# Globally-required Abilities:
# The result of 2014 Competence Survey

2015/12/20

GLU12 Universities Tuning Working Group

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## 1. Introduction

The Tuning Working Group, established in December 2013 under the Education Reform and Promotion Committee, has discussed the internationalization of university education, the restructuring of curricula and the systematization of syllabus according to international standards, the development of credit transfer system, and possible implementation of Tuning initiative. The Tuning Working Group particularly focused on the significance of improving the comparability of the university curriculum and subjects as well as the mobility of students and researchers. On the course of these activities, Furthermore, the Tuning Working Group conducted a "competence survey" from 2014 to 2015, for the first time in Japan, following Tuning Pilot Studies conducted in Europe and other parts of the world with advanced Tuning practices. The primary aim of the survey was to establish an interactive base for Japanese universities so that we could collaborate with world Tuning networks in the design of an internationally compatible curriculum.

The competence survey, which comprised questions to ask knowledge and skills that are expected to be developed through university education, was distributed among students, academics, graduates, and employers. The following specific areas were identified from the survey: 1) the composition of specific definitions for competences acquired from university education subject areas; 2) the similarities and differences between the perceptions of competence for each subject area from different stakeholders; 3) the fulfillment of the university's accountability and designing curricula that reflect the demands of the society and economy, curriculum improvement, and education content development; 4) the strength and characteristics of each university; 5) the improvement of each subject's compatibility and equivalency by referring to the common framework used by the tuning world network, which enabled the Tuning Working Group to compare the results with those of other regions; 6) the improvement of academic credibility of a joint degree or a dual degree by repeating the processes above.

Competence surveys are conducted by universities and academics as a voluntary initiative and do not intend to bring "normalization" and "standardization." The study aims to create opportunities for each university to recognize and enforce its characteristics and improve mobility and international competitiveness. The Tuning Working Group will develop Tuning with partner universities abroad. The Tuning Working Group aims to achieve a high-level curriculum adjustment, with the outcome being advertised domestically and internationally.

The Tuning Working Group received guidance and help from many people during the planning and implementation of the survey. We would like to thank the academics and staff from the participant universities who took their time to participate in the survey. Furthermore, we would like to thank the students, academics, graduates, and employers who responded to the survey. We hope that the results of this survey will be useful and informative for further enhancement of higher education in Japan.

2. Survey Outline

Period: 3 months from January 2015 to March 2015

Methods: Questionnaires

Subject areas: the six subject areas stated below were targeted.

- Natural Sciences: Four subject areas (Physics, Chemistry, Mechanical Engineering, Civil Engineering)
- Humanities: One subject area (History)
- Social Science: One subject area (Business)

Participants: The following groups of people from the participating universities (two to five universities for each subject area)

1. Students
2. Academicss
3. Graduates
4. Private companies where graduates work (employers)

Profiles of the participating universities and participants are indicated in the following tables.

Table 1 Subject areas and participating university

| Subject areas | Participating universities |
|---|---|
| Physics | University0, University1, University4, University6, University10 |
| Chemistry | University1, University4, University6 |
| Mechanical Engineering | University0, University1, University4, University6 |
| Civil Engineering | University1, University4, University6 |
| History | University1, University4, University7 |
| Business | University2, University7 |

The above universities are selected from the 12 member universities of the Tuning Working Group; Osaka University, Kyushu University, Kyoto University, Keio University, University of Tsukuba, The University of Tokyo, Tokyo Institute of Technology, Tohoku University, Nagoya University, Hitotsubashi University, Hokkaido University, and Waseda University.

Table 2 Participants

| Participants | Profile |
|---|---|
| Students | 3rd and 4th-year undergraduates, MA/Ph.D. students |
| Academics | Academics from participating universities |
| Graduates | Graduates within five years (graduate students who continued their study at the same university as their undergraduate study are categorized as students) |
| Employers | Private companies where graduates from the participating universities work |

Overview of the questionnaire:

Two questionnaires focused on the following two competences were prepared.

- Generic Competences
- Subject-specific competences

Stakeholders and questionnaires:

- Students, academics, graduates: two questionnaires (one for generic comptences and one for subject-specific competence)
- Employers: seven questionnaires (one for generic competences and six for subject-specific competences)

Questionnaire outline:

Table 3 indicates the number of questions in each questionnaire. History has 33 questions, which are ten questions more than that of the other subject areas.

Table 3 Number of questions in each subject area

| Generic/ Subject-Specific | | Number of questions | Ranking | Comments |
|---|---|---|---|---|
| Generic | | 31 | 10 | No |
| Subject-Specific | Physics | 23 | 10 | Yes |
| | Chemistry | 24 | 10 | Yes |
| | Mechanical Engineering | 24 | 10 | Yes |
| | Civil Engineering | 24 | 10 | Yes |
| | History | 33 | 10 | Yes |
| | Business | 24 | 10 | Yes |

Response rate：

49,576 questionnaires (Generic 22,083 and 6 Subject-specific 27,493 in total) were distributed among 22,083 people. We received 5,286 responses, a response rate of 10.66%. The following was the response rate for each group: students 18.02%, academics 23.74%, graduates 3.67%, employers 2.56%. Table 4 demonstratese the response rate (Table 4) and the response rate for each subject area (Table 5).

Table 4 Response rate

| | Number of people | Number of questionnaires | Number of responses | Response rate |
|---|---|---|---|---|
| Students | 10,319 | 20,638 | 3,718 | 18.02% |
| Academics | 1,470 | 2,940 | 698 | 23.74% |
| Graduates | 9,212 | 18,424 | 676 | 3.67% |
| Employers | 1,082 | 7,574 | 194 | 2.56% |
| Total | 22,083 | 49,576 | 52,86 | 10.66% |

Table 5　Subject area・University Response rates

| | Subjects Groups | Generic | Physics | Chemistry | Mech. Eng. | Civil Eng. | History | Business | Total |
|---|---|---|---|---|---|---|---|---|---|
| Number of people | Students | 10,319 | 1,865 | 2,095 | 2,939 | 1,077 | 2,106 | 237 | 20638 |
| | Academics | 1,470 | 325 | 375 | 407 | 122 | 159 | 82 | 2940 |
| | Graduates | 9,212 | 1,799 | 1,099 | 3,579 | 262 | 2,058 | 415 | 18424 |
| | Employers | 1,082 | 1,082 | 1,082 | 1,082 | 1,082 | 1,082 | 1082 | 7574 |
| | Total | 22,083 | 5,071 | 4,651 | 8,007 | 2,543 | 5,405 | 1816 | 49576 |
| Number of responses | Subjects Groups | Generic | Physics | Chemistry | Mech. Eng. | Civil Eng. | History | Business | Total |
| | Students | 1,859 | 504 | 331 | 601 | 191 | 153 | 79 | 3718 |
| | Academics | 349 | 89 | 89 | 100 | 40 | 19 | 12 | 698 |
| | Graduates | 338 | 48 | 41 | 148 | 67 | 24 | 10 | 676 |
| | Employers | 41 | 24 | 28 | 24 | 24 | 22 | 31 | 194 |
| | Total | 2,587 | 665 | 489 | 873 | 322 | 218 | 132 | 5286 |
| Response rate | Subjects Groups | Generic | Physics | Chemistry | Mech. Eng. | Civil Eng. | History | Business | Average |
| | Students | 18.02% | 27.02% | 15.80% | 20.45% | 17.73% | 7.26% | 33.33 % | 18.02% |
| | Academics | 23.74% | 27.38% | 23.73% | 24.57% | 32.79% | 11.95% | 14.63 % | 23.74% |
| | Graduates | 3.67% | 2.67% | 3.73% | 4.14% | 25.57% | 1.17% | 2.41% | 3.67% |
| | Employers | 3.79% | 2.22% | 2.59% | 2.22% | 2.22% | 2.03% | 2.87% | 2.56% |
| | Total | 12.30% | 14.82% | 11.46% | 12.84% | 19.58% | 5.60% | 13.31 % | 10.66% |

Valid Response：

The following criteria were used o determine a valid response.

1. Importance
   - Answered more than 50% of the questions→valid
   - Answered less than 50% of the questions→invalid
2. Ranking
   - Answered top 5→valid
   - Answered the consecutive numbers (1 to 10) as ranking→invalid

We considered an answer invalid when it did not meet any criteria for either the generic competences or the subject-specific competences. The overall number of valid responses was 2674. Table 6 demonstrates the number of valid responses in each subject area at each university. Please note that in some parts there were no responses or very few responses.

Table 6 Number of valid response in each subject area

| Physics | Specific | | | Generic | | |
|---|---|---|---|---|---|---|
| | Students | Academics | Graduates | Students | Academics | Graduates |
| Univ.0 | 59 | 10 | 11 | 60 | 11 | 11 |
| Univ.1 | 70 | 30 | 40 | 70 | 28 | 40 |
| Univ.4 | 216 | 17 | 0 | 215 | 17 | 0 |
| Univ.6 | 17 | 5 | 0 | 17 | 5 | 0 |
| Univ.10 | 117 | 21 | 0 | 118 | 21 | 0 |
| Total | 479 | 83 | 51 | 480 | 82 | 51 |

| Civil | Specific | | | Generic | | |
|---|---|---|---|---|---|---|
| | Students | Academics | Graduates | Students | Academics | Graduates |
| Univ.1 | 34 | 12 | 23 | 37 | 14 | 26 |
| Univ.4 | 98 | 9 | 0 | 86 | 9 | 0 |
| Univ.6 | 50 | 14 | 39 | 52 | 12 | 39 |
| Total | 182 | 35 | 62 | 175 | 35 | 65 |

| Chemistry | Specific | | | Generic | | |
|---|---|---|---|---|---|---|
| | Students | Academics | Graduates | Students | Academics | Graduates |
| Univ.1 | 80 | 64 | 37 | 82 | 67 | 38 |
| Univ.4 | 237 | 13 | 0 | 217 | 12 | 0 |
| Univ.6 | 14 | 7 | 0 | 15 | 8 | 0 |
| Total | 331 | 84 | 37 | 314 | 87 | 38 |

| History | Specific | | | Generic | | |
|---|---|---|---|---|---|---|
| | Students | Academics | Graduates | Students | Academics | Graduates |
| Univ.1 | 13 | 4 | 12 | 13 | 4 | 12 |
| Univ.4 | 35 | 5 | 0 | 37 | 5 | 0 |
| Univ.7 | 89 | 10 | 10 | 91 | 10 | 10 |
| Total | 137 | 19 | 22 | 141 | 19 | 22 |

| Mechanical | Specific | | | Generic | | |
|---|---|---|---|---|---|---|
| | Students | Academics | Graduates | Students | Academics | Graduates |
| Univ.0 | 230 | 17 | 2 | 233 | 16 | 2 |
| Univ.1 | 111 | 49 | 85 | 113 | 49 | 88 |
| Univ.4 | 151 | 10 | 0 | 148 | 10 | 0 |
| Univ.6 | 65 | 15 | 47 | 67 | 14 | 52 |
| Total | 557 | 91 | 134 | 561 | 89 | 142 |

| Business | Specific | | | Generic | | |
|---|---|---|---|---|---|---|
| | Students | Academics | Graduates | Students | Academics | Graduates |
| Univ.2 | 21 | 9 | 0 | 22 | 8 | 0 |
| Univ.7 | 56 | 3 | 10 | 56 | 3 | 10 |
| Total | 77 | 12 | 10 | 78 | 11 | 10 |

3. Methodology

Tthe following methods were adopted: 1) Basic calculation and 2) Correlation comparison. The aim of the former was to identify the competences that each stakeholder considered significant, and the latter aimed to identify the degree of consensus on the significance of each competence among the different stakeholders.

1) General Analysis

- Importance: Compare the average of each competence's importance
- Ranking: Compare the weighted ranking index

2) Correlation comparison

- Compare the correlation coefficients, which were based on the weighted ranking index between different stakeholders or different universities

■ The weighted ranking index

The weighted ranking index for each question was calculated using the following formula.

$$W = \frac{\#No.1\times 10+\#No.2\times 9+\#No.3\times 8\cdots+\#No.10\times 1}{\sum\left[\#No.1\times 10+\#No.2\times 9+\#No.3\times 8\cdots+\#No.10\times 1\right]}$$

The numerator (#No.1, #No.2, #No.3) represents the sum of the number of people who selected the competence as the first, second, and third, respectively, and the denominator represents the sum of all weighted competences.

■ Correlation comparison

The Pearson correlation coefficient was applied. Therefore, when the correlation coefficient is represented as "r". it means $|r| \leqq 1$ with correlations being stronger when r is close to 1.

4. Summary of the analysis results

In the following summary, the results of the general analysis of the subject-specific competences are discussed first, followed by a discussion of the correlation analysis. For the subject area analysis, we focus on physics. Then we analyze the generic competences and discuss the results. Finally, we examine the results and the challenges.

4.1 Subject-Specific competences

(1) General Analysis：

The average of the importance rate (Figure 1) showed that there was little difference among stakeholders

for the six competences (5. ethical awareness; 12. professional skills; 13. inter-disciplinary attitude/abilities; 21. specific communication skills; 15. managing skills; 23. teaching ability). However, employers tend to evaluate other competences to be lower than the other stakeholders. This tendency was observed in all the five subject areas except business.

For the weighted ranking index (physics) (Figure 2), 1. Ability to learn was highly evaluated. Some competences such as 17. Modeling skills and 21. Specific communication skills were differently evaluated by stakeholders. Ranking according to the weighted ranking index indicated that academics ranked 1. Ability to learn as second, and the others ranked competence as first. On the other hand, students, academics, and graduates ranked 17. Modeling skills either third or fourth, whereas employers ranked this competence as fourteenth.

Following are the results of inter-university comparison with each stakeholder (students, academics, graduates) for physics (Figure 3, Figure 4, Figure 5, respectively). First of all, the tendencies differed depending on the university. University 4's students ranked 4. Deep knowledge & understanding lower than the other universities, and University 6's students ranked 14. Literature search skills and 16. Mathematical skills higher than the others. A comparison of the result of the academics indicated the greater difference. For instance, University 6 ranked 1. Ability to learn, 6. Estimation skills, 7. Experimental skills highly whereas University 4 ranked 16. Mathematical skills and 17. Modeling skills highly. For graduates, there was the little difference when comparing the two universities.

(2) Comparison of correlation coefficient

For physics, the correlation comparison between stakeholders (Table 8) indicated that pairs that do not include employers, such as students and academics, had more than a 0.85 correlation coefficient. This was higher than the correlation coefficient in pairs that included employers. Figure 6 demonstrates the result of correlation by subject areas and Figure 7 shows the result of the correlation for University 1. The results of the correlation by subject areas from all the universities indicated that an employer/academic pair had the lowest correlation except for business and chemistry. (The correlation between employers and academics was 0.5 in physics and 0.3 in history.) Except for the student/graduate pairs, history had a low correlation in the different groups. The correlation between employers and academics by University (Figure 8) showed that the correlations differed greatly by subject areas although the universities also showed some differences. As shown in Figure 9, there was the little difference by the university in the student responses. As demonstrated in Figure 10, the academics indicated some differences, such as the difference in physics between University 4 and University 6.

4.2 Generic competences

(1) General Analysis:

The average rate of importance (Figure 11) showed that employers did not evaluate generic competences

lower than the others, unlike the subject-specific competences. However, employers regarded interpersonal skills such as 16. Ability to work in a team and 17. Interpersonal and interaction skills highly while they did not consider 8. Ability to undertake research at an appropriate level and 6. Ability to communicate in native language highly. In Figure 12, regarding the weighted ranking index of 20. Respect for diversity, academics and employers had a significant difference. While the academics evaluated 1. Ability for abstract thinking and 4. Knowledge of the subject highly, they did not rank interpersonal skills highly. In the ranking for each competence (Table 9), the academics ranked 4. Knowledge of the subject as second, but this was ranked 16th by employers. In contrast, 17. interpersonal skill was ranked 20th by academics, but employers ranked it first. There was no distinctive difference in the weighted approval rate from students (Figure 13), academics (Figure 14), and graduates (Figure 15) between the seven universities.

A comparison of the correlation among the different groups (Table 10) indicated a result smilar to the subject-specific competences. For instance, the correlation between the groups that excluded employers shows a higher correlation than the pairs that include employers. Correlations between the subject areas from all universities showed that pairs that included employers had lower correlations than the other pairs (Figure 16). The results for University 1 by subject area had a similar tendency compared to all the universities (Figure 17).

For the correlations between the different universities by subject area, the differences between the universities and subject areas were limited for students (Figure 19) and academics (Figure 20) because of the small number of responses.

## 5. Conclusion and future challenges

In this research, we analyzed people's perception of the importance of subject-specific competences and generic competences. From this research, the following conclusions were drawn.

1. Every group (students, academics, graduates, employers) evaluated learning ability highly. In physics, as pointed out, employers generally evaluate communication competency higher than the groups related to the university. However, all groups including employers answered that learning ability (1. Ability to learn) was the most important ability.

2. The recognition of what were important competences differed greatly between academics, students and employers.

- Employers tended to evaluate subject-specific competences lower compared to university related groups. For example, in physics, employers evaluated all other competences lower than university related groups, except for six competences out of the 23, which included "communication skill" and "management ability." This tendency was observed in all five subject areas except business. However, this was not the case for the generic competences.

- In some subject areas, academics and employers measure important subject-specific competences differently. In four subject areas (Physics, Mechanical Engineering, Civil Engineering, and History), the correlation between employers and academics was the lowest of the four group pairs. The correlation was especially low in physics (0.5) and history (0.3).

- Academics and employers measure important generic competences differently. There was little disparity among the different subject areas and universities for the generic competences. However, different groups had different priorities. For instance, academics prioritized analysis, knowledge and creativity, whereas employers considered teamwork and interpersonal skills important.

3. Each university had distinctive priorities for the important competencies

In the result for the weighted ranking index in Physics, University 4 considered Mathematical skills and Modeling skills important while University 6 believed Estimation skills and Experimental skills important. Furthermore, students and academics from University 4 and University 6 answered differently from the other universities.

Future Challenges

The limitation of the survey was caused from the low response rates, as the response rates from employers and graduates were as low as below 5 per cent. This low response rate influenced a valid analysis result as the number of the people who answered gave limited elaborative analysis. Therefore, we need to reconsider the survey method. Further, our analysis focused on quantitative analysis, but in future analysis, we can interpret the distinctive tendency of each subject area through discussions with subject area experts.

Figure 1 The average rate of importance; subject specific competences in physics

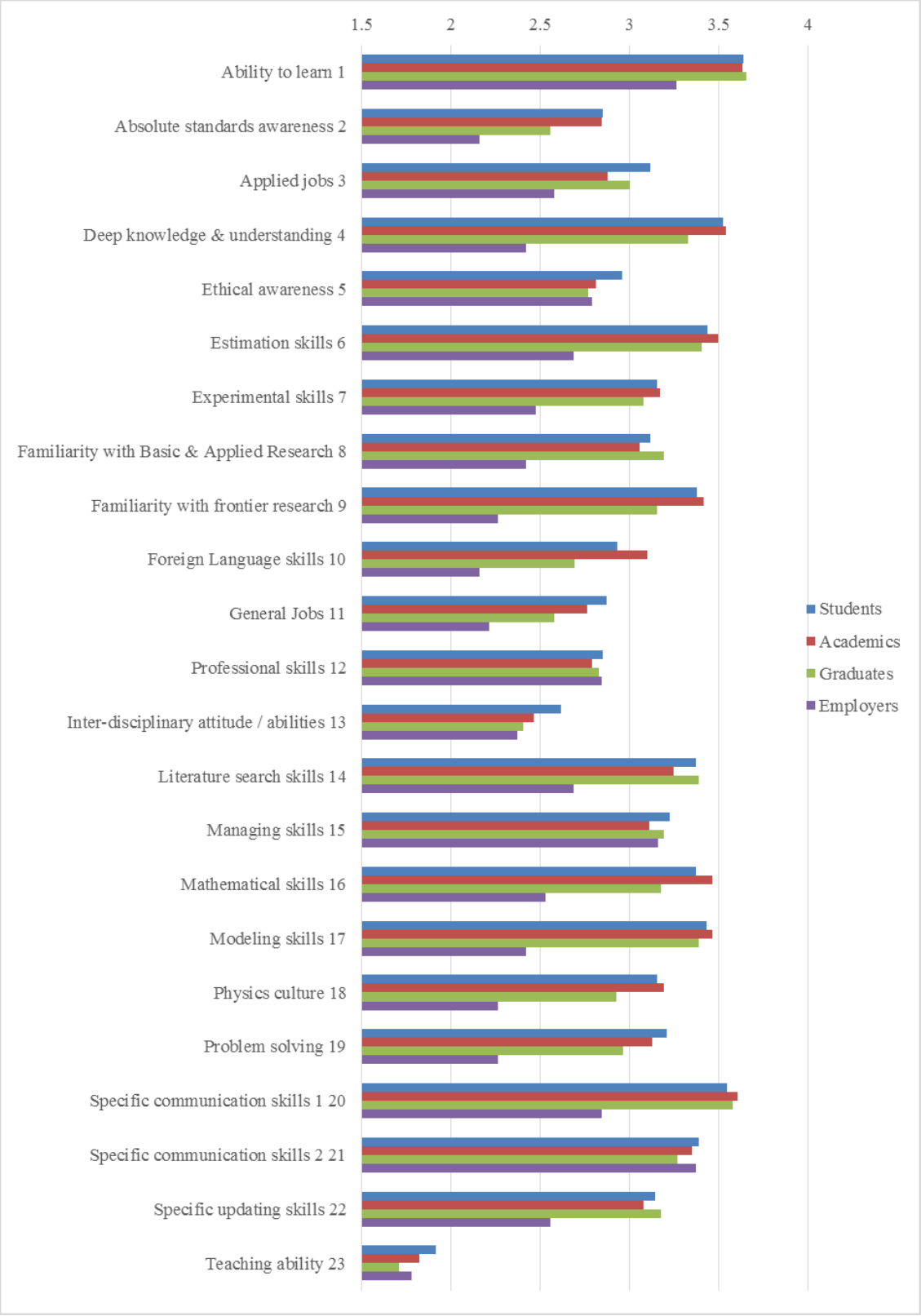


Figure 2 The ratio of the weighted ranking index; subject specific competences in physics

