Lifelong Learning Programme

Improving Teaching Effectiveness in Chemical Engineering Education

P1. Newcastle University

P2. UNIVERSITÉ DE LORRAINE

P3. INTERNATIONAL BALKAN UNIVERSITY

P4. U.PORTO

P5. STU SLOVENSKÁ TECHNICKÁ UNIVERZITA V BRATISLAVE

P6. technische universität dortmund

J. Glassey[1]

L.M. Madeira[4]

N. Kockmann[6]

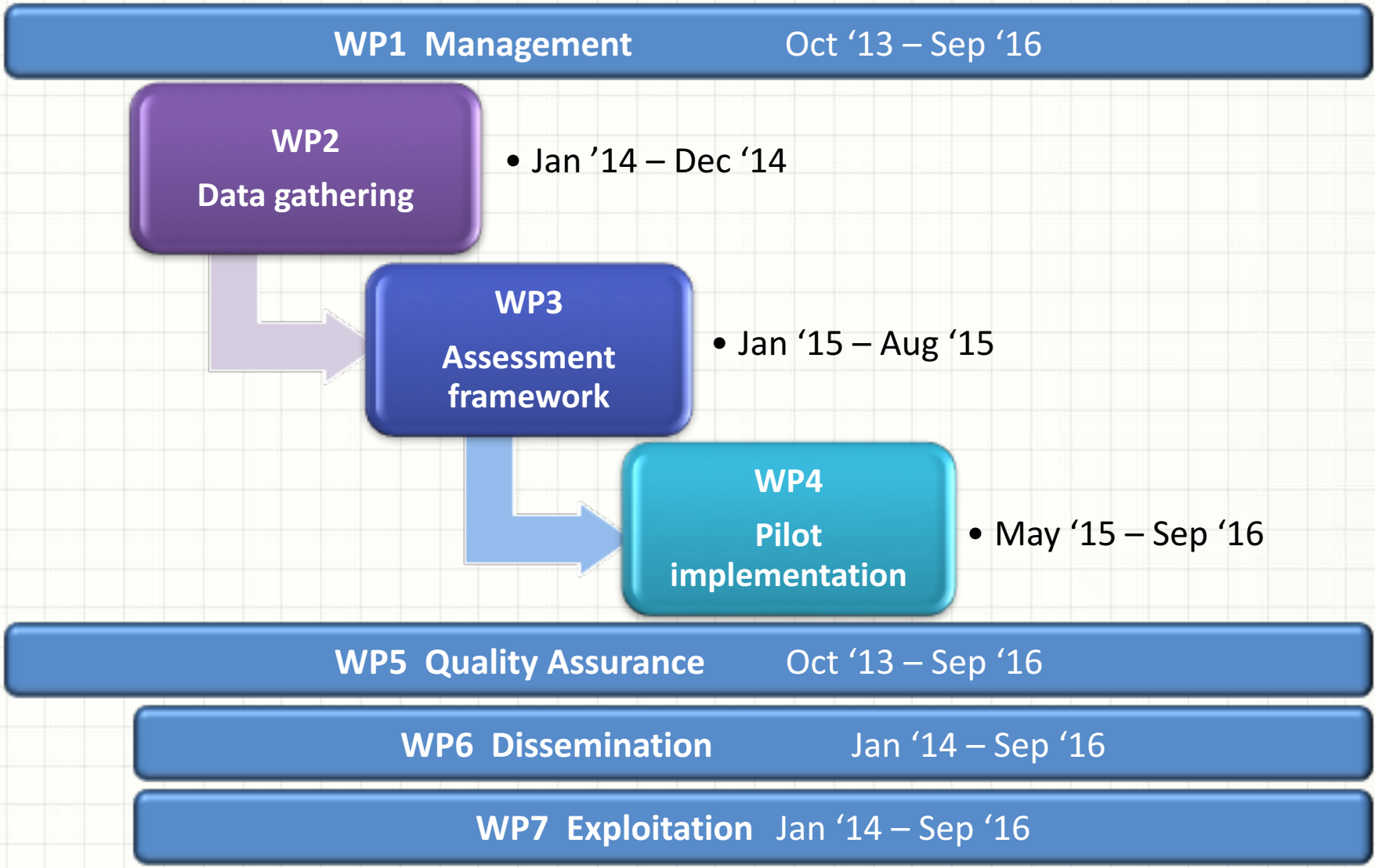
M. Polakovic[5]

E. Schaer[2]

V. Meshko[3]

Nr	Name of organisation	Type of institution	City	Country
1	Czech Society of Chemical Engineering	Professional membership association	Prague	CZ
2	Institution of Chemical Engineers (IChemE)	Global Professional membership organisation	Rugby	UK
3	Portuguese Engineers's Association ("Ordem dos Engenheiros") - Chemical and Biological Engineering Section	Professional membership association	Lisbon	PT
4	Slovak Society f oChemical Engineering	Professional membership association	Bratislava	SK
5	Société Française de Génie des Procédés	Professional membership association	Paris	FR
6	DECHEMA; ProcessNet	Professional membership association Association of chem.eng. industry and profession	Frankfurt am Main	DE
7	Industrial Advisory Board, CEAM/Chemistry	Independent Industrial advisory board	Newcastle upon Tyne	UK
8	ThyssenKrupp Uhde, GmbH	Private – chemical engineering company	Dortmund	DE
9	Portuguese Society for Engineering Education	HE association	Aveiro	PT
10	Budapest University of Technology and Economics	HE Institution	Budapest	HU
11	Danish Technical University, Lyngby	HE Institution	Lyngby	DK
12	Martin-Luther-University Halle-Wittenberg	HE Institution	Halle	DE
13	Technical University Eindhoven	HE Institution	Eindhoven	NL
14	University of Belgrade	HE Institution	Belgrade	RS
15	University of Chemical Technology and Metallurgy	HE Institution	Sofia	BG
16	University of Istanbul, Faculty of Engineering	HE Institution	Istanbul	TR

