary communication – that is, a dimension of knowledge transfer – it is only logical to start with students and professors. We began asking ourselves: Do universities in general, and TUM specifically, do a good job in preparing their protégés for working in an interdisciplinary research context – keeping in mind that this is implied in TUM's mission statement? And behold: Our project was born!

Once upon a time – that is, little more than a year ago – our project started out with the pretty, but fairly nondescript name "knowledge transfer." Since then, we – now the uniSPEAK team – have come a long way. Have you ever considered that social (or even pseudo!) interdisciplinarity might be a thing?

No?

But let's slow down a bit. At the very beginning, we chose our topic perfectly aware of how unspecific it was, and it was a conscious decision: we were quickly stumped by just how vague and multifaceted the topic was. Then, after much research and debate, the brainwave: transfer within interdisciplinary research teams! Yes, that would work!

As a first step down this path, we interviewed several professors who straddle the borderline between two fields. Our focal point: Which factors are beneficial for effectively communicating with researchers from fields different from one's own? And could possible challenges be overcome by preparing students accordingly?

The general consensus was that different fields may use the same vocabulary to mean different things, confounding any attempts to effectively communicate. However, this hurdle extends beyond the pure linguistic level: What constitutes a "reliable" result is a matter of considerable dispute between most fields. Philosophical differences on the role of science aside, we are left with sheer practical considerations – how much certainty is achievable in each field? Does a particle physics standard of reliability hold up in the social sciences? Effectively cooperating in spite of all this boils down to not only knowing about "the other field," but also empathizing with its peculiarities and quirks. This very empathy is likely key. How do we come by such empathy? Obvious strategy: social interactions.

We thus realized that social interactions with students of other subjects, especially if they involve discussing academic topics, may be extremely beneficial to one's skills in interdisciplinary cooperation. We decided to find out: Do students of different faculties significantly deviate in how and how often they communicate and exchange knowledge with friends and acquaintances from other fields of study? In other words, does the degree to which the faculty includes interdisciplinary teaching in its curriculum influence how its students interact? Intuition dictates that it should.

Info BOX: uniSPEAK

Our project aims to evaluate the links among different fields of study, students' interactions with students from other disciplines, and students' personality profiles. Even TUM's Mission Statement highlights social competence next to technical expertise. Within the project, we designed a survey to investigate how students of

If this it not the case – well, then we'd be dealing with crossing the boundaries of classic disciplines being a topic liberally expounded by senior faculty members, but not taking root in their students' behavior. We'd be dealing with teaching from other fields, despite being in the curriculum, not effecting any real communication with these fields.

Dare we say it: pseudo-interdisciplinarity?

To determine this, we designed a survey that we piloted with a group of 28 members of other teams in the current cohort of Junge Akademie projects. Our repertoire: questions about social interactions as well as a scientific personality test, since differing interaction patterns between some of the faculties may spring from differing personalities. This phase was marked by feedback ever and again returning to one idea: stereotypes! Which was unintentional but, well, we did ask personality questions.

Eventually, with our finalized questionnaire in hand, we were ready for the real survey. Getting a sufficient number of students to participate in order to make general statements? No big whoop. But what of comparing different faculties to see whether measures they take influence their students' interaction behavior, for which we would require at least 70 to 80 participants from each faculty in question? To achieve this, we needed to focus on a just a few faculties. Which ones? For one, the more they differ with respect to how they handle interdisciplinarity, the better. For another, getting those 70 participants from the smaller faculties with less than 500 students seemed unrealistic, so we could only consider larger ones. Our picks: Chemistry, Economics, Mechanical Engineering, and Medicine.

Thus, we put out the bait: a raffle where we gave away TU-film and TU-shop vouchers and, for our paper-based survey, our visually stunning Wheel of Fortune to attract passers-by as well as an on-the-spot gift of gummy bears. Interestingly, the raffle at times appeared far less motivating than the sweets (let alone the pens, of which – sadly – we only had eight and thus had to hold on to). Thus, we successfully distributed the paper-based survey on several occasions in places where students of the economics, mechanical engineering, and chemistry faculties commonly spend their free time between lectures. Even more students followed our call to participate in the online version – many of them from the faculty of medicine, where our project mentor Prof. Berberat advertised us, as well as, surprisingly, from the TUM campus Weihenstephan. Therefore, even though we did not initially plan it, we included the latter as a faculty of interest.