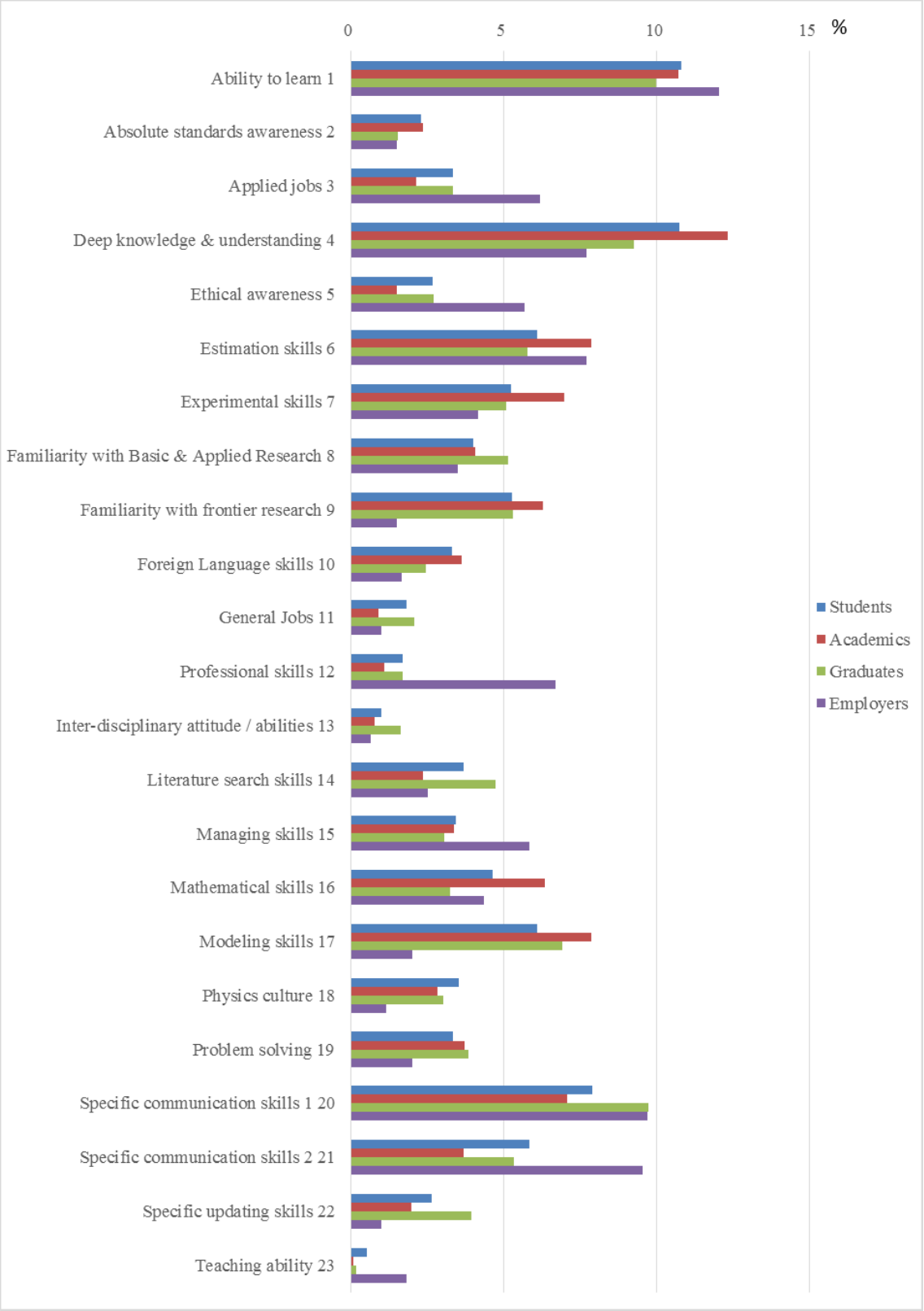


Table 7 Ranking according to the weighted ranking index; subject-specific competences in physics

| No. | Competence | Students | Academics | Graduates | Employers |
|---|---|---|---|---|---|
| 1 | Ability to learn 1 | 1 | 2 | 1 | 1 |
| 2 | Absolute standards awareness 2 | 19 | 15 | 22 | 18 |
| 3 | Applied jobs 3 | 14 | 17 | 13 | 7 |
| 4 | Deep knowledge & understanding 4 | 2 | 1 | 3 | 4 |
| 5 | Ethical awareness 5 | 17 | 19 | 17 | 9 |
| 6 | Estimation skills 6 | 5 | 3 | 5 | 4 |
| 7 | Experimental skills 7 | 8 | 6 | 9 | 11 |
| 8 | Familiarity with Basic & Applied Research 8 | 10 | 9 | 8 | 12 |
| 9 | Familiarity with frontier research 9 | 7 | 8 | 7 | 18 |
| 10 | Foreign Language skills 10 | 16 | 12 | 18 | 17 |
| 11 | General Jobs 11 | 20 | 21 | 19 | 21 |
| 12 | Professional skills 12 | 21 | 20 | 20 | 6 |
| 13 | Inter-disciplinary attitude / abilities 13 | 22 | 22 | 21 | 23 |
| 14 | Literature search skills 14 | 11 | 16 | 10 | 13 |
| 15 | Managing skills 15 | 13 | 13 | 15 | 8 |
| 16 | Mathematical skills 16 | 9 | 7 | 14 | 10 |
| 17 | Modeling skills 17 | 4 | 3 | 4 | 14 |
| 18 | Physics culture 18 | 12 | 14 | 16 | 20 |
| 19 | Problem solving 19 | 15 | 10 | 12 | 14 |
| 20 | Specific communication skills 1 20 | 3 | 5 | 2 | 2 |
| 21 | Specific communication skills 2 21 | 6 | 11 | 6 | 3 |
| 22 | Specific updating skills 22 | 18 | 18 | 11 | 21 |
| 23 | Teaching ability 23 | 23 | 23 | 23 | 16 |

Figure 3 Inter-university comparison by students; the weighted ranking index in physics

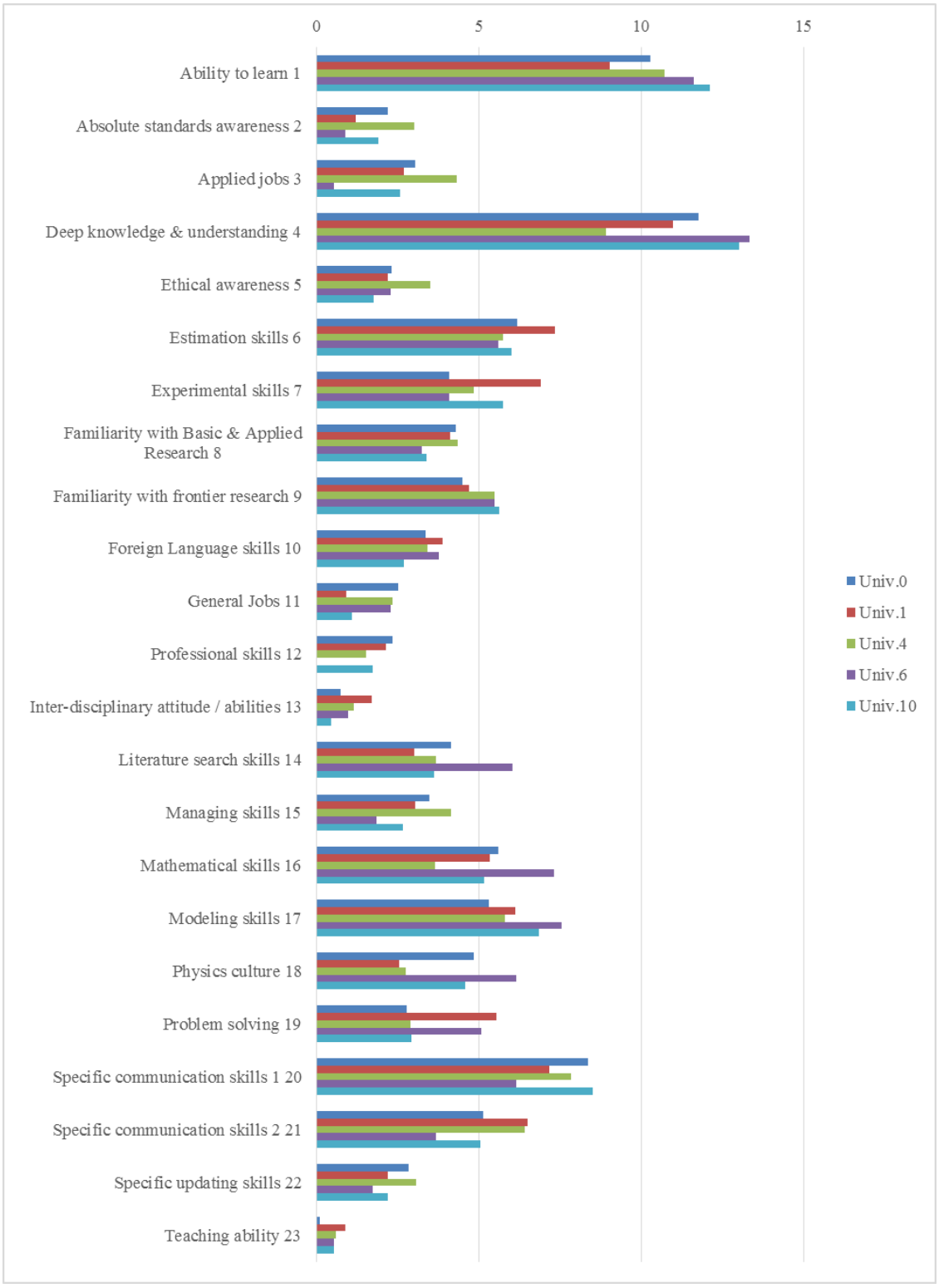


Figure 4 Inter-university comparison by academics; the weighted ranking index in physics

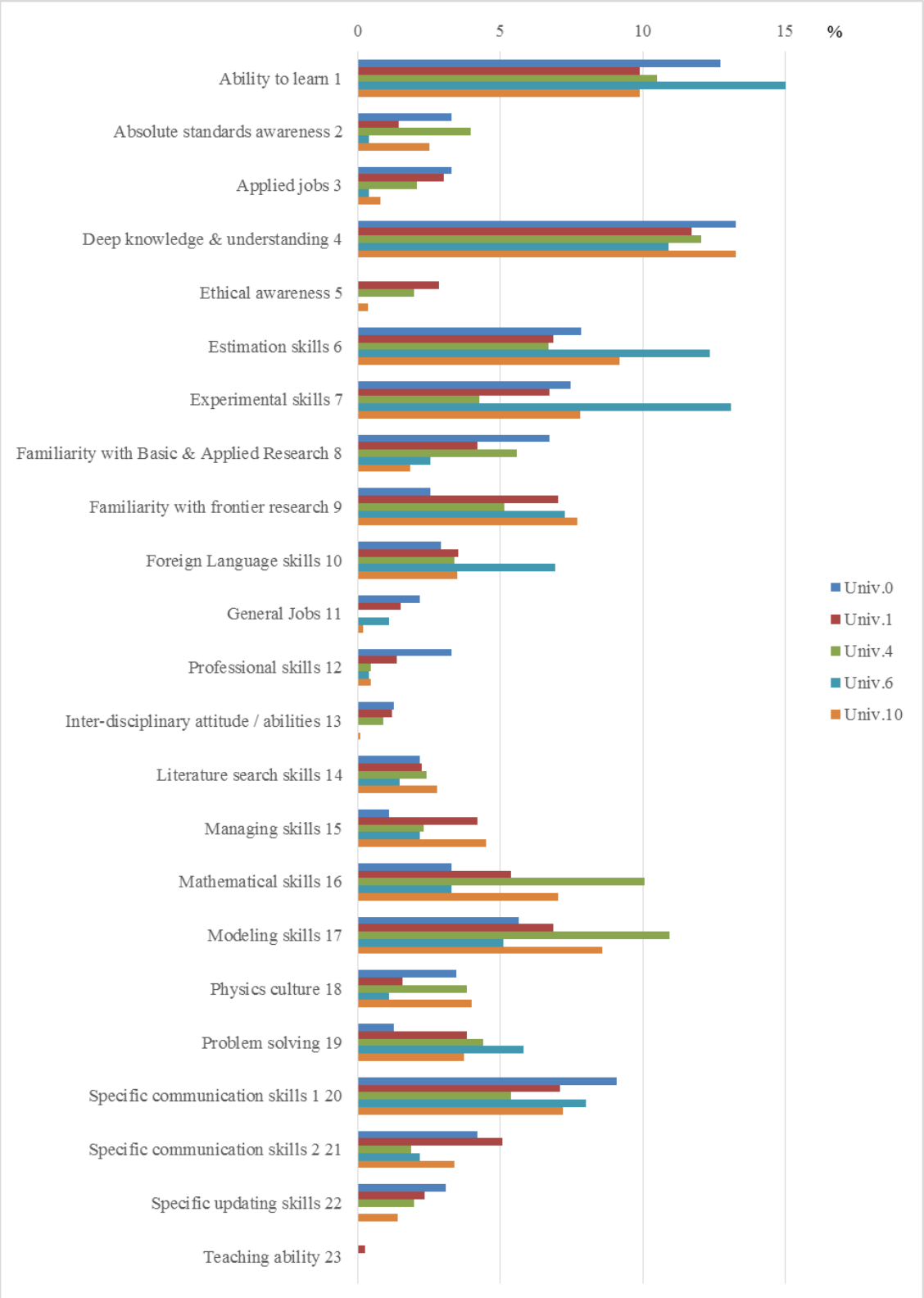


Figure 5 Inter-university comparison by graduates; subject-specific competences, the weighted ranking index in physics

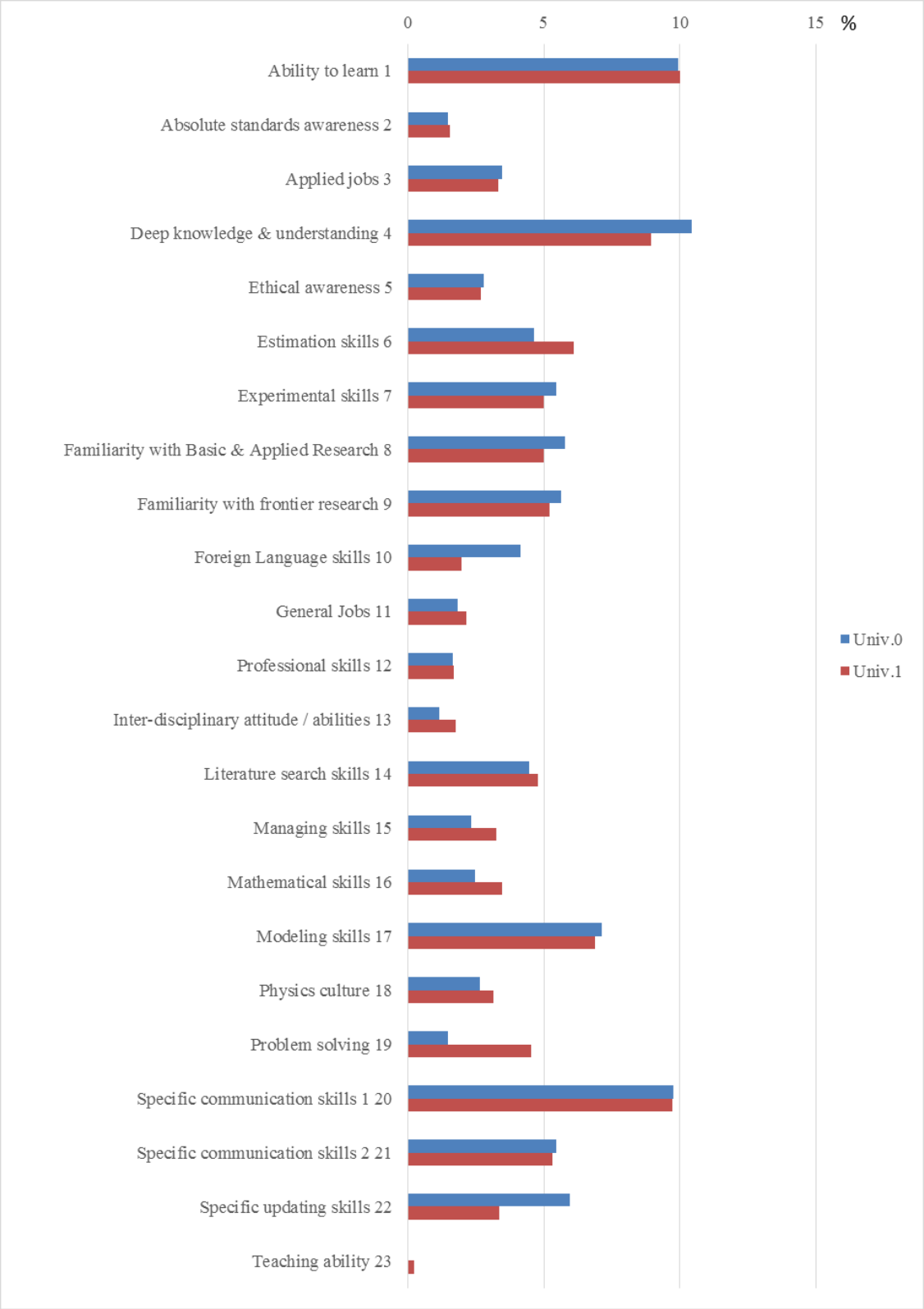


Table 8 Comparison of correlation coefficients between stakeholders in physics

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | | | |
| Academics | 0.95 | 1 | | |
| Graduates | 0.96 | 0.87 | 1 | |
| Employers | 0.70 | 0.54 | 0.64 | 1 |