Project overview



OBJECTIVES

1. Review the learning outcomes of a chemical engineering education

2. Promote closer involvement of employer organisations in chemical engineering curriculum formation by carrying out focus groups

3. Establish state-of-the art in assessing the effectiveness of teaching of core chemical engineering knowledge

OBJECTIVES

4. Define various indicators of the effectiveness of teaching in chemical engineering higher education

5. Investigate in more depth methods of effectively acquiring employability competencies

6. Use decision making technology and multi-objective optimisation to identify the most appropriate evaluation methods

7. Test the framework at partner institutions focusing on various pedagogic methodologies

Learning Outcomes

- Review the learning outcomes of a chemical engineering education

1. Underpinning Mathematics and Science
2. Core Chemical Engineering
   - *Fundamentals*
   - *Mathematical Modelling and Quantitative Methods*
   - *Process and Product Technology*
   - *Systems*

Learning Outcomes

- Review the learning outcomes of a chemical engineering education

2. Core Chemical Engineering
    - *Safety*
    - *Sustainability, Economics*
3. Engineering Practice and Design

Learning Outcomes

4. Advanced level – Masters programmes

- ***Depth***
- ***Engineering practice and design***
- ***Breadth***

5. Embedded Learning – General Transferable Skills

Sources

IChemE accreditation guidelines revision (EAF, Mar 2014)

EFCE Bologna recommendation, http://www.efce.info/Bologna_Recommendation

ABET Criteria for Accrediting Engineering Programs, 2012 – 2013, http://www.abet.org/DisplayTemplates/DocsHandbook.aspx?id=3143#sthash.r7bz7jH3.dpuf

ASIIN, Subject-specific criteria relating to the accreditation of Bachelor's and Master's degree programmes in mechanical engineering, process engineering and chemical engineering Germany, 2011

Engineers Australia, Accreditation management system education programs at the level of professional engineer, https://www.engineersaustralia.org.au/about-us/accreditation-management-system-professional-engineers

Sources

MÜDEK, Association for Evaluation and Accreditation of Engineering Programs, Criteria for Evaluating First Cycle (bachelor) Engineering Programs, Available on http://www.mudek.org.tr access date 15.12.2013

Ružica Beljo Lučić et all. CROQF_Introduction_to_qualifications, available on http://www.azvo.hr/index.php/en/visoko-obrazovanje/dokumenti access date 03.02.2014

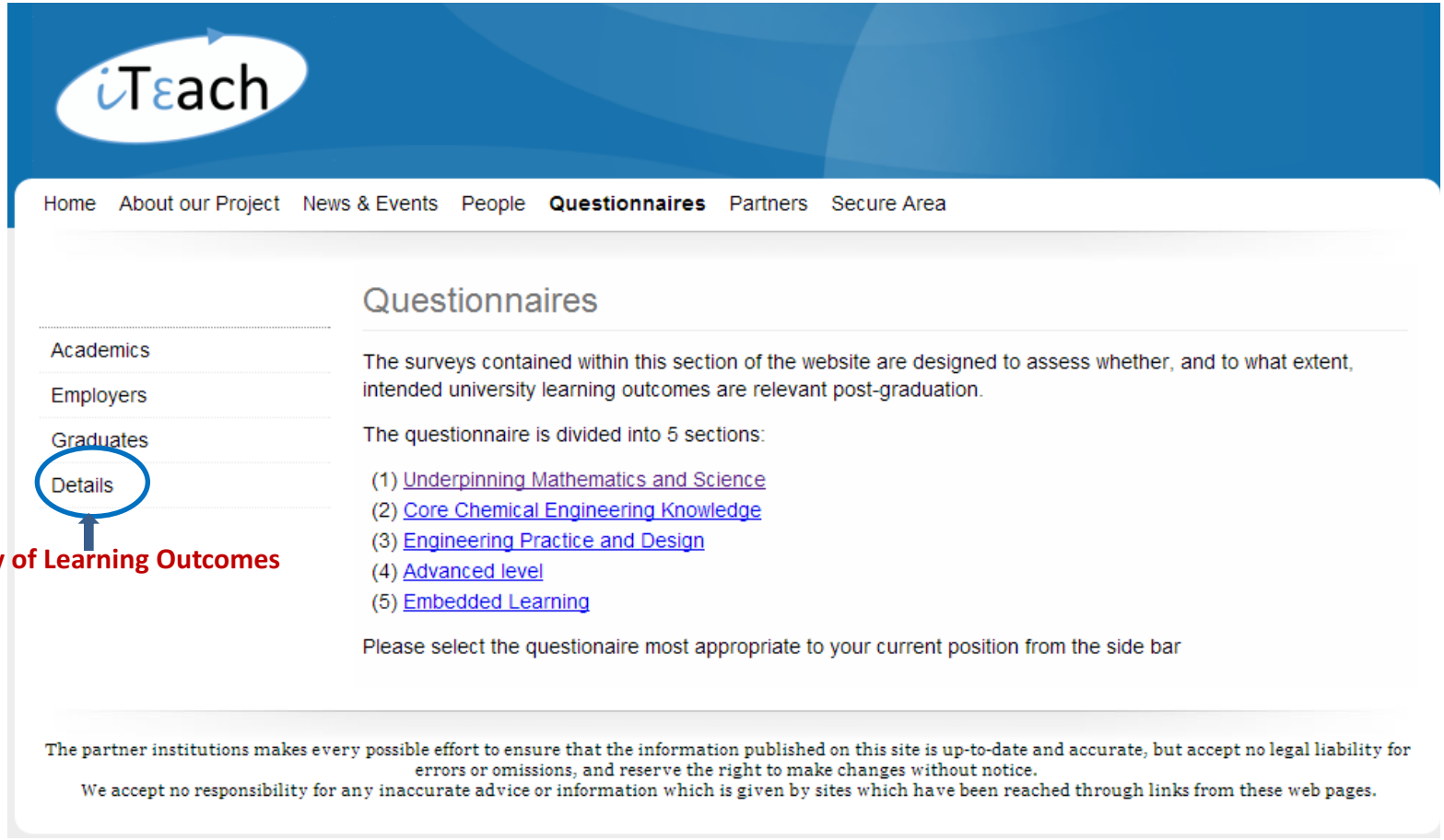
Commission for accreditation and quality assurance, Serbia; http://www.kapk.org