Final tally: over 650 participants!

The detailed results are presented in the second part of this report. In brief, we found few significant differences in students' personalities – it appears that, in this respect, stereotypes about different TUM faculties are not true. We did, however, find that the campus appears to be a large factor in determining inter-faculty connections.

Most importantly, students interacting with a higher diversity of students from other faculties do more often share academic knowledge from their own field – and are also more likely to report learning a lot about their friends' fields. Lastly, contrary to what might be expected, the faculty of interest with the most blatant inclusion of interdisciplinary teaching in its curricula – economics – does not have the students with the most diverse social contacts and who share the most knowledge with students from other fields.

So there we have it: pseudo-interdisciplinarity does seem to be a thing.

Students' **P**ersonality & **E**nsuring **A**cross-faculty **K**nowledge transfer

different fields interact, especially on a social level, and whether this is influenced by factors such as campus or proportion of interdisciplinary coursework within their curricula. We considered both the university as well as leisure activities as major points of contact.

Relevance and Influencing Factors of Interdisciplinary Social "Teaching" and "Learning" Among University Students

Abstract

In the light of interdisciplinary communication skills being much sought after in the academic environment, we set out to evaluate whether our university, TUM, is true to its responsibility of promoting these skills and to investigate how much interacting with peers from other fields on a purely social level contributes to honing them. Based on data gathered via a survey, we find that, with the exception of motivation by influence and power, personality traits do not differ significantly between several faculties and thus do not provide a basis for possible stereotypes. Considering contact diversity on each campus, spatial seclusion hinders exchange, but other factors might be in play as well. As evaluated using three self-defined contact diversity scales, we find that a high degree of such diversity is linked to increased knowledge transfer. How relevant TUM is as a locale for forming intra- and interdisciplinary contacts varies between different faculties, but university-related situations appear biased toward establishing own-field rather than other-field contacts. Overall, our study highlights the significance of social interaction for effective interdisciplinary communication and provides a basis for further research in order to facilitate interaction across field borders, particularly for students.

1. Motivation

Interdisciplinary cooperation skills are paramount in future research endeavors and, as such, imparting them to students should be a major concern of any university. Students can easily practice communicating and cooperating with representatives of different fields in interacting with them socially.

Even though including lectures from other courses of study seems to appeal to students, it is unclear whether this appeal reflects the existence of networks among students from different fields.

Past research having revealed significant differences in personality structure among students depending on their college major (cf. Balsamo, Lauriola & Saggino, 2012), we assumed that developing such networks may be hindered by stereotypes and differences in personality.

Thus, we investigate incidence and influencing factors of informal interdisciplinary interactions. Of particular interest is the degree to which TUM succeeds in providing an environment for students to develop their interdisciplinary skills.

2. Goals and Methods

2.1 Goals

In detail, we look at the following four questions:

Firstly, we consider personality traits in relation to fields of study: Do TUM students from different departments have noticeably deviating personality profiles, as was suggested in the literature? Could these differences be responsible for the development of stereotypes that hinder interdisciplinary communication?

Secondly, we determine the academic diversity of students' social circles: What is the academic background of the people with which TUM students interact? Since TUM focuses strongly on technology, does this leave a mark on its students' networking and everyday interactions?

Thirdly, we investigate the connection between students' social contacts and the extent to which they engage in interdisciplinary transfer of academic knowledge. In the context of this discussion, we interpreted the latter as a bidirectional process that comprises sharing as well as receiving knowledge, extensively and on a regular basis. We hypothesize that having more diverse social contacts is related to increased knowledge transfer.