Figure 6 Comparison of correlation coefficients by subject areas

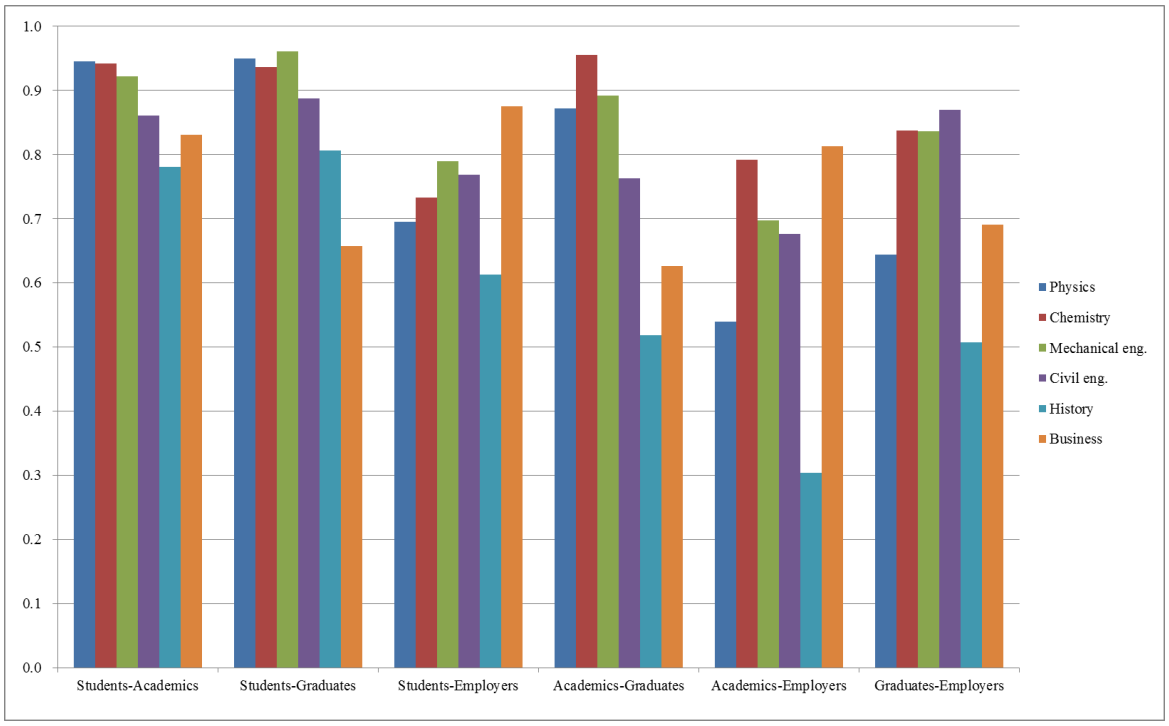


Figure 7 Comparison of correlation coefficients for Univ.1

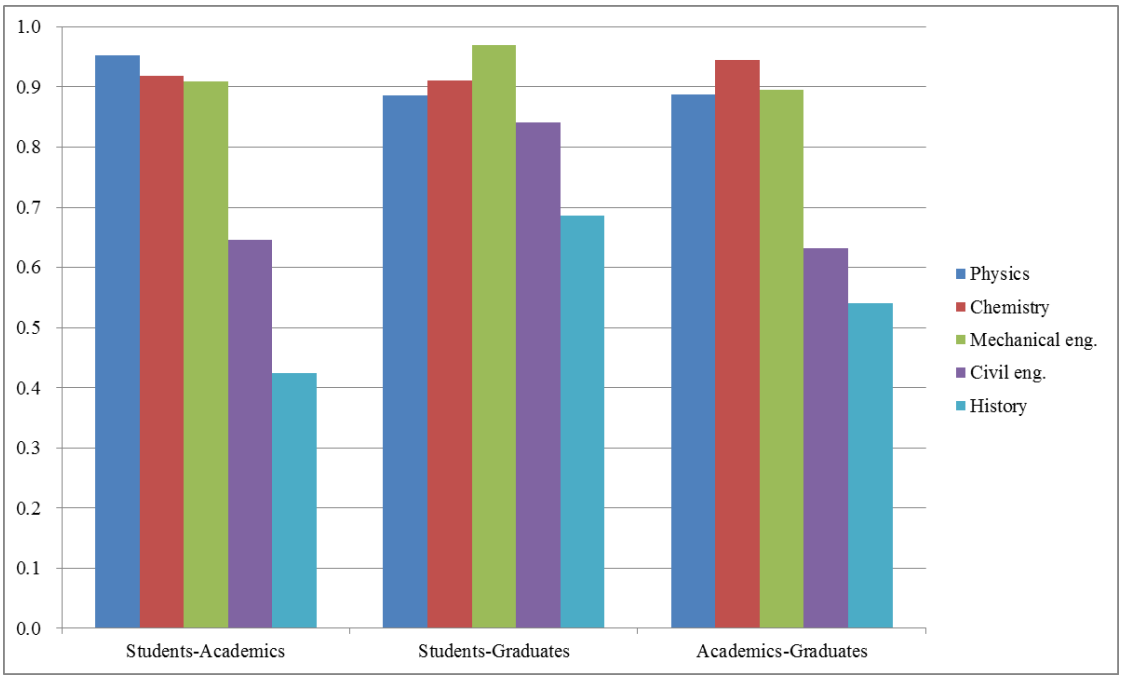



Figure 8 Correlation coefficients between employers and academics

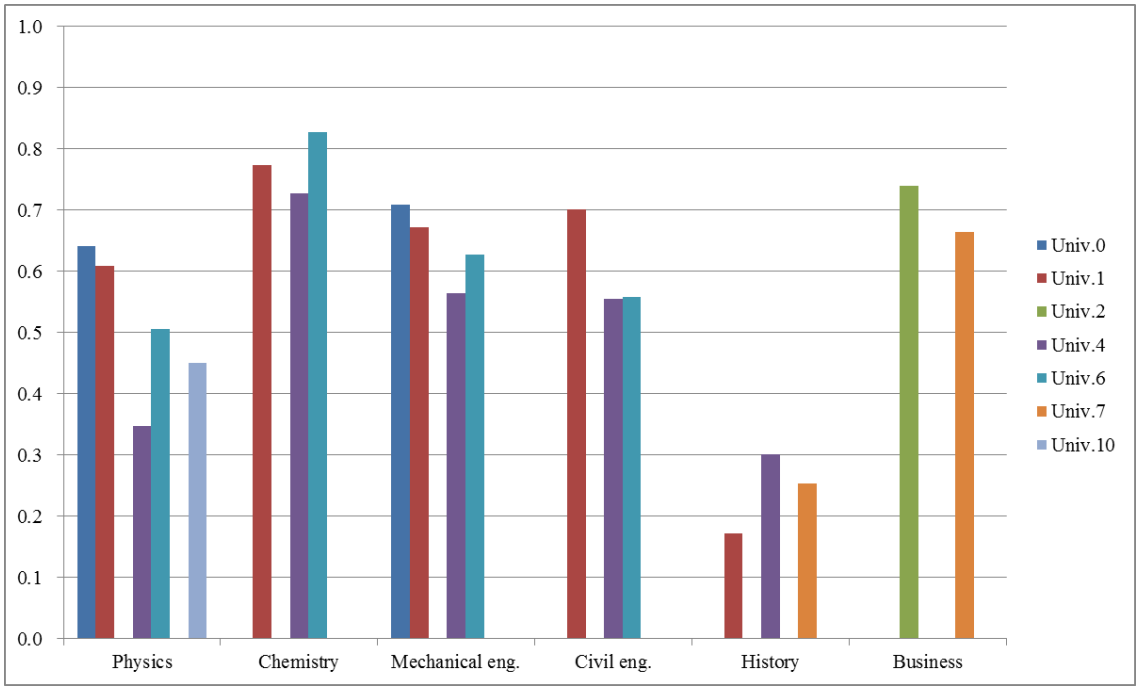


Figure 9 Inter-university comparison of correlation coefficients; students

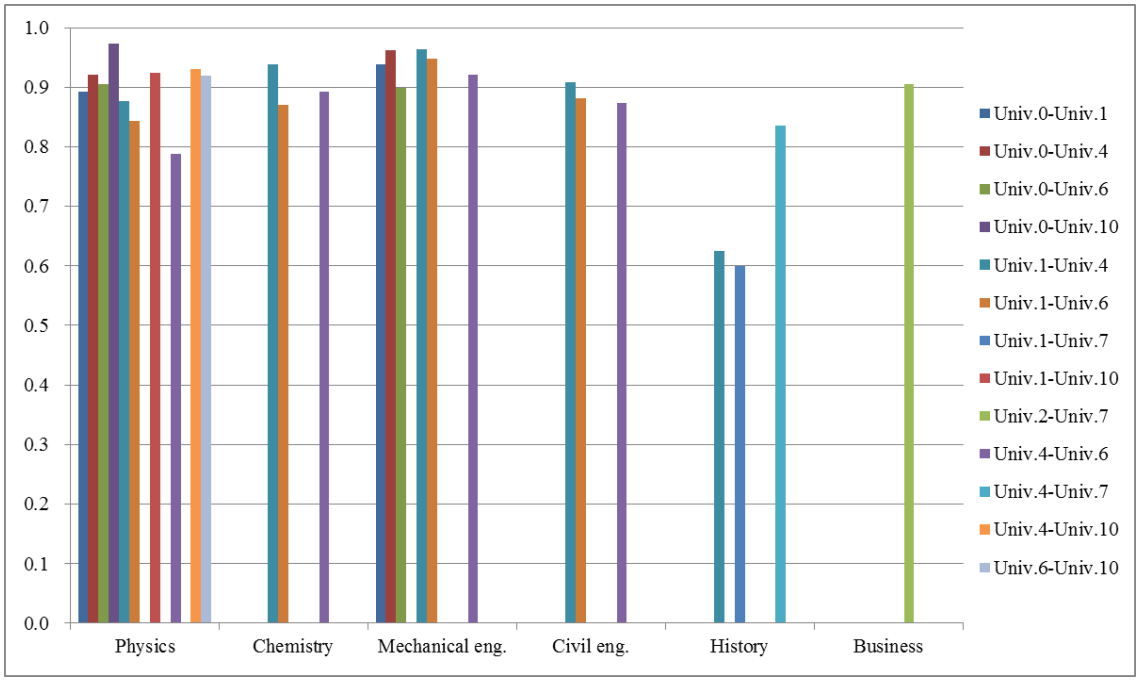



Figure 10 Inter-university comparison of correlation coefficients; academics

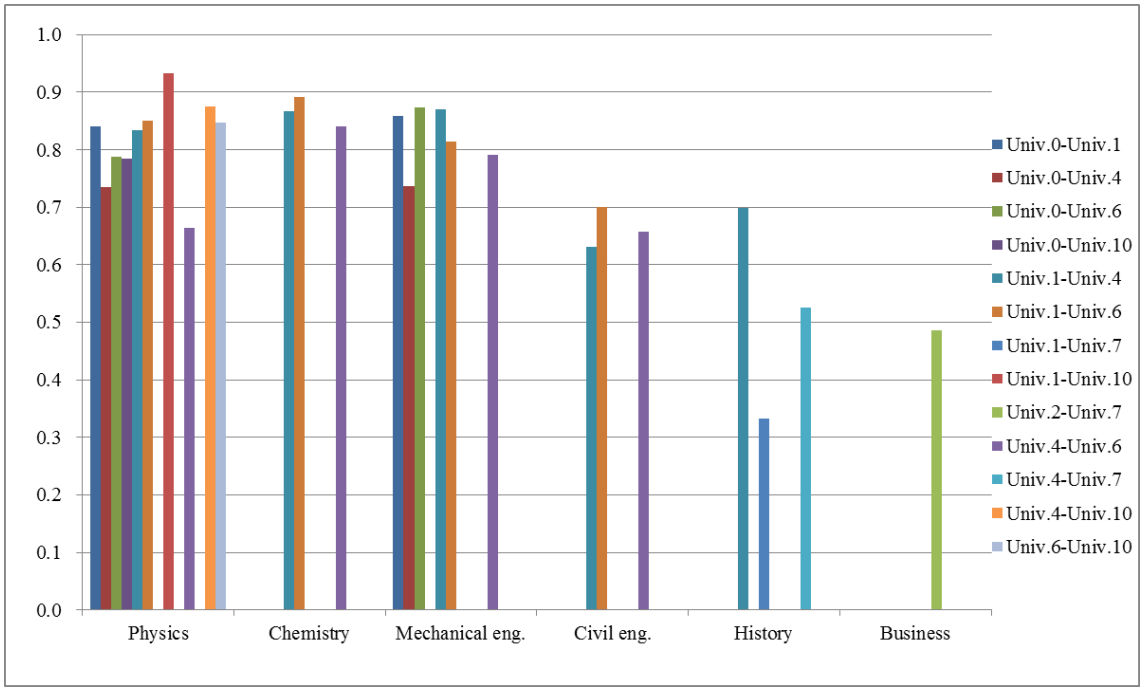


Figure 11 The average rate of importance; generic competences

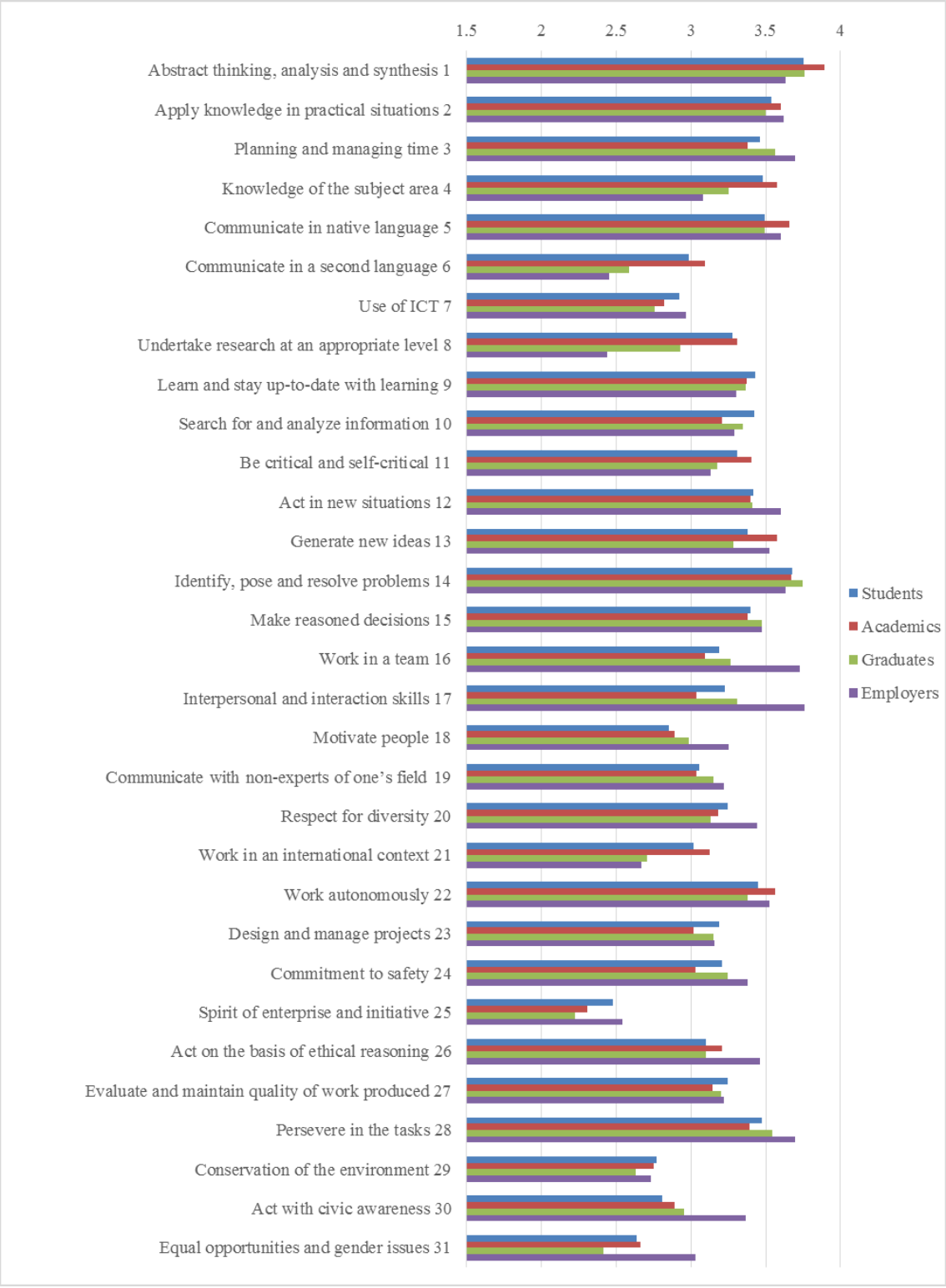


Figure 12 The weighted ranking index of importance in each stakeholder; generic competences

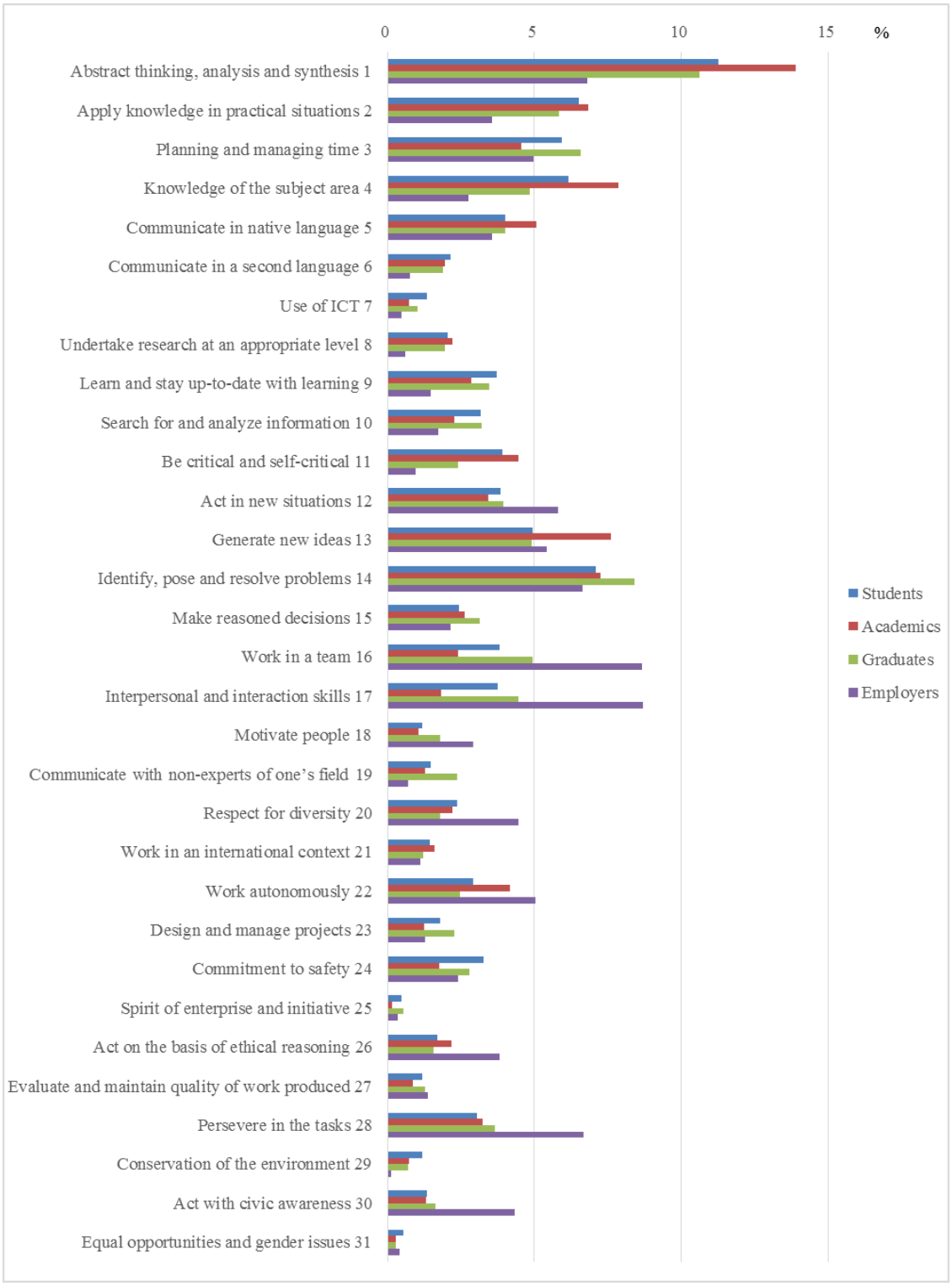


Table 9 Ranking for each competence; generic competences

| No. | Competence | Students | Academics | Graduates | Employers |
|---|---|---|---|---|---|
| 1 | Abstract thinking, analysis and synthesis 1 | 1 | 1 | 1 | 3 |
| 2 | Apply knowledge in practical situations 2 | 3 | 5 | 4 | 13 |
| 3 | Planning and managing time 3 | 5 | 7 | 3 | 9 |
| 4 | Knowledge and understanding of the subject area 4 | 4 | 2 | 7 | 16 |
| 5 | Communicate in native language 5 | 7 | 6 | 9 | 13 |
| 6 | Communicate in a second language 6 | 19 | 19 | 21 | 25 |
| 7 | Use of information and communication technologies 7 | 25 | 28 | 28 | 28 |
| 8 | Undertake research at an appropriate level 8 | 20 | 16 | 20 | 27 |
| 9 | Learn and stay up-to-date with learning 9 | 12 | 12 | 12 | 20 |
| 10 | Search for and analyze information from a variety of sources 10 | 14 | 15 | 13 | 19 |
| 11 | Be critical and self-critical 11 | 8 | 8 | 17 | 24 |
| 12 | Act in new situations 12 | 9 | 10 | 10 | 6 |
| 13 | Generate new ideas 13 | 6 | 3 | 6 | 7 |
| 14 | Identify, pose and resolve problems 14 | 2 | 4 | 2 | 5 |
| 15 | Make reasoned decisions 15 | 17 | 13 | 14 | 18 |
| 16 | Work in a team 16 | 10 | 14 | 5 | 2 |
| 17 | Interpersonal and interaction skills 17 | 11 | 20 | 8 | 1 |
| 18 | Motivate people and move toward common goals 18 | 29 | 26 | 22 | 15 |
| 19 | Communicate with non-experts of one's field 19 | 23 | 24 | 18 | 26 |
| 20 | Respect for diversity 20 | 18 | 17 | 23 | 10 |
| 21 | Work in an international context 21 | 24 | 22 | 27 | 23 |
| 22 | Work autonomously 22 | 16 | 9 | 16 | 8 |
| 23 | Design and manage projects 23 | 21 | 25 | 19 | 22 |
| 24 | Commitment to safety 24 | 13 | 21 | 15 | 17 |
| 25 | Spirit of enterprise and initiative 25 | 31 | 31 | 30 | 30 |
| 26 | Act on the basis of ethical reasoning 26 | 22 | 18 | 25 | 12 |
| 27 | Evaluate and maintain quality of work produced 27 | 27 | 27 | 26 | 21 |
| 28 | Persevere in the tasks 28 | 15 | 11 | 11 | 4 |
| 29 | Commitment to the conservation of the environment 29 | 28 | 29 | 29 | 31 |
| 30 | Act with civic awareness 30 | 26 | 23 | 24 | 11 |
| 31 | Aware of equal opportunities and gender issues 31 | 30 | 30 | 31 | 29 |