Publication Analysis and overview of NQF developments in European countries. Annual report 2012, available on http://www.ond.vlaanderen.be/hogeronderwijs/bologna/qf/national.asp , access date 03.02.2014

National Evaluation and Accreditation Agency, available on http://www.neaa.government.bg/en access date 04.02.201

Slovak accreditation requirements for chemical engineering degrees,

QUESTIONNAIRES



Glossary of Learning Outcomes

1. Review the learning outcomes of a chemical engineering education

WP2 Data gathering

- Surveys for academics, industrialists and graduate developed, tested and released in May 2014

Notes on Data Analysis

Step 1. Data screening

- All personal information was omitted from the data set.
- In the case of double –entries only the complete version was retained

WP2 Data gathering

- Surveys for academics, industrialists and graduate developed, tested and released in May 2014

Step 2. Descriptive analysis

- Measures of central tendency (M, SD, Min, Max) and frequency counts were calculated for all Likert- scale type questions
- Frequency counts were conducted for single –choice answers

WP2 Data gathering

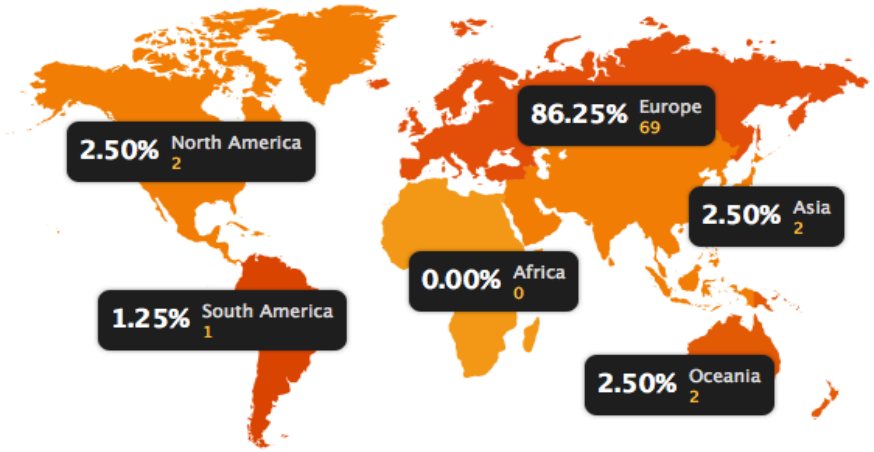
- Surveys for academics, industrialists and graduate developed, tested and released in May 2014

Step 3. Group comparisons

- Independent samples t-tests were conducted for all Likert scale type questions to compare differences between geographical regions and, were applicable, position and company size

Entries by Region

2014



Top Countries

France	17.50%	
United Kingdom	13.75%	
Macedonia	10.00%	
Belgium	8.75%	
Portugal	8.75%	
Slovakia	5.00%	
Ireland	3.75%	
Sweden	3.75%	
Germany	3.75%	
Italy	2.50%	

Top Cities

Skopje	8.75%	7
Bratislava	5.00%	4
Nancy	3.75%	3
Baltimore	2.50%	2
London	2.50%	2
Gothenburg	2.50%	2
Belgrade	2.50%	2
Dublin	2.50%	2
Lisboa	2.50%	2
Melbourne	2.50%	2

Entries by Software

2014

Internet Browser

Chrome	21.25%	17
Safari	8.75%	7
Internet Explorer	16.25%	13
Firefox	0.00%	0
Opera	0.00%	0
Other	53.75%	43

Desktop Operating System

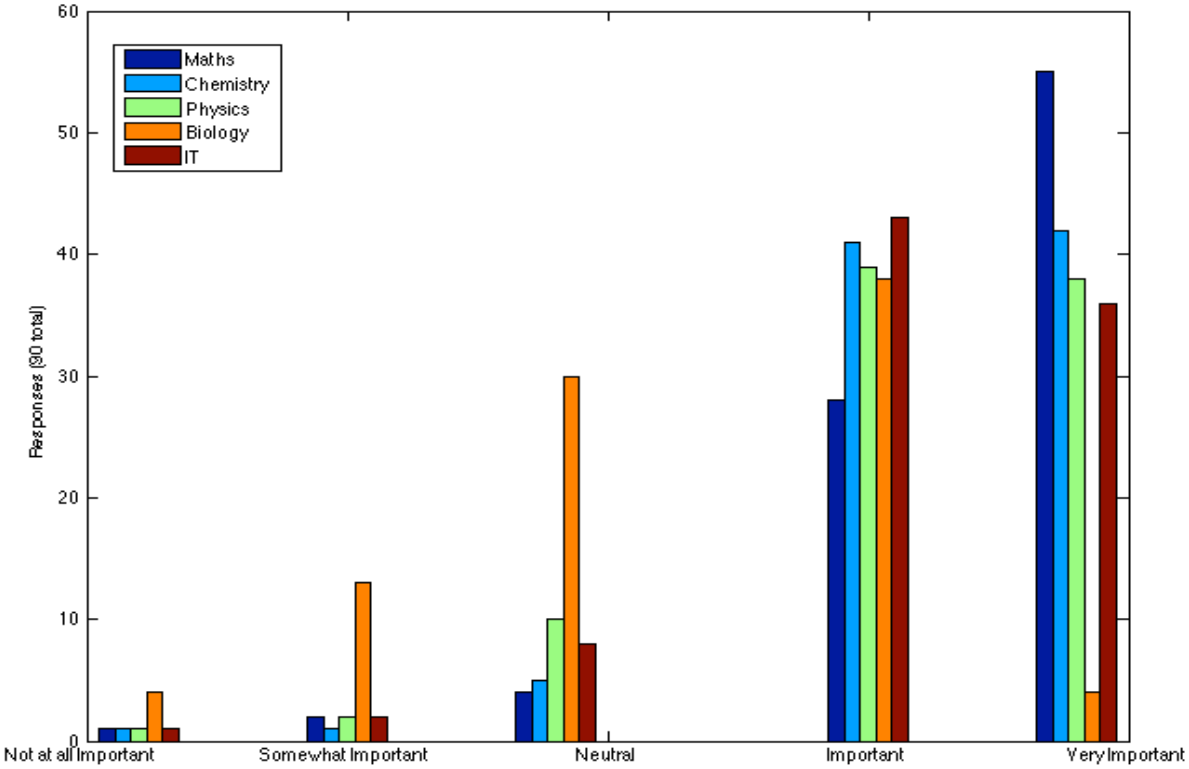
Linux	1.25%	1
Mac OS X	8.75%	7
Windows	36.25%	29
Other	53.75%	43