Lastly, we determine how significant TUM is as a locale in which its students develop social contacts. We are interested in the link between how important this locale is for the individual student and, on the one hand, how diverse their social contacts are and, on the

other hand, how much they engage in interdisciplinary knowledge transfer. Moreover, we investigate what role TUM plays in social interactions between its several spatially separated campuses. Even more significantly, some faculties include interdisciplinary coursework in their curricula more than others, prompting us to attempt an evaluation of whether this engenders increased knowledge transfer and higher diversity of social contacts.

With these questions answered, we can confidently provide an assessment of the status quo at TUM and possibly derive further areas of interest yet uncharted by our study.

2.2 Methods

We designed a survey of 55 questions split into sections on social contacts, personality, and individual background. The first section of 25 self-designed questions concerned the participants' social contact with fellow students from their own and different fields of study, and the extent to which they engage in interdisciplinary knowledge transfer. This section also probed the situations in which respondents have made friends or acquaintances from their own and from other fields of study. The following section posed 20 questions taken from two scientific personality tests: We used all questions from the 10-item BFI-10 described by Rammstedt and John (2006). From the Big Five Personality test by Satow (2012), we chose only those items testing honesty in answering the questionnaire as well as the personality dimension of motivation by power and influence. The last section comprised six items of background variables. Additionally, we incorporated the 4-item identification measure from Doosje et al. (1995).

We piloted our survey with 28 members of the current year of the TUM: Junge Akademie. The initial version contained more questions, notably including the full version of the Big Five Personality test by Satow and the opportunity to leave extensive written feedback. We used this to test our survey and had our survey reviewed multiple times by scientific employees of TUM as well as by two professors in order to cut the questionnaire down to relevant items and to validate the survey.

Next, we distributed the survey among 656 students of TUM. Of these, 408 answered an online version of the survey, while 248 filled in a paper-based version distributed on TUM campuses. We targeted students from the chemistry (CH), mechanical engineering (ME) and economics (ECO) faculties by carrying out the latter paper-based distribution in localities where these students commonly spend their free time between lectures. This ensured a sufficient sample size of these faculties (CH: 83, ME: 84, ECO: 127 participants). Additionally, the online version afforded sufficient sample size of students from the faculties of computer science (CS), medicine (MED), and life sciences (WZW) (59, 134, and 157 participants, respectively). As such, all of TUM's main campuses were represented with sufficient sample size to make reliable statements.

For the evaluation, we defined three measures of social contact diversity. The first dimension was measured by how many different categories of academic background the individuals reported their conversation partners of the last week to have had, used as an approximation of average communication since we expected regular social contacts to be engaged in at least one conversation per week. The second dimension counted the number of situations in which the respondent reported having made friends or acquaintances within their own and within different academic backgrounds, the rationale being that a person who makes friends in manifold situations can be considered to have diverse social contacts. Finally, analyzing the diversity of social communication itself proved most difficult given the survey data. As a metric, we used the average number of reported conversational topic categories out of the list of four provided.

Based on these scales, we defined a "high-diversity" group comprising respondents who reported conversation partners of at least three distinct academic backgrounds, at least three different topics, and having established contacts in at least seven situations. The median values of the respective quantities were chosen as the limit. A complementary "low-diversity" group was defined as the group of respondents who scored less than the above limits in at least two of the three indicators.

3. Outcome and Discussion

3.1 Stereotypes

Regarding most personality dimensions, we did not observe any significant deviations; the exception was the dimension "motivation by influence and power." Since the overall mean of 12.8, on a scale of 6 to 24, and standard deviation of 3.41 obtained in our

survey does not significantly deviate from values given in the B5T reference documentation (12.9 and 3.57, respectively), the average TUM student does not appear to deviate from the average person. That said, the mean/SD values of the examined faculties are: 11.7/2.84 (CH); 11.9/3.3 (MED); 13.9/3.24 (ME); 13.5/3.97 (CS); 14.6/3.3 (ECO);12.06/3.08 (WZW); the maximum (ECO: 14.6) and minimum (CH: 11.7) deviate significantly by a value of 2.9. That ECO scores highest on this scale concurs with the stereotype of the economist being power-hungry and striving for control. As might be expected if we consider the primary motivation of the doctor to be helping and healing people, MED scored low in this dimension. Interestingly, CH scored slightly lower than even MED. Thus, in our sample group, real-life personality traits do not seem to be responsible for the development of stereotypes, with the possible exception of motivation by influence and power. Assuming that a link between the "motivation by influence and power" stereotype and personality does exist, the question remains whether the personality trait drives the prospective student to choose an according subject or whether the course of studies, once chosen, shapes the student's personality – or, indeed, whether there is a combination of both factors.