Figure 13 Inter-university comparison of the weighted ranking index; students

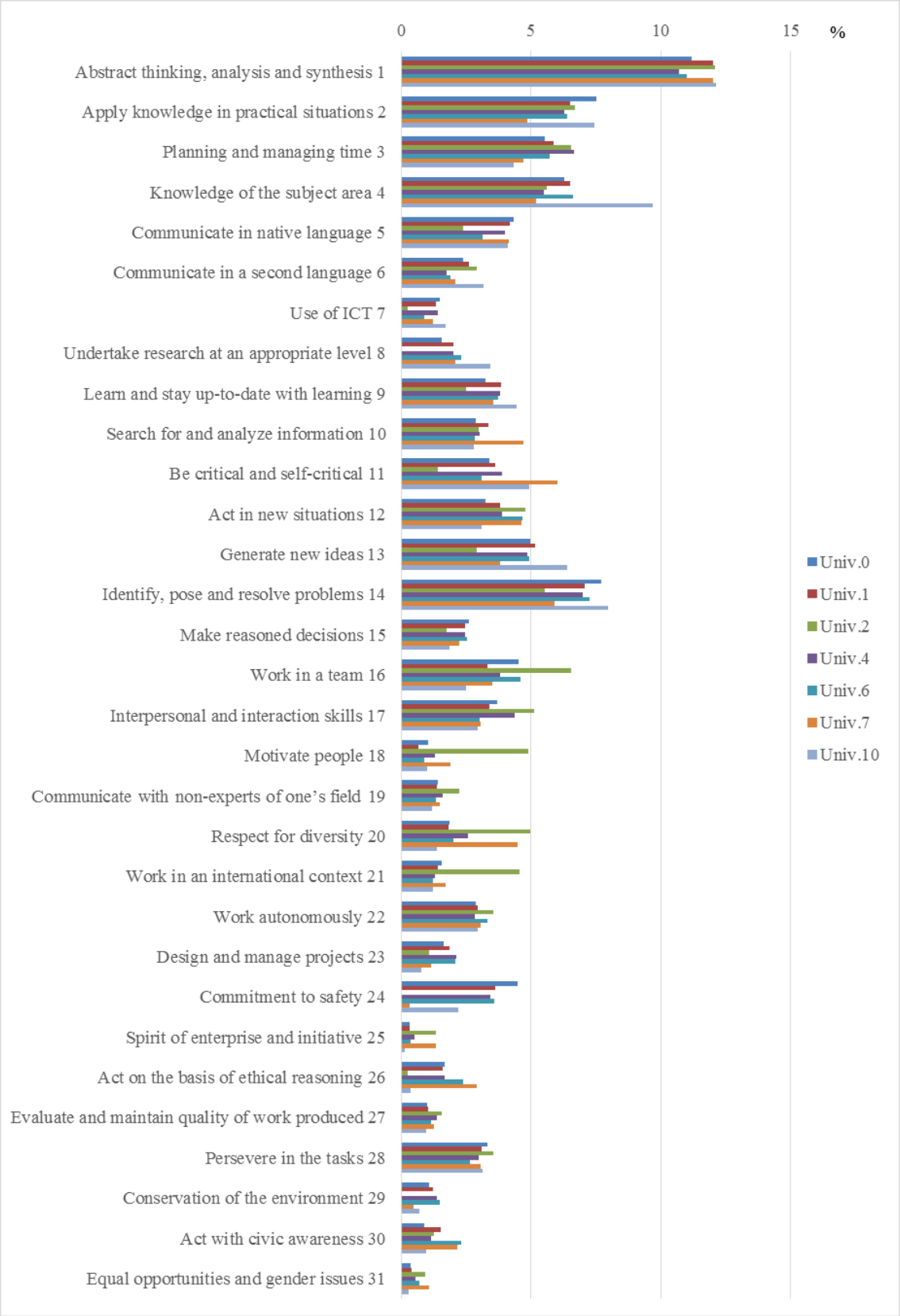


Figure 14 Inter-university comparison of the weighted ranking index; academics

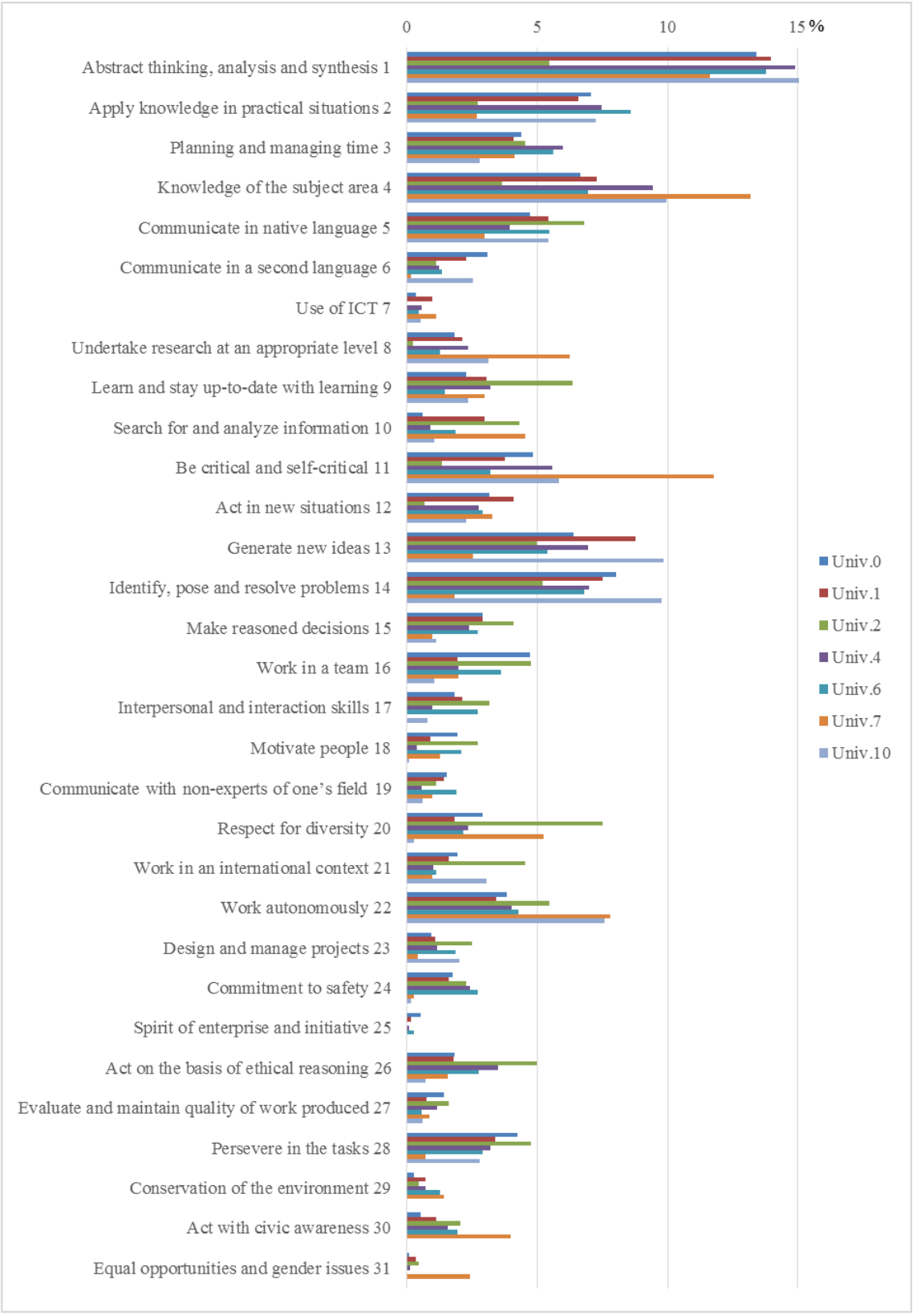


Figure 15 Inter-university comparison of the weighted ranking index; graduates

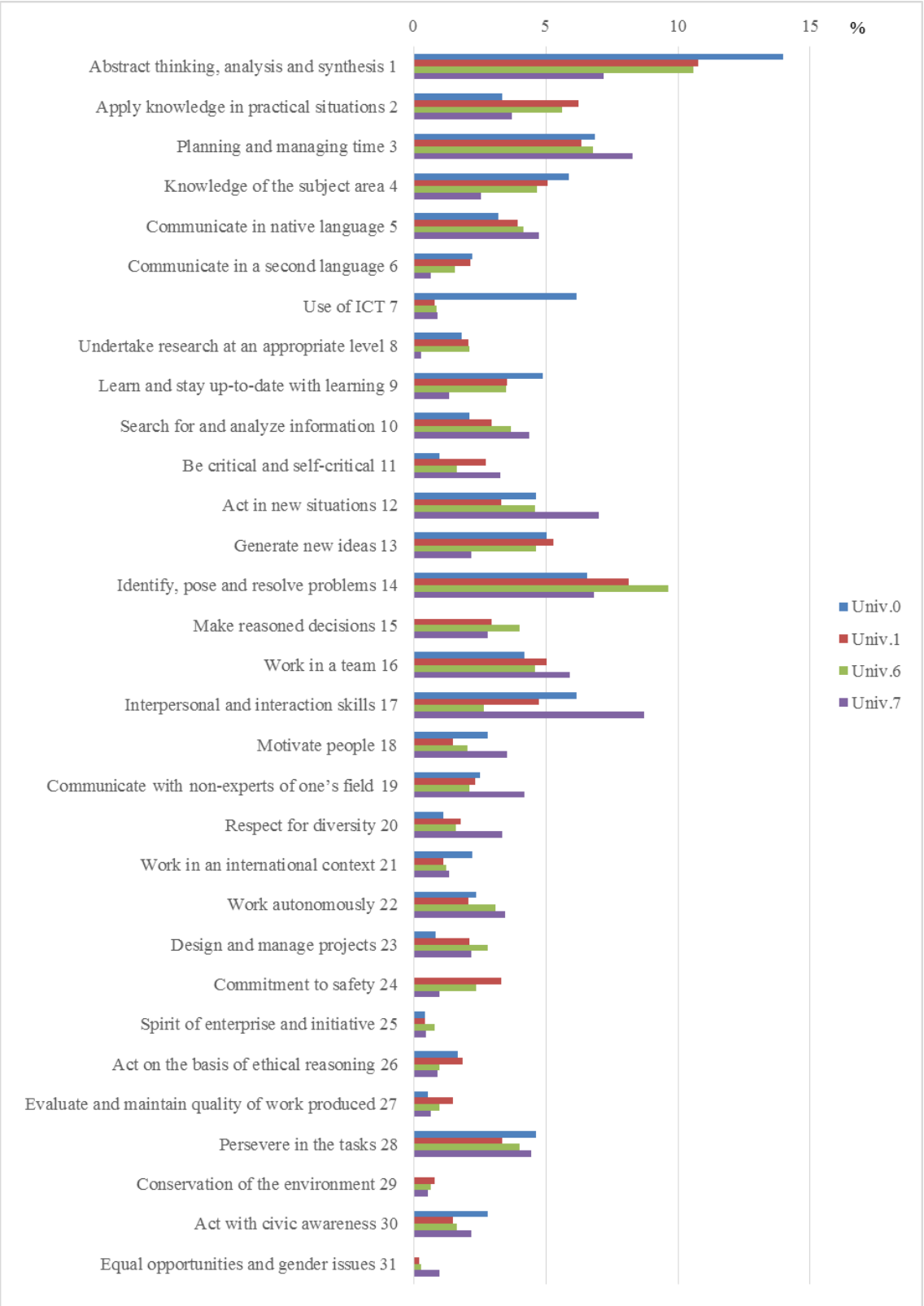


Table 10 Comparison of correlation coefficients between stakeholders

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | | | |
| Academics | 0.95 | 1 | | |
| Graduates | 0.96 | 0.87 | 1 | |
| Employers | 0.57 | 0.47 | 0.67 | 1 |

Figure 16 Comparison of correlation coefficients by subject areas

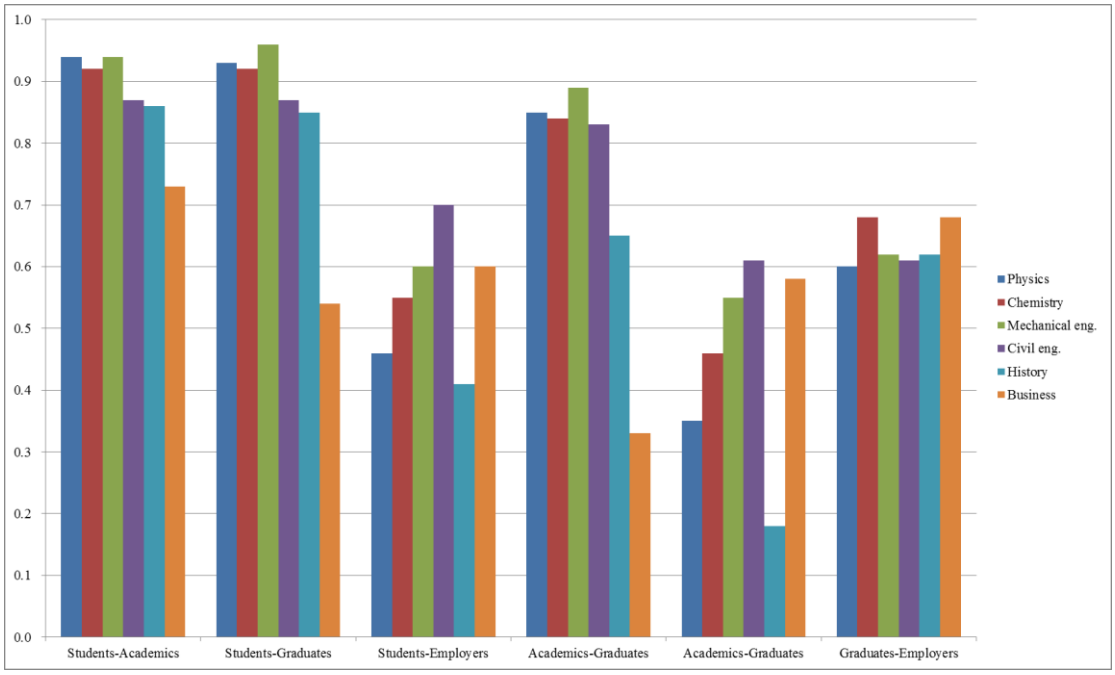



Figure 17 Comparison of correlation coefficients for Univ.1

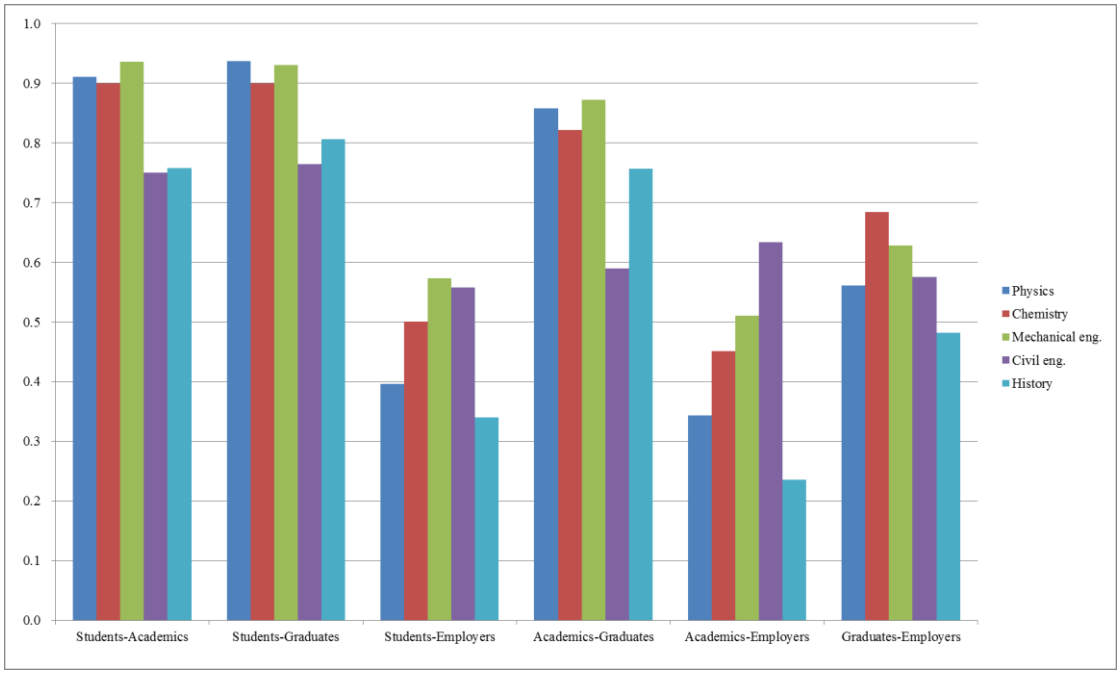


Figure 18 Correlation coefficients between employers and academics

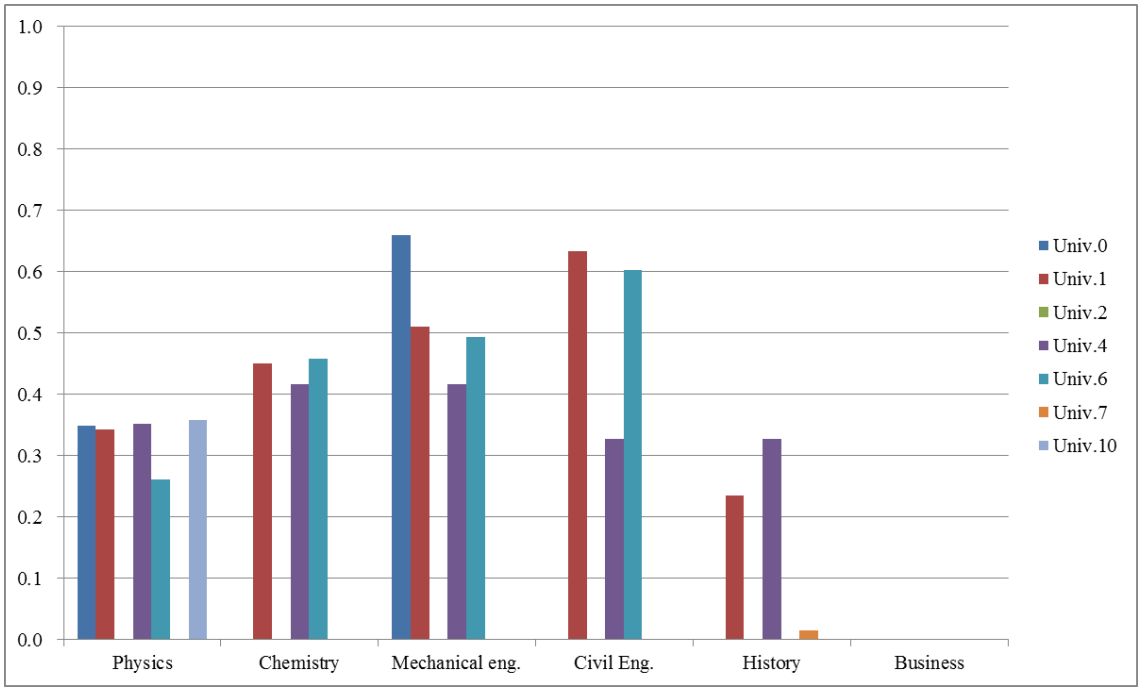



Figure 19 Inter-university comparison of correlation coefficients; students

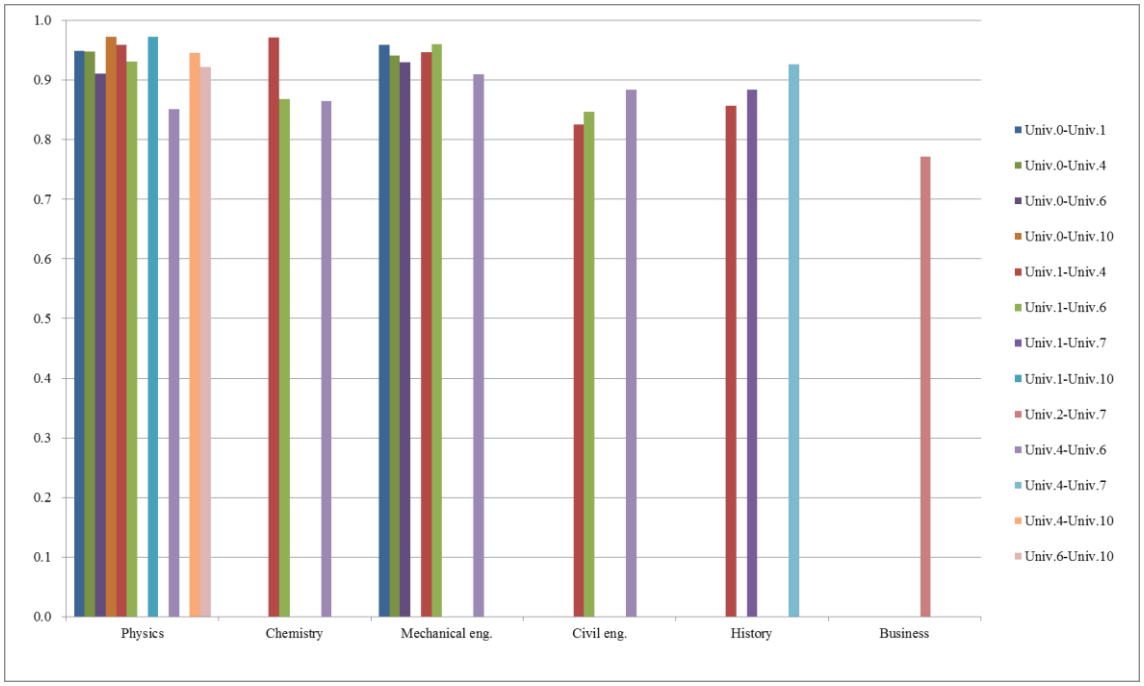
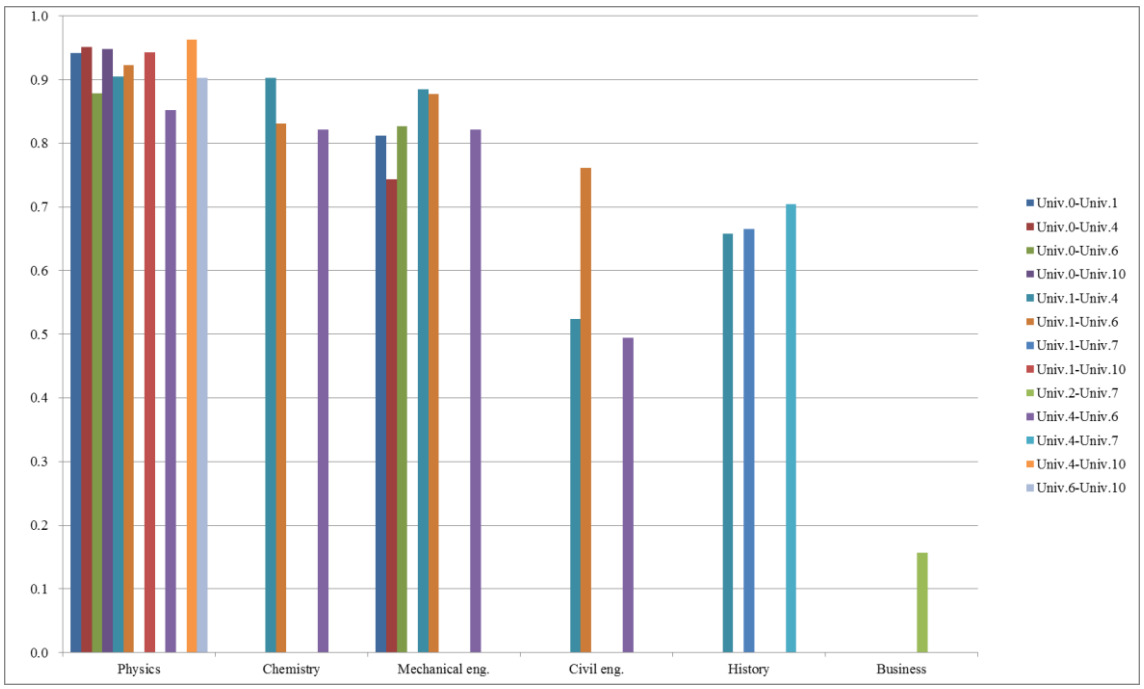


Figure 20 Inter-university comparison of correlation coefficients; academics



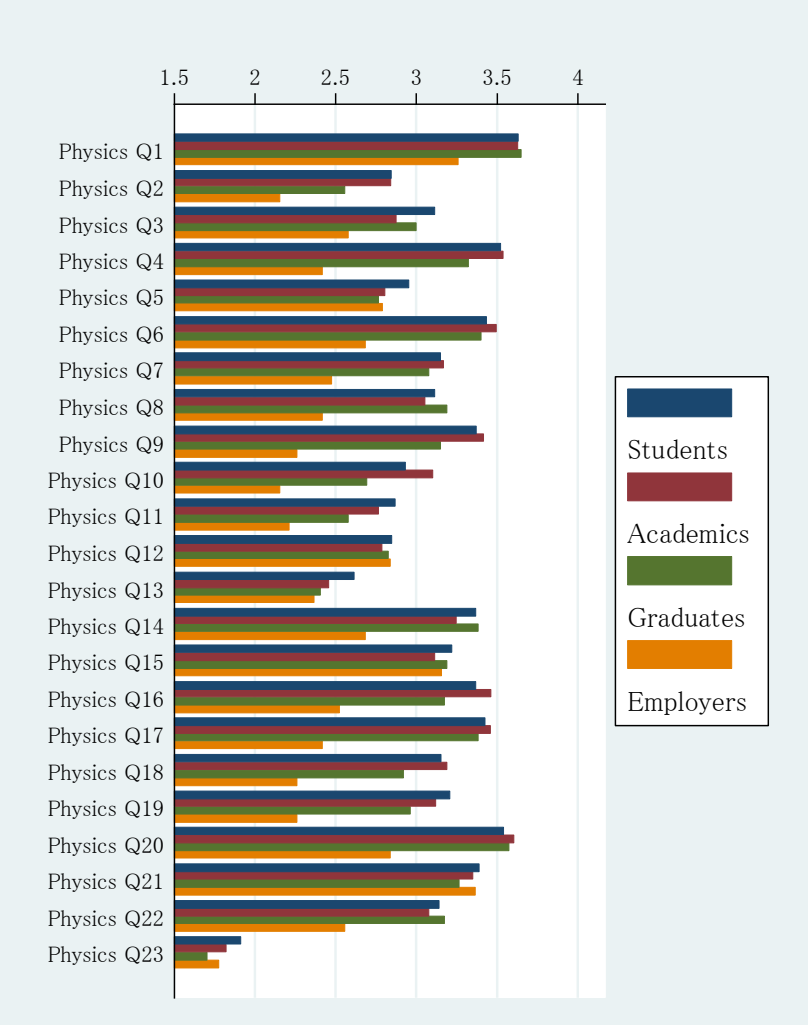
6. Figures and Tables

6.1 Analysis of Subject-specific competences

6.1.1 Participants

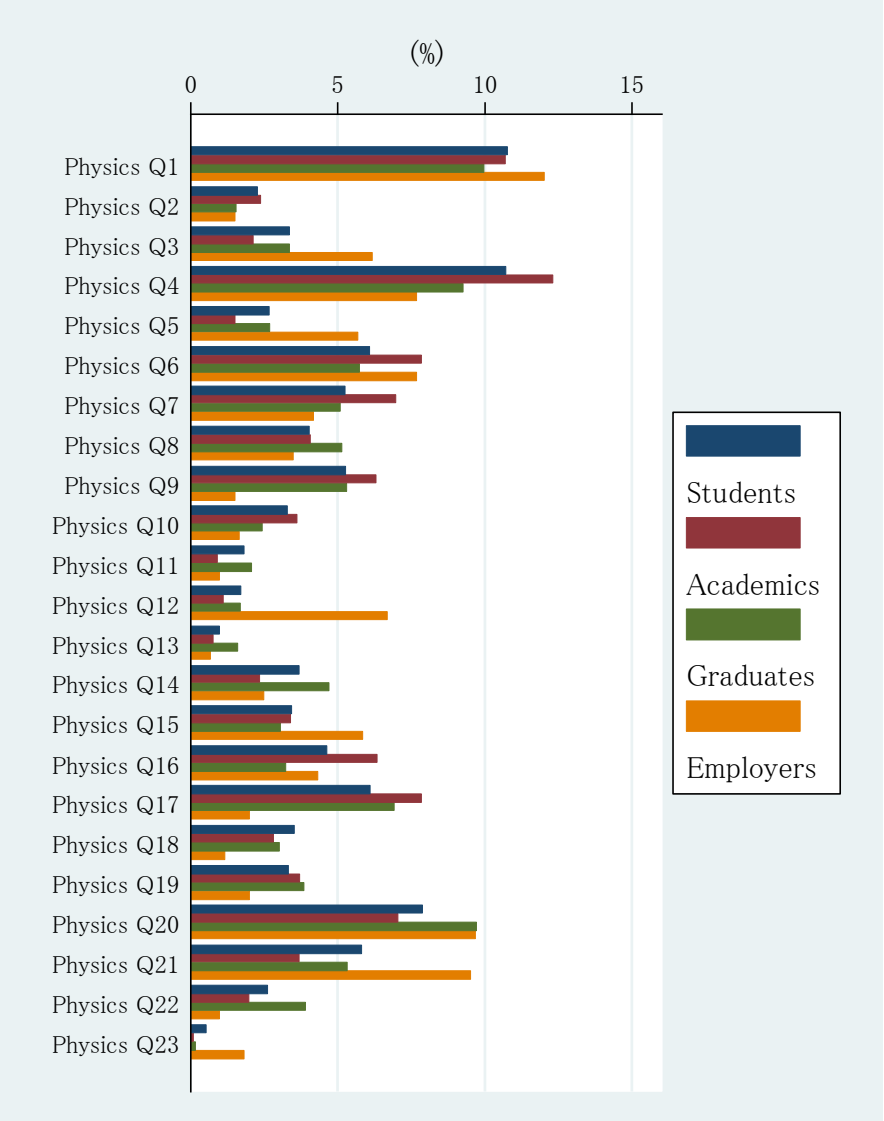
Whole Participants (physics)