Initial Results –

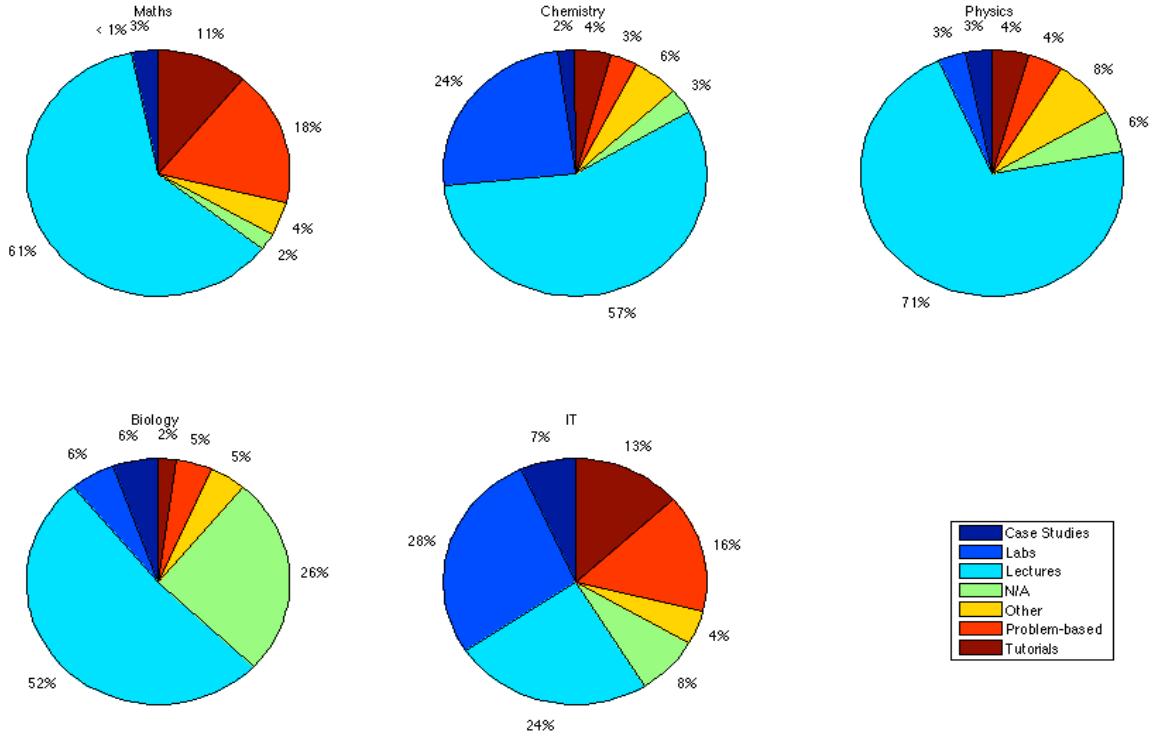
Academic Opinion Survey

1.Underpinning

a. How important do you consider the following attributes for graduates' careers after graduation?