3.2 Networking@TUM

Figures 1 and 2 illustrate the academic background of participants' interaction partners from different faculties. It is evident that academic fields not offered at TUM are underrepresented. Moreover, the campus appears to be important in terms of whether students establish contacts outside of their own field: Respondents from the Weihenstephan campus, which almost exclusively harbors life science courses of study, interacted with students of an engineering or economics background significantly less than respondents from the Munich or Garching campuses, where the majority of engineering and economics students are located. While these differences may arise from geographic seclusion alone, they might also stem from factors related to the fields of study themselves: For instance, students of the chemistry and economics faculties communicate notably less than those of comparable sets of faculties. As mentioned in the previous section, these two faculties deviated most in terms of motivation by power and influence, which constitutes a possible reason for why these students may find themselves only moderately compatible.

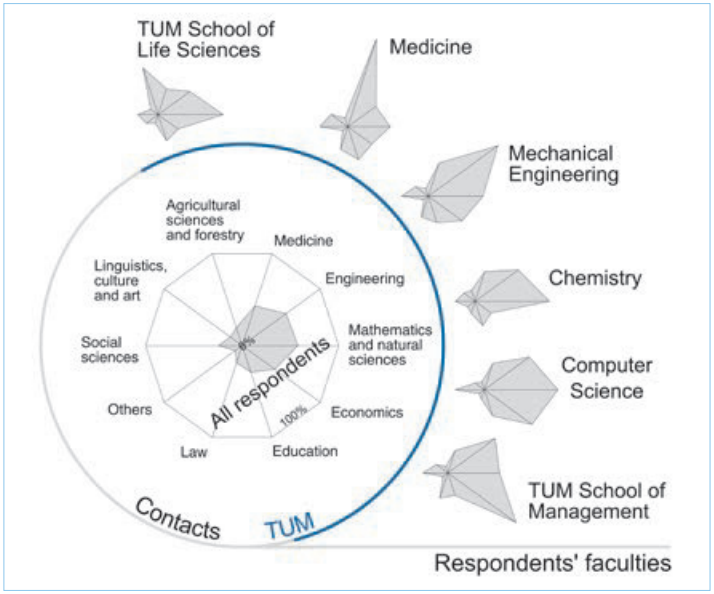

Figure 1: Percentage of respondents reporting conversations with people from different academic backgrounds, by faculty.

3.3 Are Knowledge Transfer and Diversity of Contacts Linked?

A major point of interest revolves around the following question: Is social interaction between friends from different academic backgrounds a setting in which academic knowledge is passed on? With data at hand to support this link between social interaction and knowledge transfer, how does social contact diversity impact the self-reported incidence and effectiveness of informal interdisciplinary teaching and learning?

We asked respondents how much they agreed with the statements "I pass on knowledge from my field to friends and acquaintances from different academic backgrounds" (i. e., teaching) and "I learn much about my friends' fields of study when interacting with them" (i. e., learning). We consider these two items to be of utmost relevance to our ultimate study goal, that being interdisciplinary knowledge transfer among friends in informal situations.

The results indicate that this informal teaching and learning indeed occurs: 72% of respondents affirmed this about teaching, and a majority (57%) affirmed it about learning. This confirms our hypothesis that social interactions among students do broaden their academic horizons.

Yet these results come with a caveat: Regarding content of conversation, only 42% of respondents reported academic topics as constituting an appreciable proportion of conversations with peers from different academic backgrounds. Apart from this, the considerable difference in the percentages of students who "teach" and of those who "learn" (72% vs. 57%) casts some doubt on how effective such informal interactions are as a vehicle of knowledge transfer.