Figure 21 The average rate of importance; subject-specific competences in physics (whole participants)




| | | |
|---|---|---|
| Q1 Ability to learn | Q9 Familiarity with frontier research | Q17 Modeling skills |
| Q2 Absolute standards awareness | Q10 Foreign Language skills | Q18 Physics culture |
| Q3 Applied jobs | Q11 General Jobs | Q19 Problem solving |
| Q4 Deep knowledge & understanding | Q12 Professional skills | Q20 Specific communication skills 1: Skills of presenting one's own research or literature search results |
| Q5 Ethical awareness | Q13 Inter-disciplinary attitude / abilities | |
| Q6 Experimental skills | Q14 Literature search skills | Q21 Specific communication skills 2: Skills of working in an interdisciplinary team |
| Q7 Experimental skills | Q15 Managing skills | Q22 Specific updating skills |
| Q8 Familiarity with Basic & Applied Research | Q16 Mathematical skills | Q23 Teaching ability |

Figure 22 The ratio of the weighted ranking index; subject-specific competences in physics (whole participants)




| | | |
|---|---|---|
| Q1 Ability to learn | Q9 Familiarity with frontier research | Q17 Modeling skills |
| Q2 Absolute standards awareness | Q10 Foreign Language skills | Q18 Physics culture |
| Q3 Applied jobs | Q11 General Jobs | Q19 Problem solving |
| Q4 Deep knowledge & understanding | Q12 Professional skills | Q20 Specific communication skills 1: Skills of presenting one's own research or literature search results |
| Q5 Ethical awareness | Q13 Inter-disciplinary attitude / abilities | |
| Q6 Experimental skills | Q14 Literature search skills | Q21 Specific communication skills 2: Skills of working in an interdisciplinary team |
| Q7 Experimental skills | Q15 Managing skills | Q22 Specific updating skills |
| Q8 Familiarity with Basic & Applied Research | Q16 Mathematical skills | Q23 Teaching ability |

Table 11 Ranking according to the weighted ranking index; subject-specific competences in physics

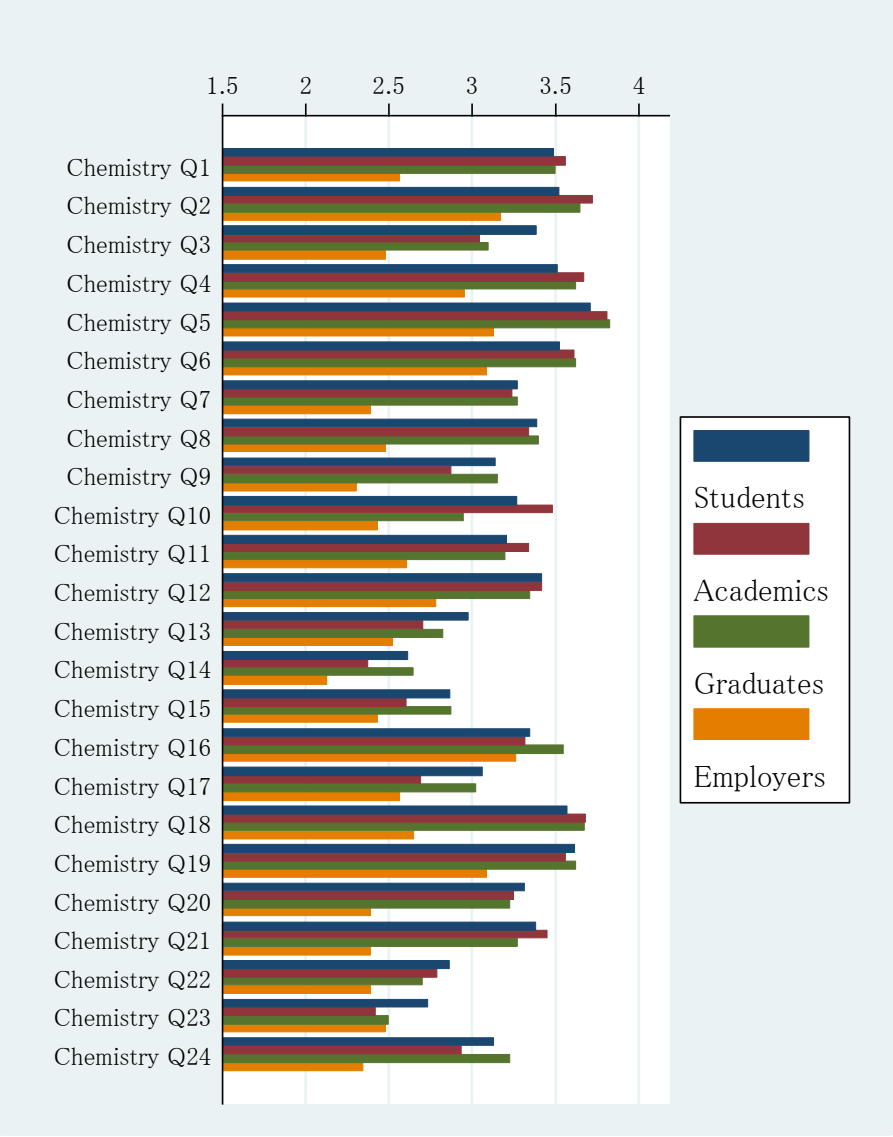
| No. | Competence | students | academics | graduates | employers |
|---|---|---|---|---|---|
| 1 | Ability to learn | 1 | 2 | 1 | 1 |
| 2 | Absolute standards awareness | 19 | 15 | 22 | 18 |
| 3 | Applied jobs | 14 | 17 | 13 | 7 |
| 4 | Deep knowledge & understanding | 2 | 1 | 3 | 4 |
| 5 | Ethical awareness | 17 | 19 | 17 | 9 |
| 6 | Estimation skills | 5 | 3 | 5 | 4 |
| 7 | Experimental skills | 8 | 6 | 9 | 11 |
| 8 | Familiarity with Basic & Applied Research | 10 | 9 | 8 | 12 |
| 9 | Familiarity with frontier research | 7 | 8 | 7 | 18 |
| 10 | Foreign Language skills | 16 | 12 | 18 | 17 |
| 11 | General Jobs | 20 | 21 | 19 | 21 |
| 12 | Professional skills | 21 | 20 | 20 | 6 |
| 13 | Inter-disciplinary attitude / abilities | 22 | 22 | 21 | 23 |
| 14 | Literature search skills | 11 | 16 | 10 | 13 |
| 15 | Managing skills | 13 | 13 | 15 | 8 |
| 16 | Mathematical skills | 9 | 7 | 14 | 10 |
| 17 | Modeling skills | 4 | 3 | 4 | 14 |
| 18 | Physics culture | 12 | 14 | 16 | 20 |
| 19 | Problem solving | 15 | 10 | 12 | 14 |
| 20 | Specific communication skills 1: Skills of presenting one's own research or literature search results | 3 | 5 | 2 | 2 |
| 21 | Specific communication skills 2: Skills of working in an interdisciplinary team | 6 | 11 | 6 | 3 |
| 22 | Specific updating skills | 18 | 18 | 11 | 21 |
| 23 | Teaching ability | 23 | 23 | 23 | 16 |

Table 12 Comparison of correlation coefficients between stakeholders in physics

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | 0.95 | 0.95 | 0.70 |
| Academics | 0.95 | 1 | 0.87 | 0.54 |
| Graduates | 0.95 | 0.87 | 1 | 0.64 |
| Employers | 0.70 | 0.54 | 0.64 | 1 |

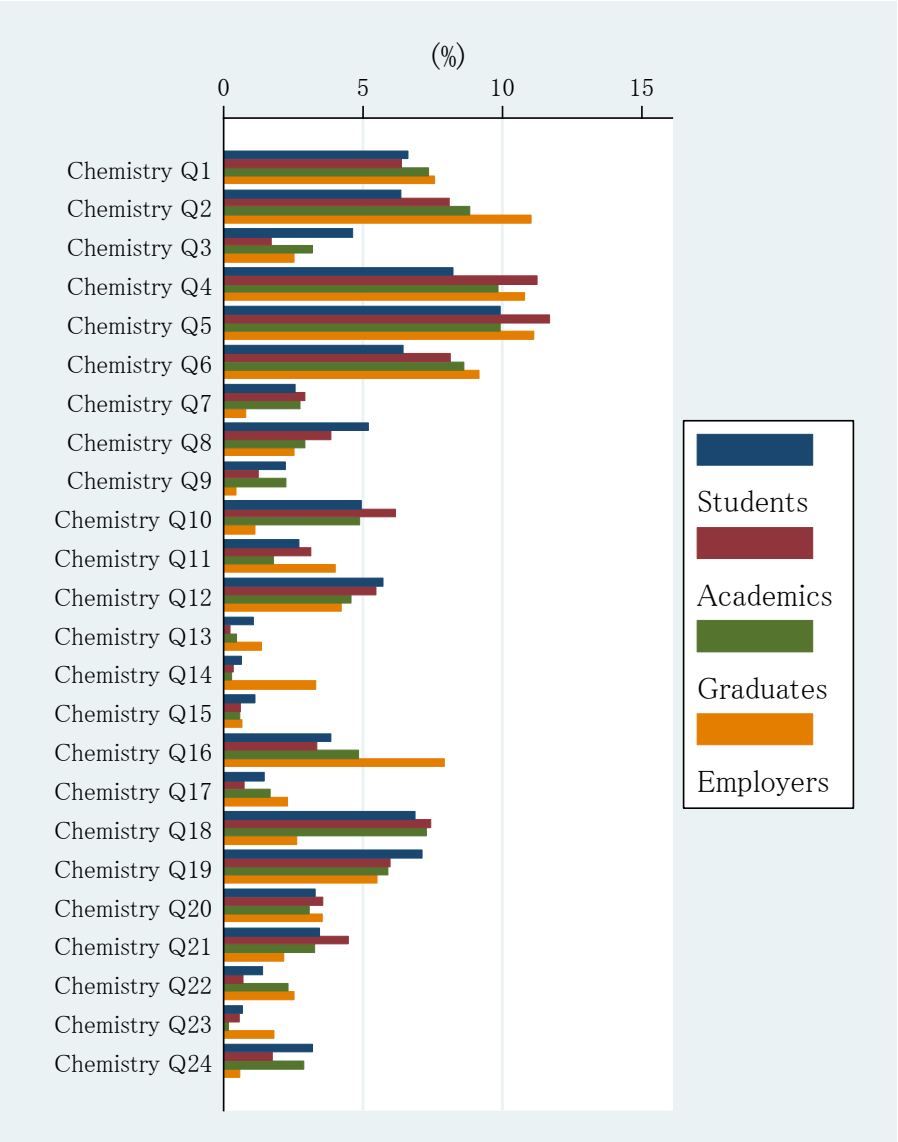
Whole participants (chemistry)

Figure 23 The average rate of importance; subject-specific competences in chemistry (whole participants)




| | | |
|---|---|---|
| Q1 Analysis of unfamiliar nature | Q9 Knowledge of main issues of Chemical research and development | Q17 Preprocessing skills using error analysis and estimation theory |
| Q2 The solution of qualitative and quantitative problems | Q10 Research and communication skills in English | Q18 Discussion skills |
| Q3 Ability to conduct risk assessments | Q11 Information skills | Q19 Ability to treat chemical substances safely |
| Q4 Ability to demonstrate knowledge and understanding | Q12 Ability to plan and design research investigations | Q20 Skills for conducting laboratory procedure |
| Q5 Ability to interpret data and relate them to appropriate theory | Q13 Data processing skills with the use of computer | Q21 Ability to implement experimental techniques |
| Q6 Ability to recognize and analyze novel problems and plans | Q14 Ability to teach Chemistry at secondary school | Q22 Ability to study and work at university and laboratory abroad |
| Q7 Ability to recognize and implement good measurement science | Q15 Computer skills for chemistry | Q23 Deep knowledge and numerical methods |
| Q8 In-depth knowledge and understanding of an specific area of chemistry | Q16 Ability to plan project with a high degree of autonomy | Q24 Ability to develop professional technology for latest researching issues |

Figure 24 The ratio of the weighted ranking index; subject-specific competences in chemistry (whole participants)




| | | |
|---|---|---|
| Q1 Analysis of unfamiliar nature | Q9 Knowledge of main issues of Chemical research and development | Q17 Preprocessing skills using error analysis and estimation theory |
| Q2 The solution of qualitative and quantitative problems | Q10 Research and communication skills in English | Q18 Discussion skills |
| Q3 Ability to conduct risk assessments | Q11 Information skills | Q19 Ability to treat chemical substances safely |
| Q4 Ability to demonstrate knowledge and understanding | Q12 Ability to plan and design research investigations | Q20 Skills for conducting laboratory procedure |
| Q5 Ability to interpret data and relate them to appropriate theory | Q13 Data processing skills with the use of computer | Q21 Ability to implement experimental techniques |
| Q6 Ability to recognize and analyze novel problems and plans | Q14 Ability to teach Chemistry at secondary school | Q22 Ability to study and work at university and laboratory abroad |
| Q7 Ability to recognize and implement good measurement science | Q15 Computer skills for chemistry | Q23 Deep knowledge of mathematical and numerical methods |
| Q8 In-depth knowledge and understanding of an specific area of chemistry | Q16 Ability to plan project with a high degree of autonomy | Q24 Ability to develop professional technology for latest researching issues |

Table 13 Ranking according to the weighted ranking index; subject-specific competences in chemistry

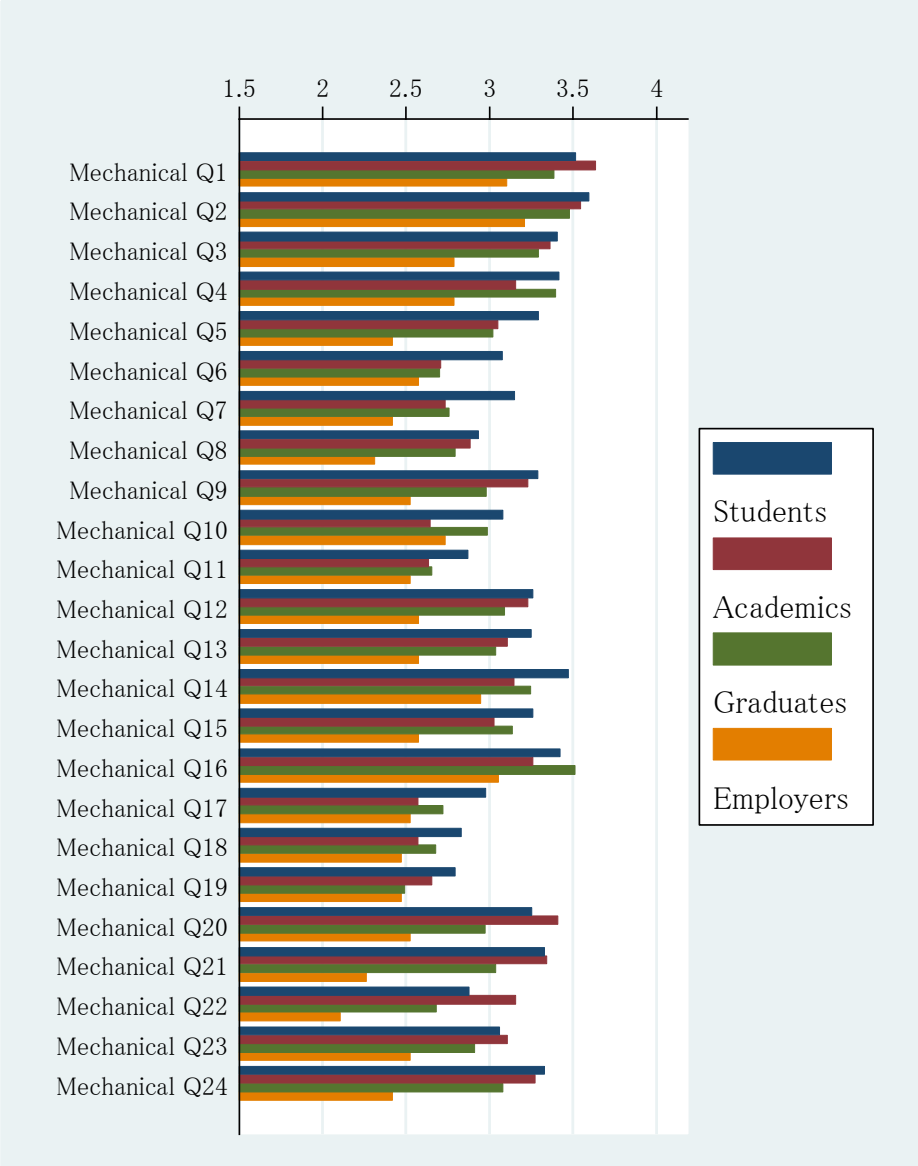
| No. | Competence | students | academics | graduates | employers |
|---|---|---|---|---|---|
| 1 | Apply chemical knowledge to analysis of unfamiliar nature | 5 | 6 | 5 | 6 |
| 2 | Apply chemical knowledge to the solution of qualitative and quantitative problems | 7 | 4 | 3 | 2 |
| 3 | Conduct risk assessments concerning the use of chemical substances and laboratory procedures | 11 | 17 | 12 | 13 |
| 4 | Demonstrate knowledge and understand of essential facts, concepts, principles and theories relating to chemistry | 2 | 2 | 2 | 3 |
| 5 | Interpret data derived from laboratory observations and measurements in terms of their significance and relate them to appropriate theory | 1 | 1 | 1 | 1 |
| 6 | Recognize and analyze novel problems and plans for their solution | 6 | 3 | 4 | 4 |
| 7 | Recognize and implement good measurement science | 17 | 15 | 16 | 21 |
| 8 | Acquire an in-depth knowledge and understand of an specific area | 9 | 11 | 14 | 13 |
| 9 | Be familiar with major issues at the frontiers of research and development | 18 | 18 | 18 | 24 |
| 10 | Read, write and present papers, and to communicate with other scientists in English | 10 | 7 | 8 | 20 |
| 11 | Search for required information using chemistry and other technical literatures | 16 | 14 | 19 | 9 |
| 12 | Implement the planning and design of research investigations | 8 | 9 | 10 | 8 |
| 13 | Process observed data via computer | 22 | 24 | 22 | 19 |
| 14 | Compete for secondary school teaching positions in chemistry | 24 | 23 | 23 | 11 |
| 15 | Apply latest computer and technology to chemistry | 21 | 21 | 21 | 22 |
| 16 | Work with a high degree of autonomy in project planning | 12 | 13 | 9 | 5 |
| 17 | Correct noisy data using error analysis and estimate | 19 | 19 | 20 | 16 |
| 18 | Have scientific arguments with other researchers | 4 | 5 | 6 | 12 |
| 19 | Take into account their physical and chemical properties in order to handle safely chemical materials | 3 | 8 | 7 | 7 |
| 20 | Skills required for the conduct of laboratory procedures involved and use of instrumentation in synthetic and analytical work, in relation to both organic and inorganic systems | 14 | 12 | 13 | 10 |
| 21 | Implement experimental techniques | 13 | 10 | 11 | 17 |
| 22 | Learn and work in foreign university and laboratory | 20 | 20 | 17 | 13 |
| 23 | Master mathematical and numerical methods | 23 | 22 | 24 | 18 |
| 24 | develop professional technology for latest researching issues | 15 | 16 | 15 | 23 |

Table 14 Comparison of correlation coefficients between stakeholders in chemistry

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | 0.94 | 0.94 | 0.73 |
| Academics | 0.94 | 1 | 0.96 | 0.79 |
| Graduates | 0.94 | 0.96 | 1 | 0.84 |
| Employers | 0.73 | 0.79 | 0.84 | 1 |

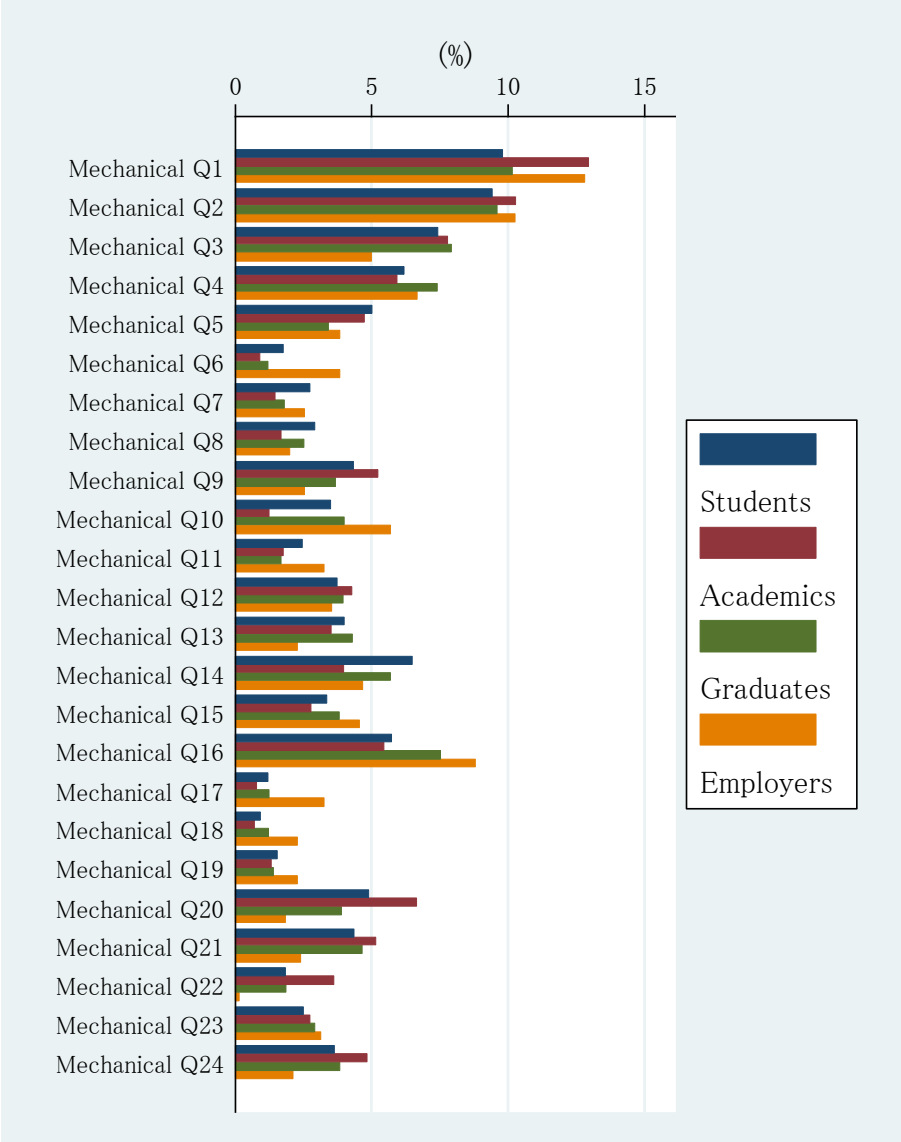
Whole participants (mechanical engineering)