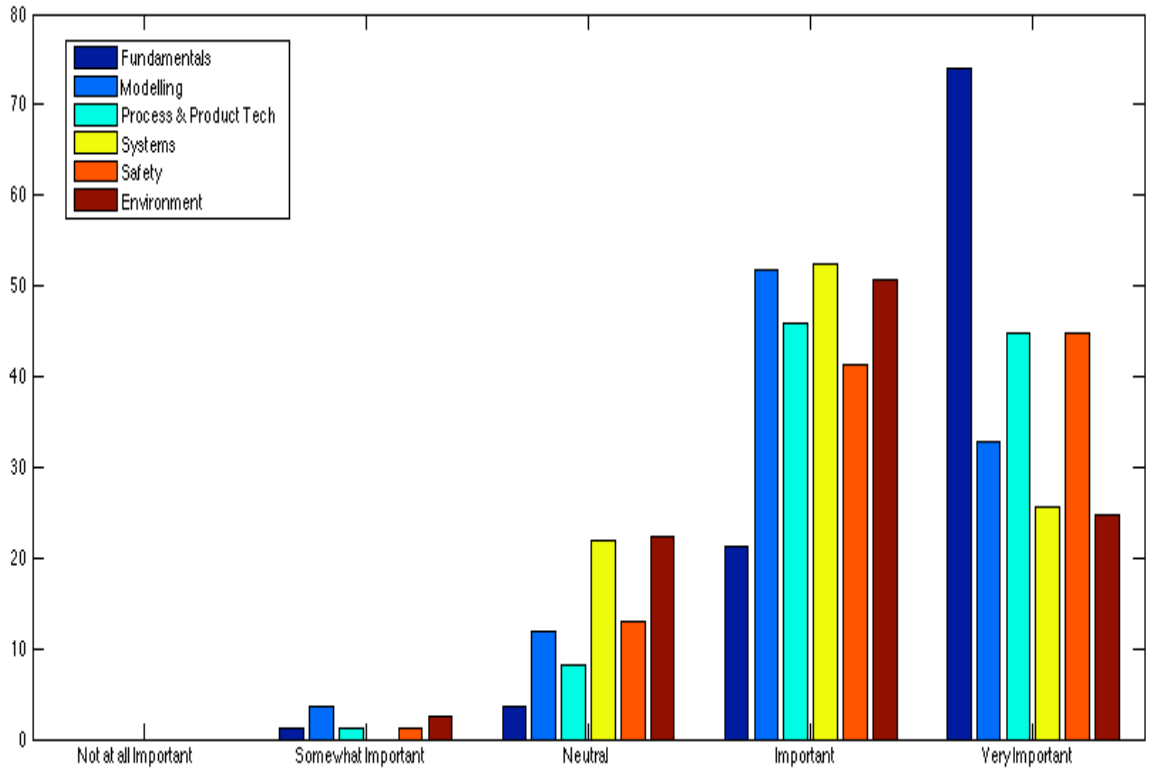


b. What is your institution's predominant method of teaching each of these competencies?