To further investigate this, we considered the group who reported not learning from peers of different background. Compared to other students, they scored notably lower on all three of our diversity measures, yet did not significantly deviate in terms of personality traits. To elaborate, their contact diversity was lower by 0.53 (no learning/learning: 2.87/3.40 at *SD = 1.8*); the diversity of conversation topics, by 0.72 (4.7/5.42, *SD = 1.68*); and the number of different situations to have made friends and acquaintances, by

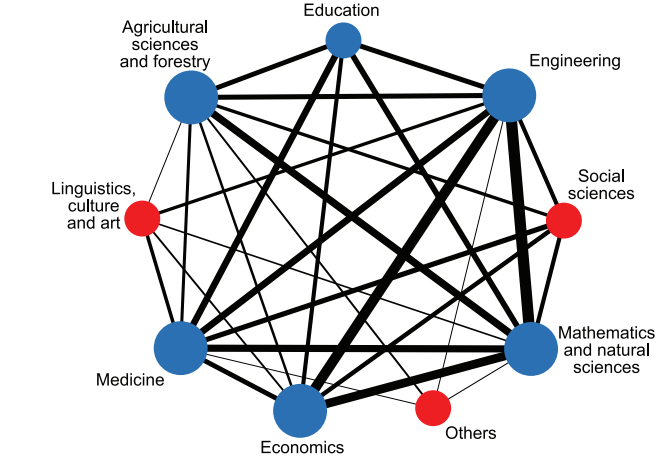

Figure 2: Intensity of interaction between different fields of study as measured by the number of contacts reported by TUM students.

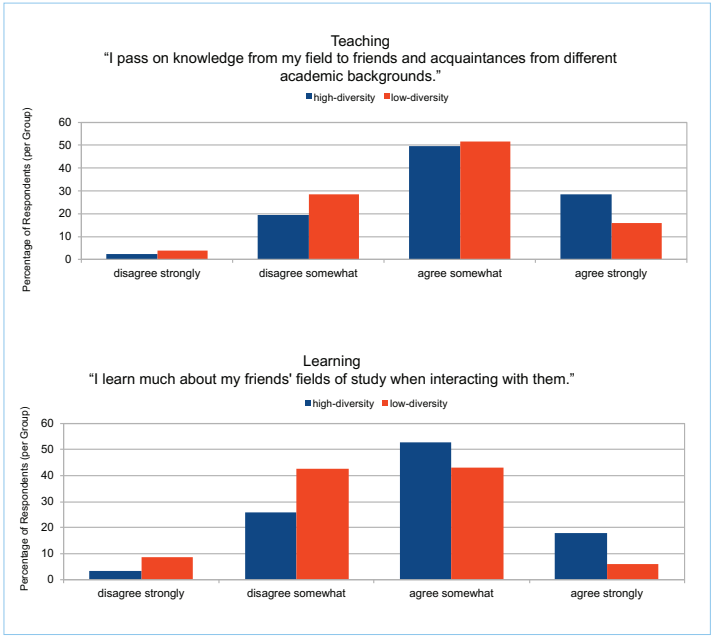

Figure 3: Response pattern to the questions of passing on and acquiring knowledge in interdisciplinary social contact among the high- and the low-diversity group.

0.46 (6.18/6.64, *SD = 1.92*). This difference in diversity is greater than between different departments and indicates that academic diversity of social contacts is an important factor in informal interdisciplinary learning.

Next, we took a closer look at the high- and low-diversity groups defined above in "Methods" to find out whether those students differ notably in their behavior regarding interdisciplinary knowledge transfer. In line with our hypothesis, the high-diversity group of 123 students scored higher in both "teaching" and "learning" than the low-diversity group of 207 (see Figure 3). The difference with regard to "teaching" was apparent in the frequency with which the "agree strongly" answer was given to the question of sharing academic knowledge with interdisciplinary peers. Regarding the "learning" part, the proportion of participants in the low-diversity group who responded with "disagree somewhat" to "I learn a lot from my interdisciplinary peers" (42.5%) is twice as large as in the high-diversity group (26.0%).

Midterm evaluation workshop

3.4 Role of the University

Thus far, one question remains: To what extent does the university environment affect social contact diversity and therefore informal interdisciplinary knowledge transfer as well?