Figure 25 The average rate of importance; subject-specific competences in mechanical engineering




| | | |
|---|---|---|
| Q1 Basic knowledge of mechanical engineering and its application | Q9 Capacity to model and assess mechanical engineering systems and processes | Q17 Quality control skill |
| Q2 Ability to identify the best technology for the situation | Q10 Skills in using material resources, tools and equipment cost-effectively | Q18 Capacity to conduct LCA |
| Q3 Skills to contribute to technological development | Q11 Capacity to consider legal, economic and financial aspects | Q19 Capacity to transform local natural resources into products or services |
| Q4 Skills to develop new mechanical products and systems | Q12 Spatial abstraction, graphic representation and engineering drawings | Q20 Ability to deal with unsolved problems |
| Q5 Ability to plan and manage mechanical engineering projects | Q13 Providing solutions for sustainable development | Q21 Ability to develop professional technology |
| Q6 Ability to manage mechanical engineering systems | Q14 Safety and risk management skill | Q22 Ability to study and work abroad at foreign university and laboratory |
| Q7 Ability to operate, maintain and repair mechanical engineering systems | Q15 Skills in using IT, software and tools | Q23 Skills for using mathematical methods and computing machine |
| Q8 Ability to evaluate the environmental and socio-economic impact of mechanical projects | Q16 Ability to communicate with multidisciplinary groups | Q24 Ability to develop technology for latest research |

Figure 26 The ratio of the weighted ranking index; subject-specific competences in mechanical engineering (whole participants)




| | | |
|---|---|---|
| Q1 Basic knowledge of mechanical engineering and its application | Q9 Capacity to model and assess mechanical engineering systems and processes | Q17 Quality control skill |
| Q2 Ability to identify the best technology for the situation | Q10 Skills in using material resources, tools and equipment cost-effectively | Q18 Capacity to conduct LCA |
| Q3 Skills to contribute to technological development | Q11 Capacity to consider legal, economic and financial aspects | Q19 Capacity to transform local natural resources into products or services |
| Q4 Skills to develop new mechanical products and systems | Q12 Spatial abstraction, graphic representation and engineering drawings | Q20 Ability to deal with unsolved problems |
| Q5 Ability to plan and manage mechanical engineering projects | Q13 Providing solutions for sustainable development | Q21 Ability to develop professional technology |
| Q6 Ability to manage mechanical engineering systems | Q14 Safety and risk management skill | Q22 Ability to study and work abroad at foreign university and laboratory |
| Q7 Ability to operate, maintain and repair mechanical engineering systems | Q15 Skills in using IT, software and tools | Q23 Skills for using mathematical methods and computing machine |
| Q8 Ability to evaluate the environmental and socio-economic impact of mechanical projects | Q16 Ability to communicate with multidisciplinary groups | Q24 Ability to develop technology for latest research |

Table 15 Ranking according to the weighted ranking index; subject-specific competences in mechanical engineering

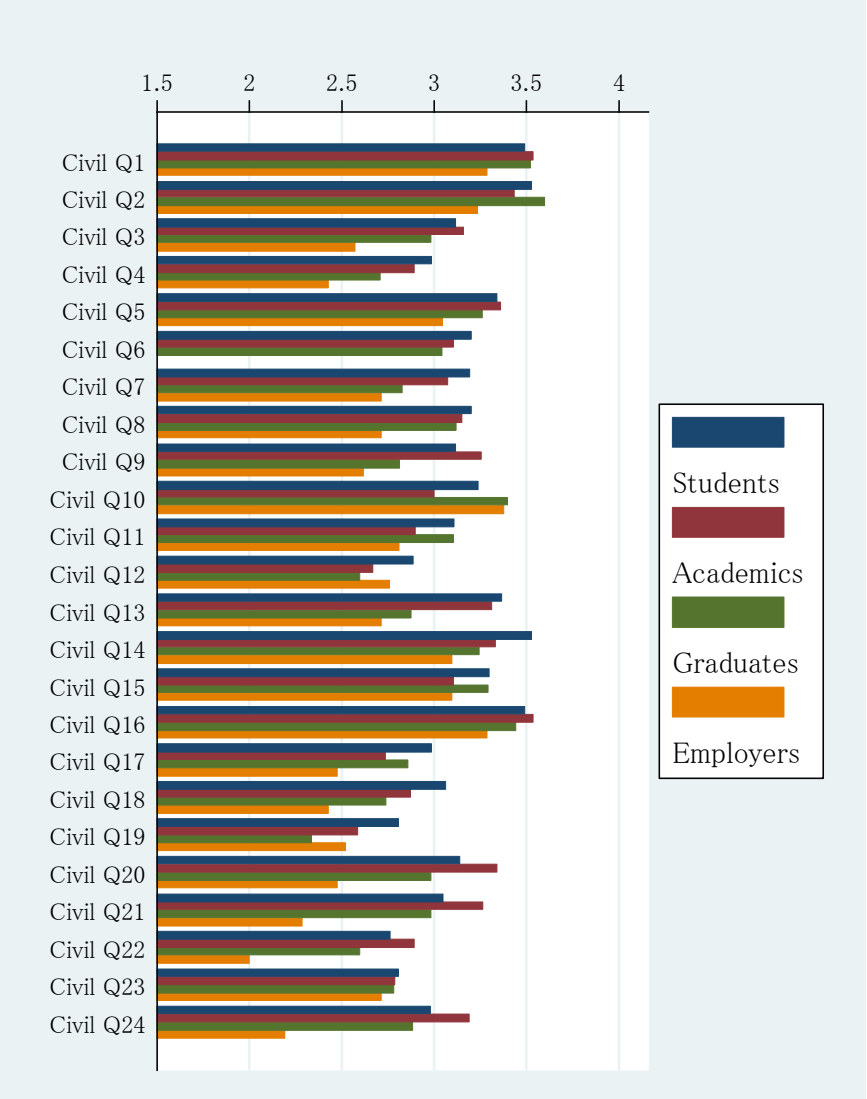
| No. | Competence | students | academics | graduates | employers |
|---|---|---|---|---|---|
| 1 | Apply knowledge of the basic and applied sciences | 1 | 1 | 1 | 1 |
| 2 | Identify and implement the most appropriate technologies | 2 | 2 | 2 | 2 |
| 3 | Create , innovate and contribute to technology | 3 | 3 | 3 | 6 |
| 4 | Conceive, analyze, design and experimentally produce | 5 | 5 | 5 | 4 |
| 5 | Plan and execute projects | 7 | 10 | 15 | 9 |
| 6 | Supervise, inspect and monitor systems | 21 | 22 | 24 | 9 |
| 7 | Operate, maintain and rehabilitate systems | 17 | 19 | 19 | 15 |
| 8 | Evaluate the environmental and socio-economic impact of systems | 16 | 18 | 17 | 22 |
| 9 | Model and simulate systems and processes | 10 | 7 | 14 | 15 |
| 10 | Select tools and equipment cost-effectively | 14 | 21 | 9 | 5 |
| 11 | Integrate legal, economic and financial aspects | 19 | 17 | 20 | 12 |
| 12 | Capacity for spatial abstraction | 12 | 11 | 10 | 11 |
| 13 | Provide mechanical engineering solutions | 11 | 14 | 8 | 18 |
| 14 | Skills in safety and risk management | 4 | 12 | 6 | 7 |
| 15 | Use information technologies | 15 | 15 | 13 | 8 |
| 16 | Interact with multidisciplinary groups | 6 | 6 | 4 | 3 |
| 17 | Quality control techniques | 23 | 23 | 22 | 12 |
| 18 | Conduct life cycle assessment | 24 | 24 | 23 | 18 |
| 19 | Transform local natural resources into products or services through value addition | 22 | 20 | 21 | 18 |
| 20 | Solve unsolved problems | 8 | 4 | 11 | 23 |
| 21 | Develop professional technology for latest researching issues | 9 | 8 | 7 | 17 |
| 22 | Be able to learn and work in foreign university and laboratory | 20 | 13 | 18 | 24 |
| 23 | Master mathematical and numerical methods | 18 | 16 | 16 | 14 |
| 24 | Develop professional technology for latest researching issues | 13 | 9 | 12 | 21 |

Table 16 Comparison of correlation coefficients between stakeholders in mechanical engineering

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | 0.92 | 0.96 | 0.79 |
| Academics | 0.92 | 1 | 0.89 | 0.70 |
| Graduates | 0.96 | 0.89 | 1 | 0.84 |
| Employers | 0.79 | 0.70 | 0.84 | 1 |

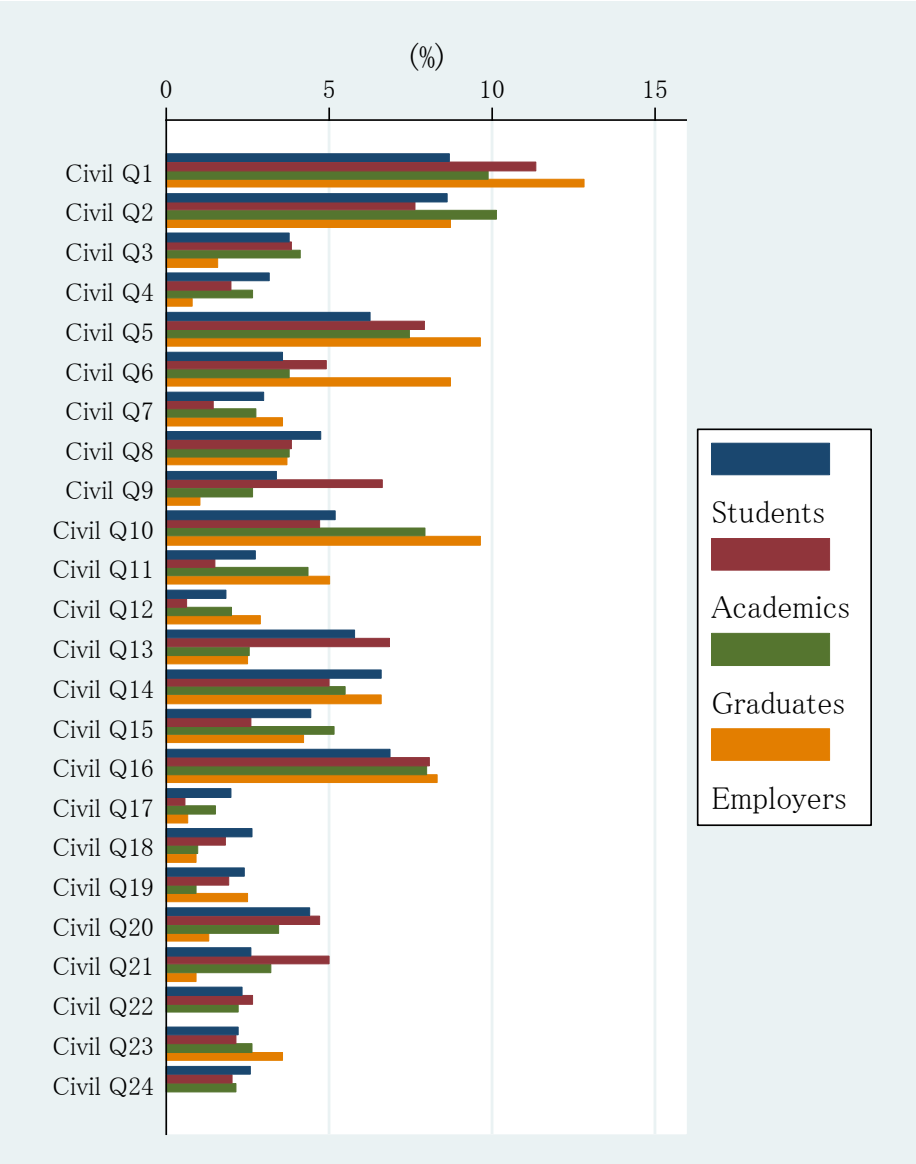
Whole participants (civil engineering)

Figure 27 The average rate of importance; subject-specific competences in civil engineering (whole participants)




| | | |
|---|---|---|
| Q1 Ability to apply knowledge of the basic sciences | Q9 Capacity to model and simulate civil engineering systems and processes | Q17 Quality control skill |
| Q2 Ability to identify the best technology for the situation | Q10 Capacity to direct and lead human resources | Q18 Capacity to conduct LCA |
| Q3 Skills to contribute to technological development | Q11 Skill in administering material resources, teams and equipment | Q19 Capacity to transform local natural resources into products or services |
| Q4 Capacity to conceive, analyze, calculate and design civil engineering works | Q12 Capacity for spatial abstraction, graphic representation and engineering drawings | Q20 Ability to deal with unsolved problems |
| Q5 Skill in planning and programming civil engineering works and services | Q13 Providing solutions for sustainable development | Q21 Ability to develop technology for latest research |
| Q6 Capacity to build, supervise, inspect and evaluate civil engineering works | Q14 Prevention of accidents | Q22 Ability to study and work abroad at foreign university and laboratory |
| Q7 Capacity to operate, maintain and repair civil engineering works | Q15 Skills in handling and interpreting | Q23 Skills for using mathematical methods and computing machine |
| Q8 Skill in evaluating the environmental and social impact of civil works | Q16 Ability to manage and interpret information from the work site | Q24 Ability to develop technology for latest research |

Figure 28 The ratio of the weighted ranking index; subject-specific competences in civil engineering (whole participants)




| | | |
|---|---|---|
| Q1 Ability to apply knowledge of the basic sciences | Q9 Capacity to model and simulate civil engineering systems and processes | Q17 Quality control skill |
| Q2 Ability to identify the best technology for the situation | Q10 Capacity to direct and lead human resources | Q18 Capacity to conduct LCA |
| Q3 Skills to contribute to technological development | Q11 Skill in administering material resources, teams and equipment | Q19 Capacity to transform local natural resources into products or services |
| Q4 Capacity to conceive, analyze, calculate and design civil engineering works | Q12 Capacity for spatial abstraction, graphic representation and engineering drawings | Q20 Ability to deal with unsolved problems |
| Q5 Skill in planning and programming civil engineering works and services | Q13 Providing solutions for sustainable development | Q21 Ability to develop technology for latest research |
| Q6 Capacity to build, supervise, inspect and evaluate civil engineering works | Q14 Prevention of accidents | Q22 Ability to study and work abroad at foreign university and laboratory |
| Q7 Capacity to operate, maintain and repair civil engineering works | Q15 Skills in handling and interpreting | Q23 Skills for using mathematical methods and computing machine |
| Q8 Skill in evaluating the environmental and social impact of civil works | Q16 Ability to manage and interpret information from the work site | Q24 Ability to develop technology for latest research |

Table 17 Ranking according to the weighted ranking index; subject-specific competences in civil engineering

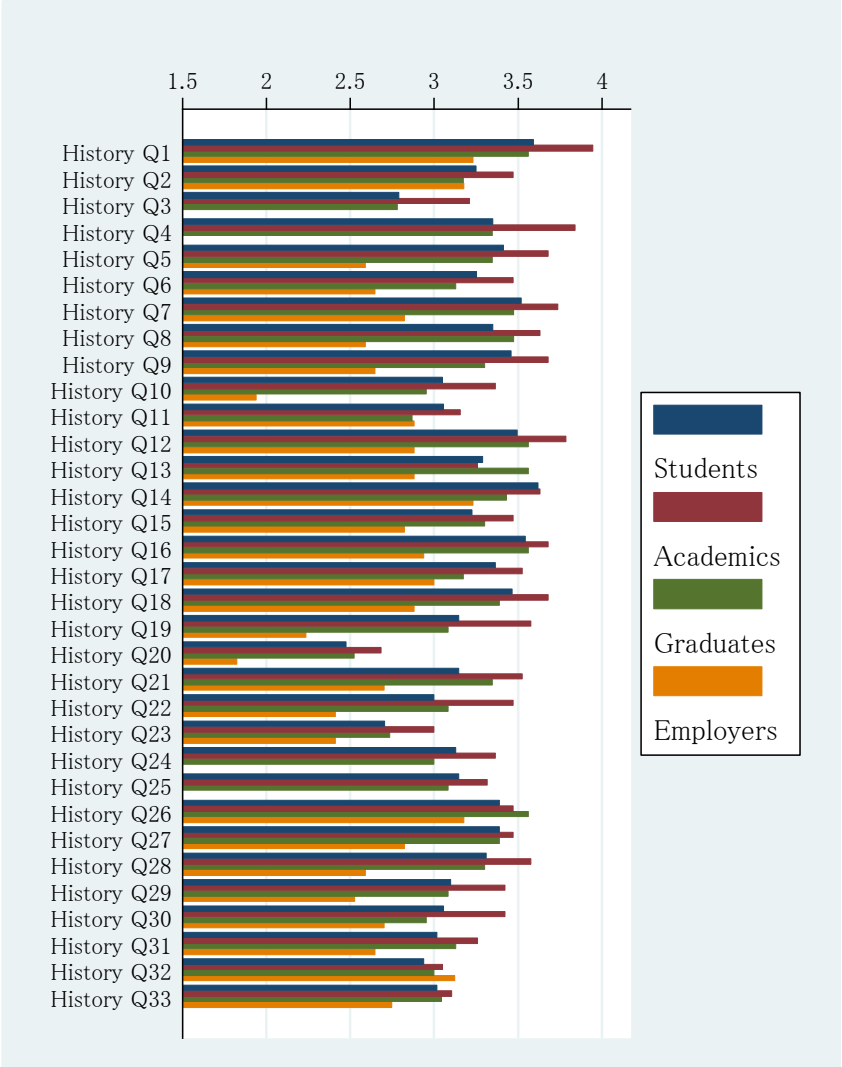
| No. | Competence | students | academics | graduates | employers |
|---|---|---|---|---|---|
| 1 | Apply knowledge of the basic sciences and sciences | 1 | 1 | 2 | 1 |
| 2 | Identify and implement the most appropriate technologies | 2 | 4 | 1 | 4 |
| 3 | Create, innovate and contribute to technological development | 11 | 12 | 9 | 16 |
| 4 | Conceive, analyze, calculate and design | 14 | 18 | 15 | 21 |
| 5 | Plan and program civil engineering works and services | 5 | 3 | 5 | 2 |
| 6 | Build, supervise, inspect and evaluate works | 12 | 9 | 10 | 4 |
| 7 | Operate, maintain and rehabilitate works | 15 | 22 | 14 | 11 |
| 8 | Evaluate the environmental and social impact of civil works | 8 | 12 | 10 | 10 |
| 9 | Model and simulate systems and processes | 13 | 6 | 15 | 18 |
| 10 | Direct and lead human resources | 7 | 10 | 4 | 2 |
| 11 | Administer material resources, teams and equipment | 16 | 21 | 8 | 8 |
| 12 | Spatial abstraction, graphic representation and engineering drawings | 24 | 23 | 21 | 13 |
| 13 | Propose solutions that will contribute to sustainable development | 6 | 5 | 18 | 14 |
| 14 | Prevent and evaluate accidents and risks | 4 | 7 | 6 | 7 |
| 15 | Handle and interpret field information | 9 | 15 | 7 | 9 |
| 16 | Interact with multidisciplinary groups | 3 | 2 | 3 | 6 |
| 17 | Employ quality control techniques | 23 | 24 | 22 | 22 |
| 18 | Conduct life cycle assessment for products and systems | 17 | 20 | 23 | 19 |
| 19 | Employ skills to transform local natural resources into products or services through value addition | 20 | 19 | 24 | 14 |
| 20 | Solve unsolved problems | 10 | 10 | 12 | 17 |
| 21 | Develop professional technology for latest researching issues | 18 | 7 | 13 | 19 |
| 22 | Be able to learn and work in foreign university and laboratory | 21 | 14 | 19 | 23 |
| 23 | Master mathematical and numerical methods | 22 | 16 | 17 | 11 |
| 24 | Develop professional technology for latest researching issues | 19 | 17 | 20 | 23 |

Table 18 Comparison of correlation coefficients between stakeholders in civil engineering

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | 0.86 | 0.89 | 0.77 |
| Academics | 0.86 | 1 | 0.76 | 0.68 |
| Graduates | 0.89 | 0.76 | 1 | 0.87 |
| Employers | 0.77 | 0.68 | 0.87 | 1 |

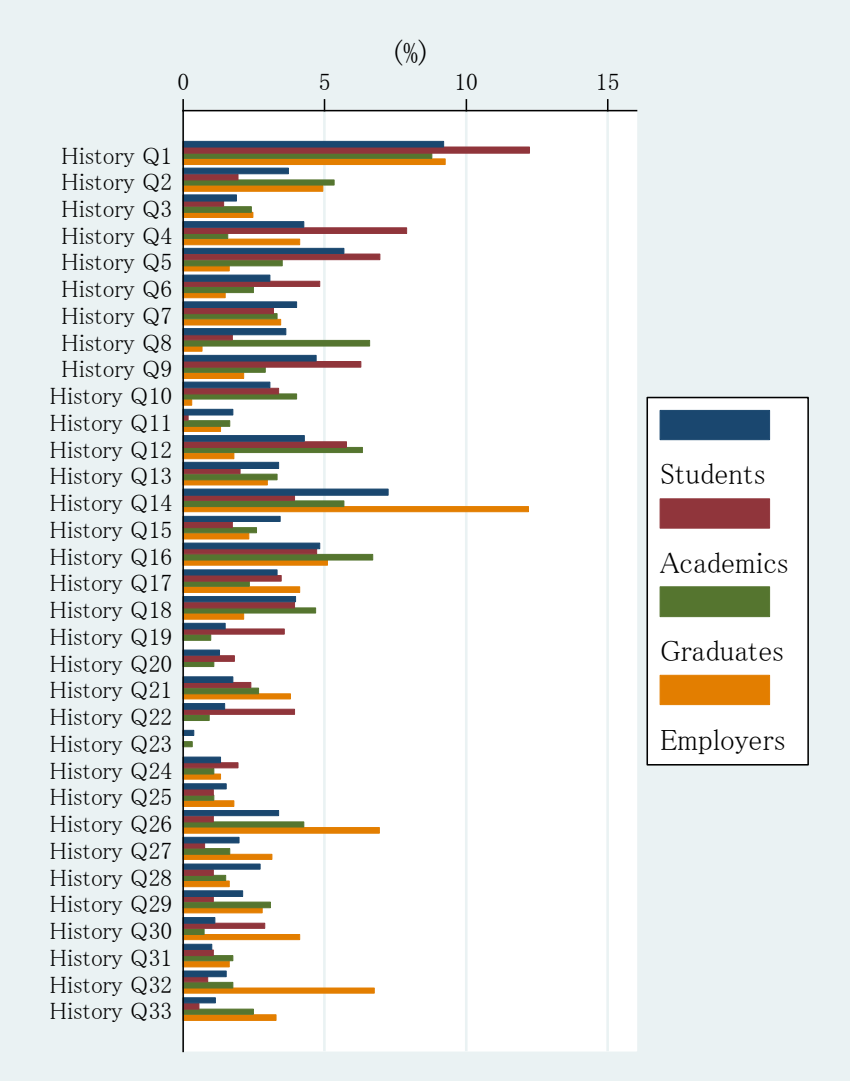
Whole participants (history)