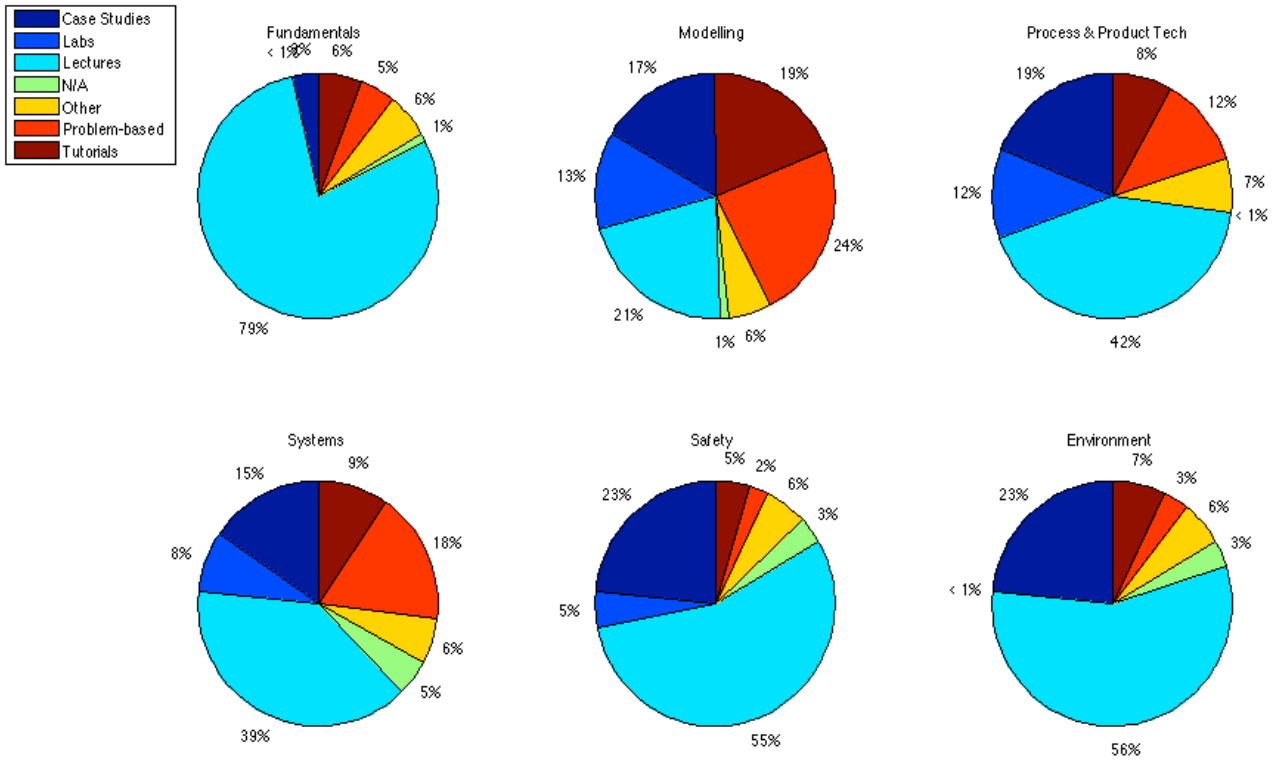


2. Core Chemical Engineering

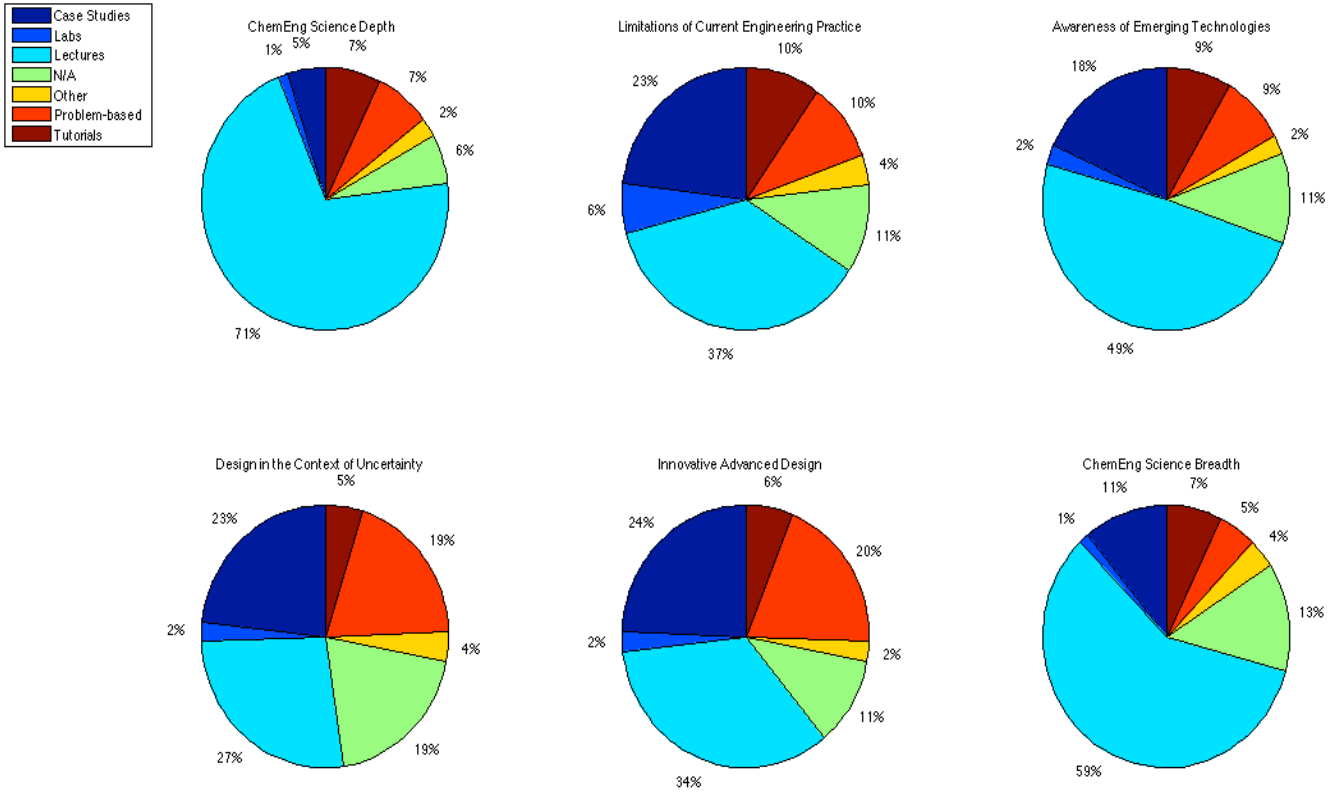
a. How important do you consider the following attributes for graduates' careers after graduation?



b. What is your institution's predominant method of teaching each of these competencies?



b. What is your institution's predominant method of teaching each of these competencies? - MASTER LEVEL