The most direct way to put the university into the picture is to consider how university-associated situations fare when overall situational diversity decreases.

Interestingly, students who report not talking to their interdisciplinary peers about their subject report a situational diversity lower by 0.43 compared to those who do (6.14 vs. 6.57), and we observe a larger difference in diversity of private or non-university-related situations (5.02 vs. 5.53) than university-related ones (4.55 vs. 4.92). On average, the respondents reported having made friends or acquaintances from their own field of study in 2.92 out of the five university-related situations they were asked about. For interdisciplinary contacts, the average was 1.87 out of the five. When offered a pool of five situations not related to university, these figures changed to 2.70 and 2.65 for intradisciplinary and interdisciplinary contacts, respectively.

For intradisciplinary contacts, the mean ratio of the reported number of situations related and not related to university was 1.08 (calculated from the means); for interdisciplinary contacts, 0.7. This indicates that contacts established at university are biased towards the students' own fields. This, of course, is expected given the academic purpose of studying as well as the large proportion of unique compulsory lectures for many courses.

However, subdividing the study's participants revealed differences between the faculties. With regard to intradisciplinary contacts, said ratio lay in the range of 0.96 (medicine) to 1.22 (computer science) for all 6 faculties of interest. For interdisciplinary contacts, however, the faculty of medicine scored a ratio of only 0.41 while the other five ranged from 0.74 (economics) to 0.87 (computer science).

Analysis grouped by campus instead of faculty yielded similar results. The same applied if the ratios were calculated for every single respondent and then averaged over the respective groups.

These findings suggest that the medicine department offers fewer opportunities for students to create contacts with peers from other fields than do other faculties, or they are engaged in such opportunities less often. In contrast, the computer science department seems to be well connected to the other disciplines. This may be due to various applications of information technology as a tool throughout all modern sciences, but note that the numbers may be biased by the faculties of mathematics and computer science sharing one building at the Garching campus, which probably engenders many contacts between these students. The data gathered in the present study does not allow us to quantify this possible effect.

4. Summary and Future Goals

Contrary to our expectations after studying the literature, we find little to no connection between a student's personality and their faculty. Therefore, distinct personality traits cannot be responsible for stereotypes that students may harbor about other faculties.
TUM, as a technical university, clearly leaves its mark on students' social circles in the sense that its students have little contact with students from fields not represented at TUM. Moreover, interaction with fields not represented at one's own campus is also less likely. What causes these shortcomings should be further investigated, and if they are related to institutional factors within our university, they should be remedied since discouraging contact with students of other fields negatively impacts educational quality.

We constructed three measures of diversity, all of which were found to be positively related to successful knowledge transfer. This confirms that our approach of investigating the social aspect of interdisciplinarity among students is valid.

We found that, regarding faculties, the university is not equally significant for its students' social contacts. This deviation is larger for social contacts outside the students' own fields.

When investigating whether students learn from their interdisciplinary peers, we asked respondents to self-evaluate the question "do you learn from your them about their fields" – but do students really learn about different fields from informal interaction? A future study could analyze actually retained knowledge of participants who report learning from their peers.

Future research should further take into account the exact number of contacts established at university as opposed to other situations. Additionally, since this study exclusively uses information obtained from TUM students, a comparison between different universities would be interesting to contextualize our findings.

In conclusion, we have established that having diverse social contacts is linked to increased knowledge transfer across the borders of faculties – the university providing ample opportunity for students to interact with students from other fields could thus be a vehicle for interdisciplinary communication skills.

Acknowledgments

No project can be carried out alone. Therefore, we would like to thank all who supported us and our ideas during the challenging working process. We are indebted to our mentors Prof. Dr. Pascal Berberat, Prof. Dr. Christina Raasch and Prof. Dr. Klaus Mainzer, without whose specialized knowledge our project would have been impossible.

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Last but not least, we thank the whole team of the TUM: Junge Akademie, especially Prof. Dr. Gerhard Müller, Peter Finger and Maria Hannecker, and all current and former members of the TUM: Junge Akademie who offered help and advice.

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