Figure 29 The average rate of importance; subject-specific competences in hisory (whole participants)




| | | | |
|---|---|---|---|
| Q1 Critical thinking | Q10 Ability to read historiographical texts in foreign languages | Q19 Knowledge of one or more specific periods of the human past | Q28 Knowledge of world history |
| Q2 Editing skill | Q11 Ability to use computer and internet resources and techniques | Q20 Knowledge of ancient languages | Q29 Understanding the social role of historian |
| Q3 Communication skill in foreign languages | Q12 Ability to write in one's own language | Q21 Knowledge and ability to use information retrieval tools | Q30 Ability to design, organize, and develop historical research projects |
| Q4 Communication skill in one's own language | Q13 Ability to use tools of humanities and social sciences | Q22 Knowledge and ability to use the specific tools | Q31 Ability to take part in interdisciplinary research work |
| Q5 Ability to define research topics | Q14 Respect for diversity | Q23 Knowledge of didactics of history | Q32 Ability to recognize, contribute to, and participate in socio-cultural community activities |
| Q6 Ability to give narrative form to research results | Q15 Ability to link the methods and issues of different branches of historical research | Q24 Knowledge of Asian history | |
| Q7 Ability to identify and utilize sources of information | Q16 Awareness of the differences in historical outlooks | Q25 Knowledge of the national or local history | Q33 Ability to apply historical education techniques and methods |
| Q8 Ability to organize complex historical information in coherent | Q17 Awareness of the issues and themes in historical debate | Q26 Knowledge of one's own national history | |
| Q9 Ability to read historiographical texts in one's own language | Q18 Awareness of the on-going nature of historical research and debate | Q27 Knowledge of the general diachronic framework of the past | |

Figure 30 The ratio of the weighted ranking index; subject-specific competences in history




| | | | |
|---|---|---|---|
| Q1 Critical thinking | Q10 Ability to read historiographical texts in foreign languages | Q19 Knowledge of one or more specific periods of the human past | Q28 Knowledge of world history |
| Q2 Editing skill | Q11 Ability to use computer and internet resources and techniques | Q20 Knowledge of ancient languages | Q29 Understanding the social role of historian |
| Q3 Communication skill in foreign languages | Q12 Ability to write in one's own language | Q21 Knowledge and ability to use information retrieval tools | Q30 Ability to design, organize, and develop historical research projects |
| Q4 Communication skill in one's own language | Q13 Ability to use tools of humanities and social sciences | Q22 Knowledge and ability to use the specific tools | Q31 Ability to take part in interdisciplinary research work |
| Q5 Ability to define research topics | Q14 Respect for diversity | Q23 Knowledge of didactics of history | Q32 Ability to recognize, contribute to, and participate in socio-cultural community activities |
| Q6 Ability to give narrative form to research results | Q15 Ability to link the methods and issues of different branches of historical research | Q24 Knowledge of Asian history | |
| Q7 Ability to identify and utilize sources of information | Q16 Awareness of the differences in historical outlooks | Q25 Knowledge of the national or local history | Q33 Ability to apply historical education techniques and methods |
| Q8 Ability to organize complex historical information in coherent form | Q17 Awareness of the issues and themes in historical debate | Q26 Knowledge of one's own national history | |
| Q9 Ability to read historiographical texts in one's own language | Q18 Awareness of the on-going nature of historical research and debate | Q27 Knowledge of the general diachronic framework of the past | |

Table 19 Ranking according to the weighted ranking index; subject-specific competences in history

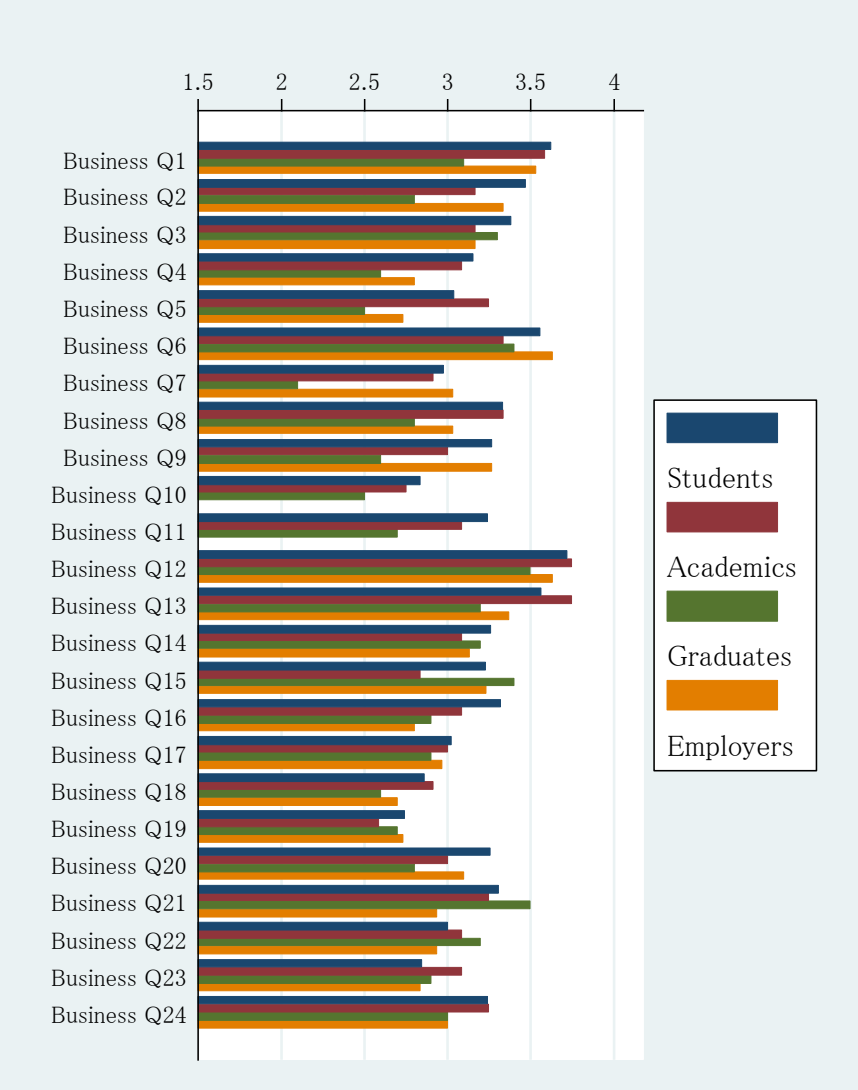
| No. | Competence | students | academics | graduates | employers |
|---|---|---|---|---|---|
| 1 | Think critical about the relationship between current events and the past. | 1 | 1 | 1 | 2 |
| 2 | Comment, annotate or edit texts and documents correctly | 10 | 18 | 6 | 6 |
| 3 | Communicate orally in foreign languages | 21 | 23 | 19 | 16 |
| 4 | Communicate orally in one's own language | 7 | 2 | 25 | 7 |
| 5 | Define research topics that contribute to the development of history | 3 | 3 | 10 | 22 |
| 6 | Give narrative form to research results | 16 | 6 | 17 | 25 |
| 7 | Identify and utilize appropriately sources of information | 8 | 14 | 11 | 11 |
| 8 | Organize complex historical information in coherent form | 11 | 21 | 3 | 28 |
| 9 | Read historiographical texts or original documents in one's own language | 5 | 4 | 14 | 18 |
| 10 | Read historical texts or original documents in other languages | 16 | 13 | 9 | 29 |
| 11 | Use computer and internet resources and techniques | 22 | 32 | 23 | 26 |
| 12 | Write in one's own language using correctly the various types of historical writing. | 6 | 5 | 4 | 20 |
| 13 | Use tools of human and social sciences | 13 | 17 | 11 | 14 |
| 14 | Recognize and respect for diversity in cultural background | 2 | 8 | 5 | 1 |
| 15 | Link the methods and issues of different branches | 12 | 21 | 16 | 17 |
| 16 | Awareness of the differences in historical outlooks | 4 | 7 | 2 | 5 |
| 17 | Awareness of the issues and themes of present day | 15 | 12 | 20 | 7 |
| 18 | Awareness of the on-going nature of historical research and debate | 9 | 8 | 7 | 18 |
| 19 | Detailed knowledge of one or more specific periods of the human past | 26 | 11 | 30 | 30 |
| 20 | Knowledge of ancient languages | 29 | 20 | 27 | 30 |
| 21 | Use information retrieval tools | 22 | 16 | 15 | 10 |
| 22 | Use the specific tools | 27 | 8 | 31 | 30 |
| 23 | Knowledge of didactics of history | 33 | 33 | 33 | 30 |
| 24 | Knowledge of Asian history | 28 | 18 | 27 | 26 |
| 25 | Knowledge of the national or local history | 24 | 24 | 27 | 20 |
| 26 | Knowledge of one's own national history | 14 | 24 | 8 | 3 |
| 27 | Knowledge of the general diachronic framework of the past | 20 | 30 | 23 | 13 |
| 28 | Knowledge of world history | 18 | 24 | 26 | 22 |
| 29 | Understand the social role of the historian | 19 | 24 | 13 | 15 |
| 30 | Design, organize, and develop historical research projects. | 31 | 15 | 32 | 7 |
| 31 | Take part in interdisciplinary research work | 32 | 24 | 21 | 22 |
| 32 | Recognize, contribute to, and participate in socio-cultural community activities | 24 | 29 | 21 | 4 |
| 33 | Apply historical education techniques and methods | 30 | 31 | 17 | 12 |

Table 20 Comparison of correlation coefficients between stakeholders in history

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | 0.78 | 0.81 | 0.61 |
| Academics | 0.78 | 1 | 0.52 | 0.30 |
| Graduates | 0.81 | 0.52 | 1 | 0.51 |
| Employers | 0.61 | 0.30 | 0.51 | 1 |

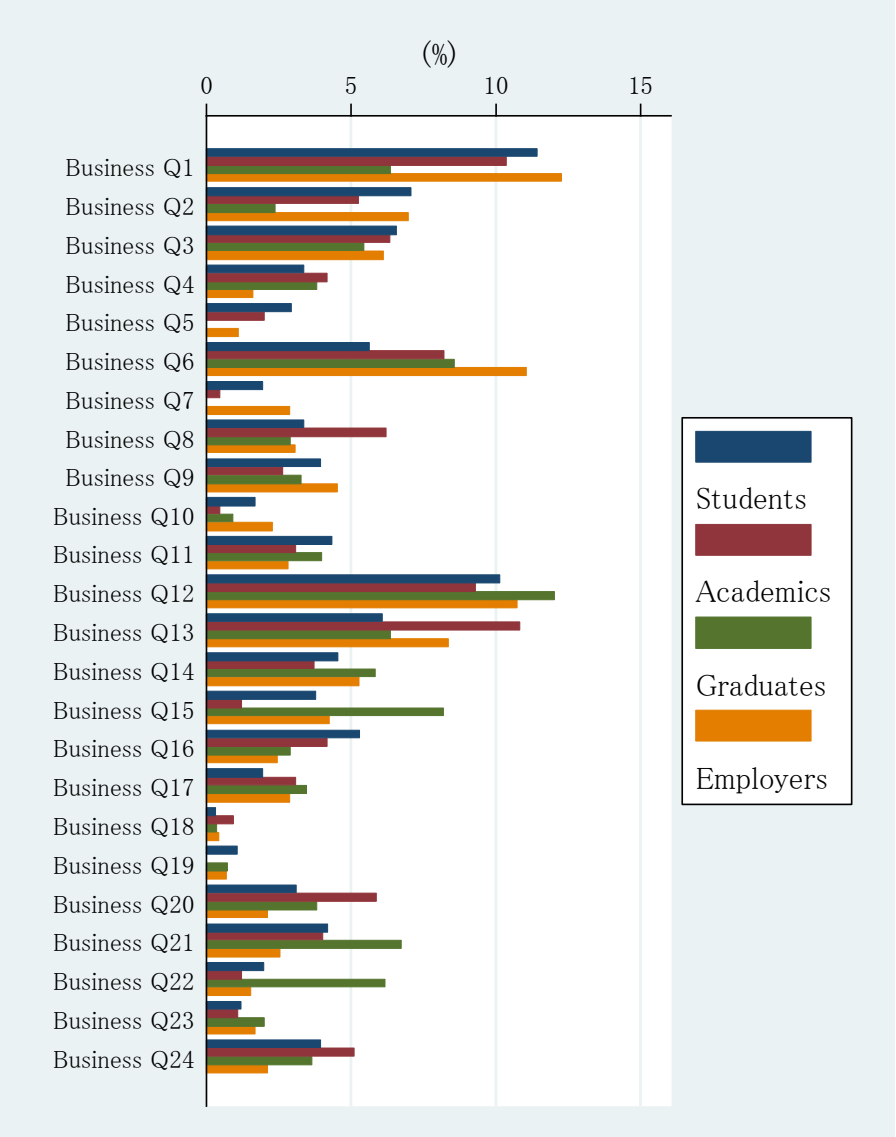
Whole participants (business)

Figure 31 The average rate of importance; subject-specific competences in business (whole participants)




| | | |
|---|---|---|
| Q1 Planning skill | Q9 Interpreting accounting and financial information | Q17 Using IT and communication technology |
| Q2 Identifying and administering business risks | Q10 Using costing information | Q18 Managing the technological infrastructure |
| Q3 Identifying and optimizing business processes | Q11 Taking decisions regarding investments, financing and management of financial resources | Q19 Formulating and optimizing information systems |
| Q4 Administrating an integral logistic system | Q12 Leadership skills | Q20 Formulating market plans |
| Q5 Developing business control systems | Q13 Managing and developing human talent | Q21 Communication skill in English |
| Q6 Identifying functional interrelations within organizations | Q14 Identifying ethical and cultural aspects of reciprocal impact | Q22 Understanding Japanese business manner |
| Q7 Evaluating the legal framework applied to business control systems | Q15 Improving and innovating administrative processes | Q23 Understanding Japanese economic structures and their history |
| Q8 Producing, evaluating and managing business projects | Q16 Undertaking new business and/or developing new products | Q24 Ability to understand other Asian countries' society and economical structures |

Figure 32 The ratio of the weighted ranking index; subject-specific competences in business (whole participants)




| | | |
|---|---|---|
| Q1 Planning skill | Q9 Interpreting accounting and financial information | Q17 Using IT and communication technology |
| Q2 Identifying and administering business risks | Q10 Using costing information | Q18 Managing the technological infrastructure |
| Q3 Identifying and optimizing business processes | Q11 Taking decisions regarding investments, financing and management of financial resources | Q19 Formulating and optimizing information systems |
| Q4 Administrating an integral logistic system | Q12 Leadership skills | Q20 Formulating market plans |
| Q5 Developing business control systems | Q13 Managing and developing human talent | Q21 Communication skill in English |
| Q6 Identifying functional interrelations within organizations | Q14 Identifying ethical and cultural aspects of reciprocal impact | Q22 Understanding Japanese business manner |
| Q7 Evaluating the legal framework applied to business control systems | Q15 Improving and innovating administrative processes | Q23 Understanding Japanese economic structures and their history |
| Q8 Producing, evaluating and managing business projects | Q16 Undertaking new business and/or developing new products | Q24 Ability to understand other Asian countries' society and economical structures |

Table 21 Ranking according to the weighted ranking index; subject-specific competences in business

| No. | Competence | students | academics | graduates | employers |
|---|---|---|---|---|---|
| 1 | Develop strategic, tactical and operational planning skills | 1 | 2 | 5 | 1 |
| 2 | Identify and administer business risks in organizations | 3 | 8 | 18 | 5 |
| 3 | Identify and optimize business processes within organizations | 4 | 5 | 9 | 6 |
| 4 | Administrate an integral logistic system | 14 | 10 | 11 | 20 |
| 5 | Develop, implement, and manage business control systems | 17 | 17 | 23 | 22 |
| 6 | Identify functional inter relations within organizations | 6 | 4 | 2 | 2 |
| 7 | Evaluate the legal framework applied to business control systems | 19 | 22 | 23 | 11 |
| 8 | Produce, evaluate and managing business projects within different types of organizations | 14 | 6 | 16 | 10 |
| 9 | Interpret accounting and financial information | 11 | 16 | 15 | 8 |
| 10 | Use costing information | 21 | 22 | 20 | 16 |
| 11 | Take decisions regarding investments, financing and management of financial resources | 9 | 14 | 10 | 13 |
| 12 | Leadership skills, for the achievement of and following up of aims | 2 | 3 | 1 | 3 |
| 13 | Manage and develop human talent | 5 | 1 | 5 | 4 |
| 14 | Identify ethical and cultural aspects of reciprocal impact | 8 | 13 | 8 | 7 |
| 15 | Improve and innovating administrative processes | 13 | 18 | 3 | 9 |
| 16 | Detect opportunities for undertaking new business and or developing new products | 7 | 10 | 16 | 15 |
| 17 | Use information and communication technology in management | 19 | 14 | 14 | 11 |
| 18 | Manage the technological infrastructure of a business | 24 | 21 | 22 | 24 |
| 19 | Formulate and optimize information systems | 23 | 24 | 21 | 23 |
| 20 | Formulate market plans | 16 | 7 | 11 | 17 |
| 21 | English skills | 10 | 12 | 4 | 14 |
| 22 | Understand business manners particularly used in Japan | 18 | 18 | 7 | 21 |
| 23 | Understand Japanese economic structures and their history | 22 | 20 | 19 | 19 |
| 24 | Understand other Asian countries' society and build relation to those countries | 11 | 9 | 13 | 17 |

Table 22 Comparison of correlation coefficients between stakeholders in business

| | Students | Academics | Graduates | Employers |
|---|---|---|---|---|
| Students | 1 | 0.83 | 0.66 | 0.87 |
| Academics | 0.83 | 1 | 0.63 | 0.81 |
| Graduates | 0.66 | 0.63 | 1 | 0.69 |
| Employers | 0.87 | 0.81 | 0.69 | 1 |

7. Appendix：Questionnaire

(1) 【General competence questionnaire: students, academic, employers】
(2) 【General competence questionnaire: graduates】
(3) 【Physics competence questionnaire: students, academic, employers, graduates】
(4) 【Chemistry competence questionnaire: students, academic, employers, graduates】
(5) 【Mechanical engineering competence questionnaire: students, academic, employers, graduates】
(6) 【Civil engineering competence questionnaire: students, academic, employers, graduates】
(7) 【History competence questionnaire: students, academic, employers, graduates】
(8) 【Business competence questionnaire: students, academic, employers, graduates】

| | | |
|---|---|---|
| * | * | * |

【General competence questionnaire: students, academics, employers】

Competence Survey on Globally-Required Abilities

Listed below are *generic competences* important for the professional development of university graduates. For each of the competences, please estimate the importance for work in your profession.

Generic Competence

| For each competence, circle one number for its importance | | Importance<br>Weak → Strong |
|---|---|---|
| 1 | Ability for abstract thinking, analysis and synthesis. | 1 2 3 4 |
| 2 | Ability to apply knowledge in practical situations. | 1 2 3 4 |
| 3 | Ability to plan and manage time. | 1 2 3 4 |
| 4 | Knowledge and understanding of the subject area and understanding of the profession. | 1 2 3 4 |
| 5 | Ability to communicate both orally and through the written word in native language. | 1 2 3 4 |
| 6 | Ability to communicate in a second language. | 1 2 3 4 |
| 7 | Skills in the use of information and communication technologies. | 1 2 3 4 |
| 8 | Ability to undertake research at an appropriate level. | 1 2 3 4 |
| 9 | Capacity to learn and stay up-to-date with learning. | 1 2 3 4 |
| 10 | Ability to search for, process and analyze information from a variety of sources. | 1 2 3 4 |
| 11 | Ability to be critical and self-critical. | 1 2 3 4 |
| 12 | Ability to adapt to and act in new situations. | 1 2 3 4 |
| 13 | Capacity to generate new ideas (creativity). | 1 2 3 4 |
| 14 | Ability to identify, pose and resolve problems. | 1 2 3 4 |
| 15 | Ability to make reasoned decisions. | 1 2 3 4 |
| 16 | Ability to work in a team. | 1 2 3 4 |
| 17 | Interpersonal and interaction skills. | 1 2 3 4 |
| 18 | Ability to motivate people and move toward common goals. | 1 2 3 4 |
| 19 | Ability to communicate with non-experts of one’s field. | 1 2 3 4 |
| 20 | Appreciation and respect for diversity. | 1 2 3 4 |
| 21 | Ability to work in an international context. | 1 2 3 4 |
| 22 | Ability to work autonomously. | 1 2 3 4 |

| | | |
|---|---|---|
| 23 | Ability to design and manage projects. | 1 2 3 4 |
| 24 | Commitment to safety. | 1 2 3 4 |
| 25 | Spirit of enterprise, ability to take initiative. | 1 2 3 4 |
| 26 | Ability to act on the basis of ethical reasoning. | 1 2 3 4 |
| 27 | Ability to evaluate and maintain quality of work produced. | 1 2 3 4 |
| 28 | Determination and perseverance in the tasks given and responsibilities taken. | 1 2 3 4 |
| 29 | Commitment to the conservation of the environment. | 1 2 3 4 |
| 30 | Ability to act with social responsibility and civic awareness. | 1 2 3 4 |
| 31 | Ability to show awareness of equal opportunities and gender issues. | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

| | | | |
|---|---|---|---|
| (First) | (No. ) | (Sixth) | (No. ) |
| (Second) | (No. ) | (Seventh) | (No. ) |
| (Third) | (No. ) | (Eighth) | (No. ) |
| (Fourth) | (No. ) | (Ninth) | (No. ) |
| (Fifth) | (No. ) | (Tenth) | (No. ) |

Many thanks for your cooperation.

| | | |
|---|---|---|
| * | * | * |

【General competence questionnaire: graduates】

Competence Survey on Globally-Required Abilities

This questionnaire presents a series of questions related to the *skills* and *competences* that may be important for success in your career. Please answer about yourself and your degree first.

1. Year of graduation： _____

2. Sex： ① Male □
② Female □

3. Final degree acquired_____

4. Area of specialization/Major_____

5. Your degree and present employment situation）：
   ① Working in a position related to your degree □
   ② Working in a position not related to your degree □
   ③ Continuing your study □
   ④ Looking for your job □
   ⑤ Other □
   Please specify：
   _____

6. How would you rate the employment potential of your degree?
   ① Very good □
   ② Good □
   ③ Fair □
   ④ Poor □
   ⑤ Very poor □

7. Do you feel that the education you have received at the university has been adequate?
   ① Very much □
   ② Much □

③ Some □

④ Little □

⑤ Very little □

Following shows *generic competences* useful for any professions. For each of the competences, please estimate the importance for work in your profession.