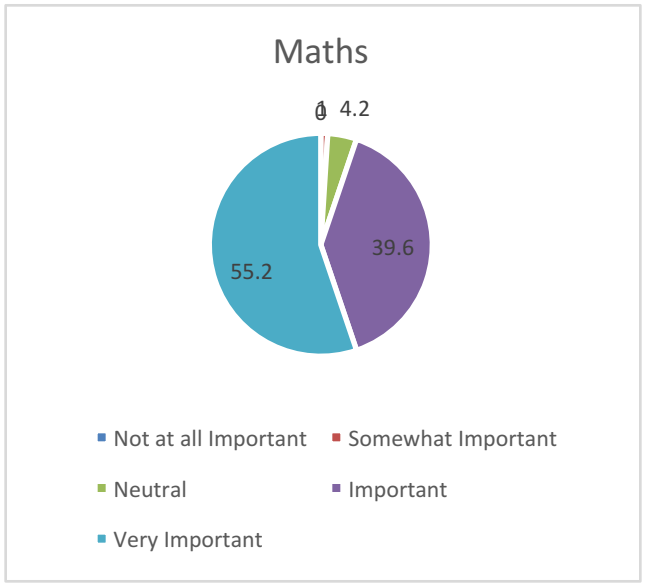


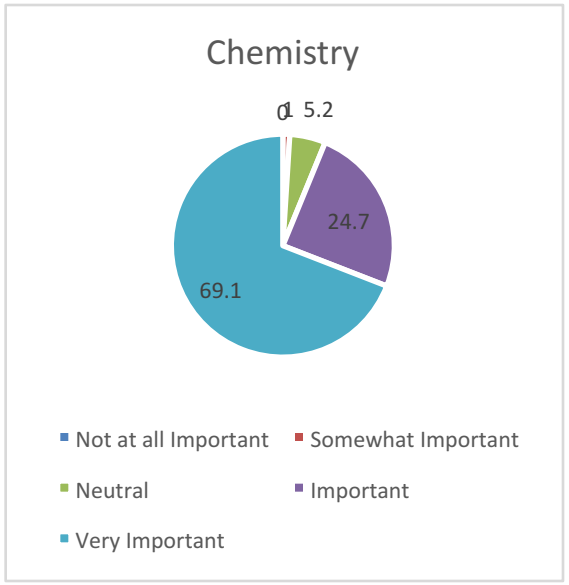
Initial Results –

Employer Opinion Survey

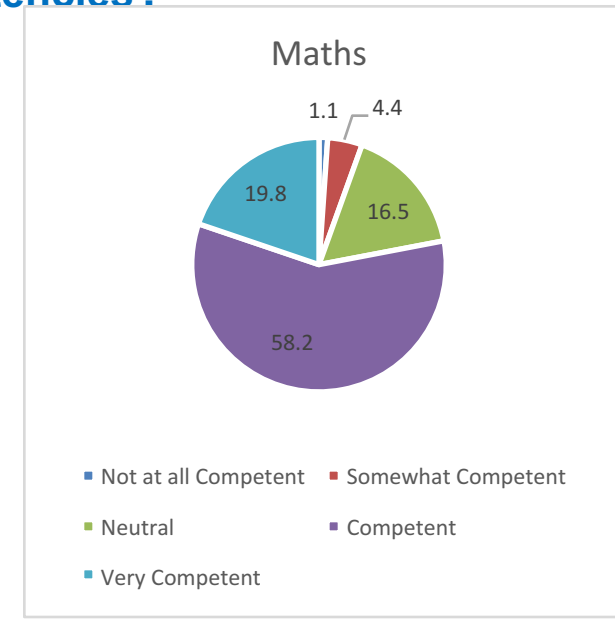
1. UNDERPINNING

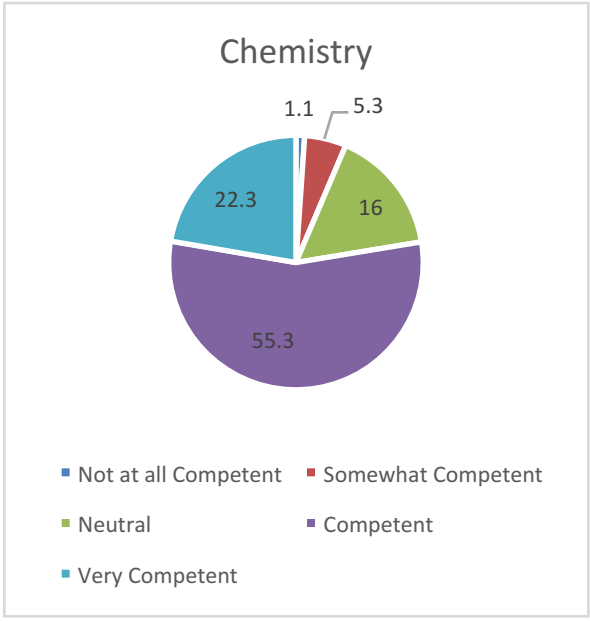
a. How important do you consider the following graduate attributes for your business?





b. According to your experience, how would you rate recent university graduates on each of these competencies?





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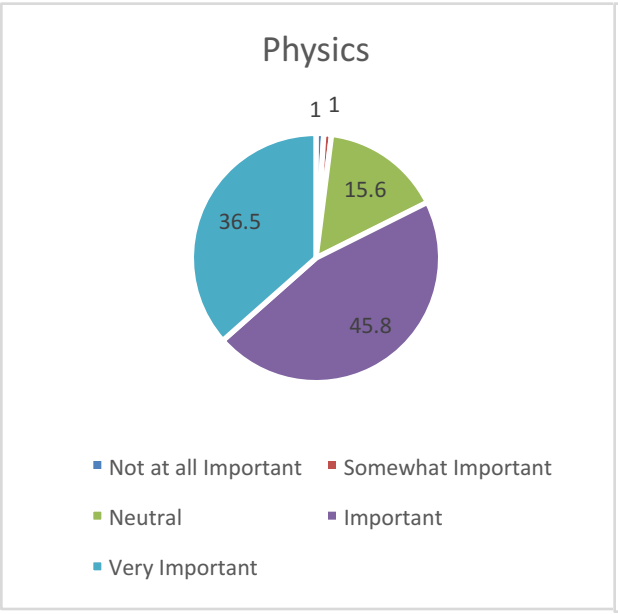

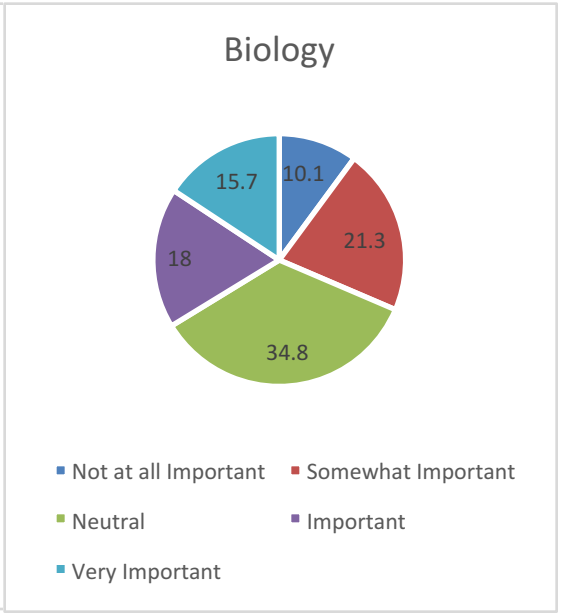

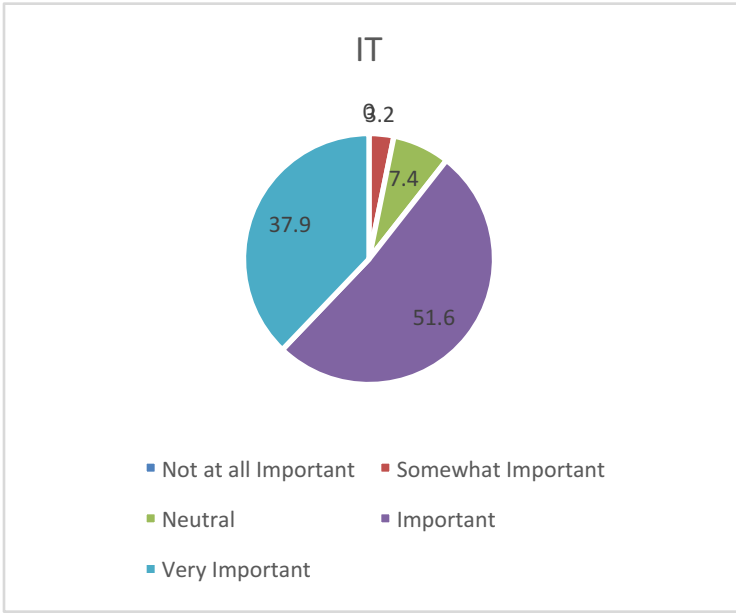

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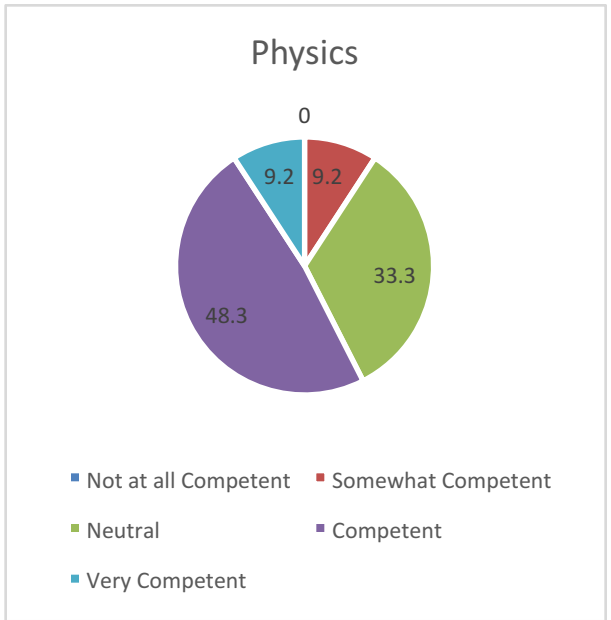