Generic Competence

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1 Ability for abstract thinking, analysis and synthesis. | 1 2 3 4 |
| 2 Ability to apply knowledge in practical situations. | 1 2 3 4 |
| 3 Ability to plan and manage time. | 1 2 3 4 |
| 4 Knowledge and understanding of the subject area and understanding of the profession. | 1 2 3 4 |
| 5 Ability to communicate both orally and through the written word in native language. | 1 2 3 4 |
| 6 Ability to communicate in a second language. | 1 2 3 4 |
| 7 Skills in the use of information and communication technologies. | 1 2 3 4 |
| 8 Ability to undertake research at an appropriate level. | 1 2 3 4 |
| 9 Capacity to learn and stay up-to-date with learning. | 1 2 3 4 |
| 10 Ability to search for, process and analyze information from a variety of sources. | 1 2 3 4 |
| 11 Ability to be critical and self-critical. | 1 2 3 4 |
| 12 Ability to adapt to and act in new situations. | 1 2 3 4 |
| 13 Capacity to generate new ideas (creativity). | 1 2 3 4 |
| 14 Ability to identify, pose and resolve problems. | 1 2 3 4 |
| 15 Ability to make reasoned decisions. | 1 2 3 4 |
| 16 Ability to work in a team. | 1 2 3 4 |
| 17 Interpersonal and interaction skills. | 1 2 3 4 |
| 18 Ability to motivate people and move toward common goals. | 1 2 3 4 |
| 19 Ability to communicate with non-experts of one's field. | 1 2 3 4 |
| 20 Appreciation and respect for diversity. | 1 2 3 4 |
| 21 Ability to work in an international context. | 1 2 3 4 |
| 22 Ability to work autonomously. | 1 2 3 4 |
| 23 Ability to design and manage projects. | 1 2 3 4 |
| 24 Commitment to safety. | 1 2 3 4 |

| | | | | | |
|---|---|---|---|---|---|
| 25 | Spirit of enterprise, ability to take initiative. | 1 | 2 | 3 | 4 |
| 26 | Ability to act on the basis of ethical reasoning. | 1 | 2 | 3 | 4 |
| 27 | Ability to evaluate and maintain quality of work produced. | 1 | 2 | 3 | 4 |
| 28 | Determination and perseverance in the tasks given and responsibilities taken. | 1 | 2 | 3 | 4 |
| 29 | Commitment to the conservation of the environment. | 1 | 2 | 3 | 4 |
| 30 | Ability to act with social responsibility and civic awareness. | 1 | 2 | 3 | 4 |
| 31 | Ability to show awareness of equal opportunities and gender issues. | 1 | 2 | 3 | 4 |

Please choose 10 top competences you think most important from the above list

| | | | |
|---|---|---|---|
| (First) (No. ) | (Sixth) (No. ) |
| (Second) (No. ) | (Seventh) (No. ) |
| (Third) (No. ) | (Eighth) (No. ) |
| (Fourth) (No. ) | (Ninth) (No. ) |
| (Fifth) (No. ) | (Tenth) (No. ) |

Many thanks for your cooperation.

| | | |
|---|---|---|
| * | * | * |

【Physics competence questionnaire: students, academic, employers, graduates】

Competence Survey on Globally-Required Abilities

Physics

Listed below are competences in the area of physics important for the professional development of university graduates. For each of the competences, please estimate the importance for work in physics.

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1. Ability to learn<br>Be able to enter new fields through independent study. | 1 2 3 4 |
| 2. Absolute standards awareness<br>Have become familiar with "the work of genius", i.e. with the variety and delight of physical discoveries and theories, thus developing an awareness of the highest standards. | 1 2 3 4 |
| 3. Applied jobs (lower level positions)<br>Be able to carry out professional activities in the frame of applied technologies. | 1 2 3 4 |
| 4. Deep knowledge & understanding<br>Have a good understanding of the most important physical theories (logical and mathematical structure, experimental support, described physical phenomena), including a deep knowledge of the foundations of modern physics, say quantum theory, etc. | 1 2 3 4 |
| 5. Ethical awareness (relevant to physics)<br>Be able to understand the socially related problems that confront the profession and to comprehend the ethical characteristics of research and of the professional activity in physics and its responsibility to protect public health and the environment. | 1 2 3 4 |
| 6. Estimation skills<br>Be able to evaluate clearly the orders of magnitude in situations which are physically different, but show analogies, thus allowing the use of known solutions in new problems; be able to appreciate the significance of the results. | 1 2 3 4 |
| 7. Experimental skills<br>Be able to perform experiments independently, as well as to describe, analyze and critically evaluate experimental data and have become familiar with most important experimental methods. | 1 2 3 4 |
| 8. Familiarity with Basic & Applied Research<br>Have acquired an understanding of the nature and ways of physics research and of how physics research is applicable to many fields other than physics, e.g. engineering. | 1 2 3 4 |
| 9. Familiarity with frontier research<br>Have a good knowledge of the state of the art in - at least - one of the presently active physics specialties. | 1 2 3 4 |
| 10. Foreign Language skills<br>Have improved command of foreign languages through participation in courses taught in foreign language: i.e. study abroad via mobility/exchange programmes, and recognition of credits at foreign universities or research centres. | 1 2 3 4 |

| | |
|---|---|
| 11. General Jobs (high level positions)<br>Be able to carry out the following activities: promoting and developing scientific and technological innovation; planning and management of technologies related to physics; high level popularisation of scientific culture issues. | 1 2 3 4 |
| 12. Professional skills<br>Be able to gain professional flexibility through the wide spectrum of scientific techniques offered in the curriculum. | 1 2 3 4 |
| 13. Inter-disciplinary attitude / abilities<br>Acquire additional qualifications for career, through optional units other than physics. | 1 2 3 4 |
| 14. Literature search skills<br>Be able to search for and use physical and other technical literature, as well as any other sources of information relevant to research work and technical project development. Good knowledge of technical English as well as on-line computer searching skills are required too. | 1 2 3 4 |
| 15. Managing skills<br>Be able to work with a high degree of autonomy, even accepting responsibilities in project planning and in the managing of structures. | 1 2 3 4 |
| 16. Mathematical skills<br>Be able to understand and master the use of the most commonly used mathematical and numerical methods. | 1 2 3 4 |
| 17. Modeling skills<br>(a) be able to identify the essentials of a process / situation and to set up a working model of the same;<br>(b) be able to perform the required approximations; i.e. critical thinking to construct physical models<br>(c) be able to adapt available models to new experimental data | 1 2 3 4 |
| 18. Physics culture<br>Be familiar with the most important areas of physics and with those approaches, which span many areas in physics. | 1 2 3 4 |
| 19. Problem solving<br>Be able to perform calculations independently, even when a small PC or a large computer is needed, including capacity to utilize or develop computation systems or programmes for information processing, numerical calculus, simulation of physical processes. | 1 2 3 4 |
| 20. Specific communication skills 1<br>Be able to present one's own research or literature search results to professional as well as to lay audiences (orally and in written form to describe complex phenomena/problems in everyday language, as appropriate to the audience). | 1 2 3 4 |
| 21. Specific communication skills 2<br>Be able to work in an interdisciplinary team. | 1 2 3 4 |
| 22. Specific updating skills<br>Enjoy facility to remain informed of new developments and methods and be able to provide professional advice on their possible range of applications. | 1 2 3 4 |

| | |
|---|---|
| 23. Teaching ability<br>Be prepared to compete for secondary school teaching positions in physics. | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

| | | | | | |
|---|---|---|---|---|---|
| (First) | (No. ) | | (Sixth) | (No. ) | |
| (Second) | (No. ) | | (Seventh) | (No. ) | |
| (Third) | (No. ) | | (Eighth) | (No. ) | |
| (Fourth) | (No. ) | | (Ninth) | (No. ) | |
| (Fifth) | (No. ) | | (Tenth) | (No. ) | |

| Comment |
|---|
| |

| | | |
|---|---|---|
| * | * | * |

【Chemistry competence questionnaire: students, academic, employers, graduates】

Competence Survey on Globally-Required Abilities

Chemistry

Listed below are competences in the area of chemistry important for the professional development of university graduates. For each of the competences, please estimate the importance for work in chemistry.

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1. Be able to apply chemical knowledge and understanding to analysis of unfamiliar nature | 1 2 3 4 |
| 2. Be able to apply such knowledge and understanding to the solution of qualitative and quantitative problems | 1 2 3 4 |
| 3. Be able to conduct risk assessments concerning the use of chemical substances and laboratory procedures | 1 2 3 4 |
| 4. Be able to demonstrate knowledge and understanding of essential facts, concepts, principles and theories relating to chemistry | 1 2 3 4 |
| 5. Be able to interpret data derived from laboratory observations and measurements in terms of their significance and relate them to appropriate theory | 1 2 3 4 |
| 6. Be able to recognize and analyze novel problems and plans for their solution | 1 2 3 4 |
| 7. Be able to recognize and implement good measurement science | 1 2 3 4 |
| Be able to acquire an in-depth knowledge and understanding of an specific area of chemistry | 1 2 3 4 |
| 8. Be able to be familiar with major issues at the frontiers of chemical research and development | 1 2 3 4 |
| 9. Be able to read, write and present papers, and to communicate with other scientists in English | 1 2 3 4 |
| 10. Be able to search for required information using chemistry and other technical literatures | 1 2 3 4 |
| 11. Be able to implement the planning and design of research investigations | 1 2 3 4 |
| 12. Be able to process observed data via computer | 1 2 3 4 |
| 13. Be prepared to compete for secondary school teaching positions in chemistry | 1 2 3 4 |
| 14. Be able to apply latest computer and technology to chemistry | 1 2 3 4 |

| | |
|---|---|
| 15. Be able to work with a high degree of autonomy in project planning | 1 2 3 4 |
| 16. Be able to correct noisy data using error analysis and estimate | 1 2 3 4 |
| 17. Be able to have scientific arguments with other researchers | 1 2 3 4 |
| 18. Be able to take into account their physical and chemical properties in order to handle safely chemical materials | 1 2 3 4 |
| 19. Skills required for the conduct of laboratory procedures involved and use of instrumentation in synthetic and analytical work, in relation to both organic and inorganic systems | 1 2 3 4 |
| 20. Be able to implement experimental techniques | 1 2 3 4 |
| 21. Be able to learn and work in foreign university and laboratory | 1 2 3 4 |
| 22. Master mathematical and numerical methods | 1 2 3 4 |
| 23. Be able to develop professional technology for latest researching issues | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

| | | | |
|---|---|---|---|
| (First) | (No. ) | (Sixth) | (No. ) |
| (Second) | (No. ) | (Seventh) | (No. ) |
| (Third) | (No. ) | (Eighth) | (No. ) |
| (Fourth) | (No. ) | (Ninth) | (No. ) |
| (Fifth) | (No. ) | (Tenth) | (No. ) |

| Comment |
|---|
| |

| | | |
|---|---|---|
| * | * | * |

【Mechanical engineering competence questionnaire: students, academic, employers, graduates】

Competence Survey on Globally-Required Abilities

Mechanical Engineering

Listed below are competences in the area of mechanical engineering important for the professional development of university graduates. For each of the competences, please estimate the importance for work in mechanical engineering.

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1. Ability to apply knowledge of the basic and applied sciences of mechanical engineering | 1 2 3 4 |
| 2. Ability to identify and implement the most appropriate technologies for the context in hand | 1 2 3 4 |
| 3. Capacity to create, innovate and contribute to technological development | 1 2 3 4 |
| 4. Capacity to conceive, analyze, design and experimentally produce mechanical products and systems | 1 2 3 4 |
| 5. Skills in planning and executing mechanical engineering projects | 1 2 3 4 |
| 6. Capacity to supervise, inspect and monitor mechanical engineering systems | 1 2 3 4 |
| 7. Capacity to operate, maintain and rehabilitate mechanical engineering systems | 1 2 3 4 |
| 8. Skills in evaluating the environmental and socio-economic impact of mechanical projects | 1 2 3 4 |
| 9. Capacity to model and simulate mechanical engineering systems and processes | 1 2 3 4 |
| 10. Skills in selecting, mobilizing and administering material resources, tools and equipment cost-effectively | 1 2 3 4 |
| 11. Capacity to integrate legal, economic and financial aspects in decision-making in mechanical engineering projects | 1 2 3 4 |
| 12. Capacity for spatial abstraction, graphic representation and engineering drawings | 1 2 3 4 |
| 13. Providing mechanical engineering solutions to societal problems for sustainable development | 1 2 3 4 |
| 14. Skills in safety and risk management in mechanical engineering systems | 1 2 3 4 |
| 15. Skills in using information technologies, software and tools for mechanical engineering | 1 2 3 4 |
| 16. Capacity to interact with multidisciplinary groups towards developing integrated | 1 2 3 4 |

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| solutions | |
| 17. Skills in employing quality control techniques in managing materials, products, resources and services | 1 2 3 4 |
| 18. Capacity to conduct life cycle assessment for products and systems | 1 2 3 4 |
| 19. Capacity to employ mechanical engineering skills to transform local natural resources into products or services through value addition | 1 2 3 4 |
| 20. Be able to solve unsolved problems in mechanical engineering | 1 2 3 4 |
| 21. Be able to develop professional technology for latest researching issues | 1 2 3 4 |
| 22. Be able to learn and work in foreign university and laboratory | 1 2 3 4 |
| 23. Master mathematical and numerical methods | 1 2 3 4 |
| 24. Be able to develop professional technology for latest researching issues | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

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|---|---|---|---|
| (First) | (No. ) | (Sixth) | (No. ) |
| (Second) | (No. ) | (Seventh) | (No. ) |
| (Third) | (No. ) | (Eighth) | (No. ) |
| (Fourth) | (No. ) | (Ninth) | (No. ) |
| (Fifth) | (No. ) | (Tenth) | (No. ) |

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【Civil engineering competence questionnaire: students, academic, employers, graduates】

Competence Survey on Globally-Required Abilities

Civil Engineering

Listed below are competences in the area of civil engineering important for the professional development of university graduates. For each of the competences, please estimate the importance for work in civil engineering.

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1. Ability to apply knowledge of the basic sciences and sciences of civil engineering | 1 2 3 4 |
| 2. Ability to identify and implement the most appropriate technologies for the context in hand | 1 2 3 4 |
| 3. Capacity to create, innovate and contribute to technological development | 1 2 3 4 |
| 4. Capacity to conceive, analyze, calculate and design civil engineering works | 1 2 3 4 |
| 5. Skill in planning and programming civil engineering works and services | 1 2 3 4 |
| 6. Capacity to build, supervise, inspect and evaluate civil engineering works | 1 2 3 4 |
| 7. Capacity to operate, maintain and rehabilitate civil engineering works | 1 2 3 4 |
| 8. Skill in evaluating the environmental and social impact of civil works | 1 2 3 4 |
| 9. Capacity to model and simulate civil engineering systems and processes | 1 2 3 4 |
| 10. Capacity to direct and lead human resources | 1 2 3 4 |
| 11. Skill in administering material resources, teams and equipment | 1 2 3 4 |
| 12. Capacity for spatial abstraction, graphic representation and engineering drawings | 1 2 3 4 |
| 13. Capacity to propose solutions that will contribute to sustainable development | 1 2 3 4 |
| 14. Skill in preventing and evaluating accidents and risks in civil engineering works | 1 2 3 4 |
| 15. Skill in handling and interpreting field information | 1 2 3 4 |
| 16. Capacity to interact with multidisciplinary groups towards developing integrated solutions | 1 2 3 4 |
| 17. Skill in employing quality control techniques in managing civil engineering materials and services | 1 2 3 4 |
| 18. Capacity to conduct life cycle assessment for products and systems | 1 2 3 4 |
| 19. Capacity to employ civil engineering skills to transform local natural resources into products or services through value addition | 1 2 3 4 |

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| 20. Be able to solve unsolved problems in civil engineering | 1 2 3 4 |
| 21. Be able to develop professional technology for latest researching issues | 1 2 3 4 |
| 22. Be able to learn and work in foreign university and laboratory | 1 2 3 4 |
| 23. Master mathematical and numerical methods | 1 2 3 4 |
| 24. Be able to develop professional technology for latest researching issues | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

| | | | |
|---|---|---|---|
| (First) | (No. ) | (Sixth) | (No. ) |
| (Second) | (No. ) | (Seventh) | (No. ) |
| (Third) | (No. ) | (Eighth) | (No. ) |
| (Fourth) | (No. ) | (Ninth) | (No. ) |
| (Fifth) | (No. ) | (Tenth) | (No. ) |

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【History competence questionnaire: students, academic, employers, graduates】

Competence Survey on Globally-Required Abilities

History

Listed below are competences in the area of history important for the professional development of university graduates. For each of the competences, please estimate the importance for work in history.

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1. Ability to think critical about the relationship between current events and the past. | 1 2 3 4 |
| 2. Ability to comment, annotate or edit texts and documents correctly according to the canons of the discipline. | 1 2 3 4 |
| 3. Ability to communicate orally in foreign languages using the terminology and techniques accepted in history. | 1 2 3 4 |
| 4. Ability to communicate orally in one's own language using the terminology and techniques accepted in history. | 1 2 3 4 |
| 5. Ability to define research topics that contribute to the development of history. | 1 2 3 4 |
| 6. Ability to give narrative form to research results according to the canons of the discipline. | 1 2 3 4 |
| 7. Ability to identify and utilize appropriately sources of information (bibliography, documents, oral testimony etc.) for research project. | 1 2 3 4 |
| 8. Ability to organize complex historical information in coherent form. | 1 2 3 4 |
| 9. Ability to read historiographical texts or original documents in one's own language; to summarize or transcribe and catalogue information as appropriate. | 1 2 3 4 |
| 10. Ability to read historical texts or original documents in other languages; to summarize or transcribe and catalogue information as appropriate. | 1 2 3 4 |
| 11. Ability to use computer and internet resources and techniques elaborating historical or related data (using statistical or creating databases, etc.). | 1 2 3 4 |
| 12. Ability to write in one's own language using correctly the various types of historical writing. | 1 2 3 4 |
| 13. Ability to use tools of human and social sciences (e.g., anthropology, sociology, philosophy etc.). | 1 2 3 4 |
| 14. Ability to recognize and respect for diversity in cultural background. | 1 2 3 4 |
| 15. Ability to link the methods and issues of different branches (economic, social, | 1 2 3 4 |

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| politic, etc.) of historical research. | |
| 16. Awareness of the differences in historical outlooks in various periods and contexts. | 1 2 3 4 |
| 17. Awareness of the issues and themes of present day in historical debate. | 1 2 3 4 |
| 18. Awareness of the on-going nature of historical research and debate. | 1 2 3 4 |
| 19. Detailed knowledge of one or more specific periods of the human past. | 1 2 3 4 |
| 20. Knowledge of ancient languages. | 1 2 3 4 |
| 21. Knowledge and ability to use information retrieval tools, such as bibliographical repertoires, archival inventories. | 1 2 3 4 |
| 22. Knowledge and ability to use the specific tools necessary to study documents of particular periods. | 1 2 3 4 |
| 23. Knowledge of didactics of history. | 1 2 3 4 |
| 24. Knowledge of Asian history | 1 2 3 4 |
| 25. Knowledge of the national or local history. | 1 2 3 4 |
| 26. Knowledge of one's own national history. | 1 2 3 4 |
| 27. Knowledge of the general diachronic framework of the past. | 1 2 3 4 |
| 28. Knowledge of world history. | 1 2 3 4 |
| 29. Understanding the social role of the historian. | 1 2 3 4 |
| 30. Ability to design, organize, and develop historical research projects. | 1 2 3 4 |
| 31. Ability to take part in interdisciplinary research work. | 1 2 3 4 |
| 32. Ability to recognize, contribute to, and participate in socio-cultural community activities. | 1 2 3 4 |
| 33. Ability to apply historical education techniques and methods. | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

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| (First) | (No. | ) | (Sixth) | (No. | ) |
| (Second) | (No. | ) | (Seventh) | (No. | ) |
| (Third) | (No. | ) | (Eighth) | (No. | ) |
| (Fourth) | (No. | ) | (Ninth) | (No. | ) |
| (Fifth) | (No. | ) | (Tenth) | (No. | ) |

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【Business competence questionnaire: students, academic, employers, graduates】

Competence Survey on Globally-Required Abilities

Business Administration

(Listed below are competences in the area of business administration important for the professional development of university graduates. For each of the competences, please estimate the importance for work in business administration.)

| For each competence, circle one number for its importance | Importance<br>Weak → Strong |
|---|---|
| 1. Developing strategic, tactical and operational planning skills | 1 2 3 4 |
| 2. Identifying and administering business risks in organizations | 1 2 3 4 |
| 3. Identifying and optimizing business processes within organizations | 1 2 3 4 |
| 4. Administrating an integral logistic system | 1 2 3 4 |
| 5. Developing, implementing, and managing business control systems | 1 2 3 4 |
| 6. Identifying functional inter relations within organizations | 1 2 3 4 |
| 7. Evaluating the legal framework applied to business control systems | 1 2 3 4 |
| 8. Producing, evaluating and managing business projects within different types of organizations | 1 2 3 4 |
| 9. Interpreting accounting and financial information for the taking of managerial decisions | 1 2 3 4 |
| 10. Using costing information for planning, control and decision making | 1 2 3 4 |
| 11. Taking decisions regarding investments, financing and management of financial resources within a company | 1 2 3 4 |
| 12. Leadership skills, for the achievement of and following up of aims within the organization | 1 2 3 4 |
| 13. Managing and developing human talent within the organization | 1 2 3 4 |
| 14. Identifying ethical and cultural aspects of reciprocal impact within the organization and the social environment | 1 2 3 4 |
| 15. Improving and innovating administrative processes | 1 2 3 4 |
| 16. Detecting opportunities for undertaking new business and or developing new products | 1 2 3 4 |

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| 17. Using information and communication technology in management | 1 2 3 4 |
| 18. Managing the technological infrastructure of a business | 1 2 3 4 |
| 19. Formulating and optimizing information systems for management | 1 2 3 4 |
| 20. Formulating market plans | 1 2 3 4 |
| 21. Ability to understanding, reading, speaking, and writing in English. | 1 2 3 4 |
| 22. Ability to understand business manners particularly used in Japan. | 1 2 3 4 |
| 23. Ability to understand Japanese economic structures and their history. | 1 2 3 4 |
| 24. Ability to understand other Asian countries' society and economical structures, and to build relation to those countries. | 1 2 3 4 |

Please choose 10 top competences you think most important from the above list

| | | | |
|---|---|---|---|
| (First) | (No. ) | (Sixth) | (No. ) |
| (Second) | (No. ) | (Seventh) | (No. ) |
| (Third) | (No. ) | (Eighth) | (No. ) |
| (Fourth) | (No. ) | (Ninth) | (No. ) |
| (Fifth) | (No. ) | (Tenth) | (No. ) |

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