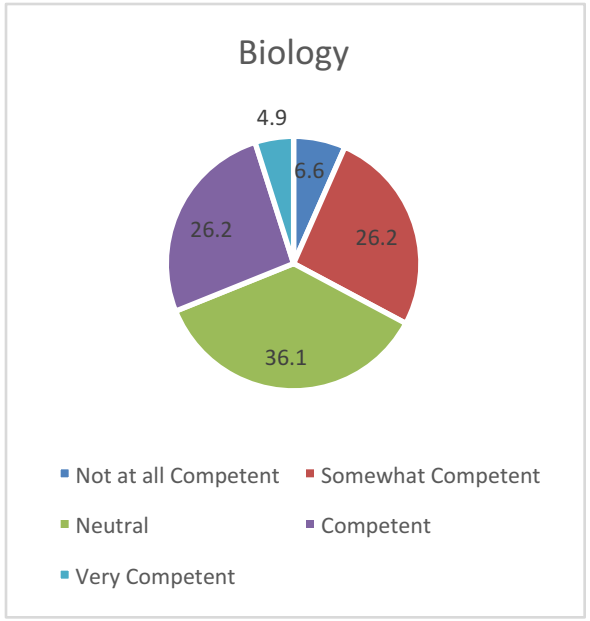

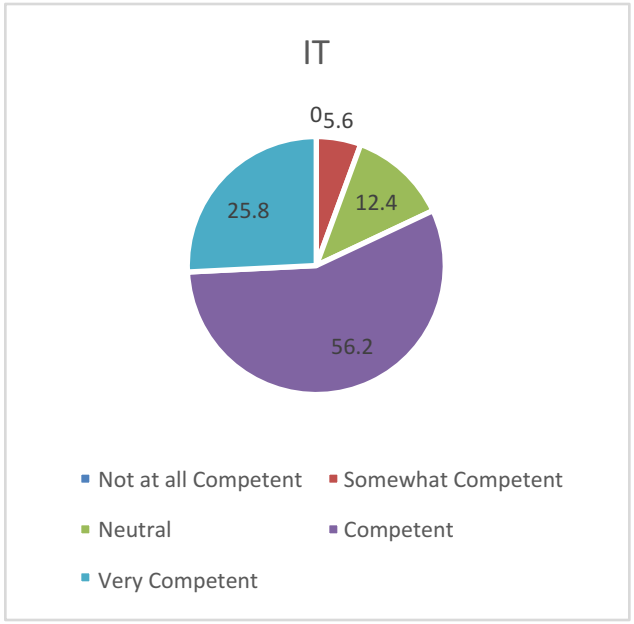

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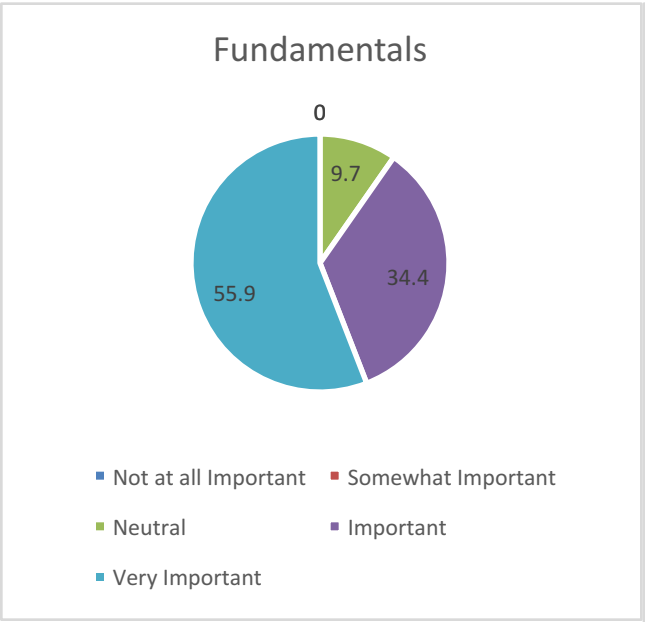

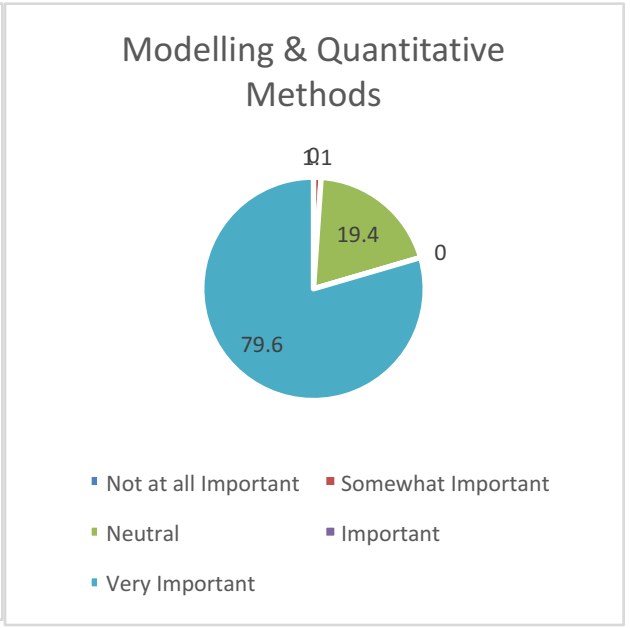

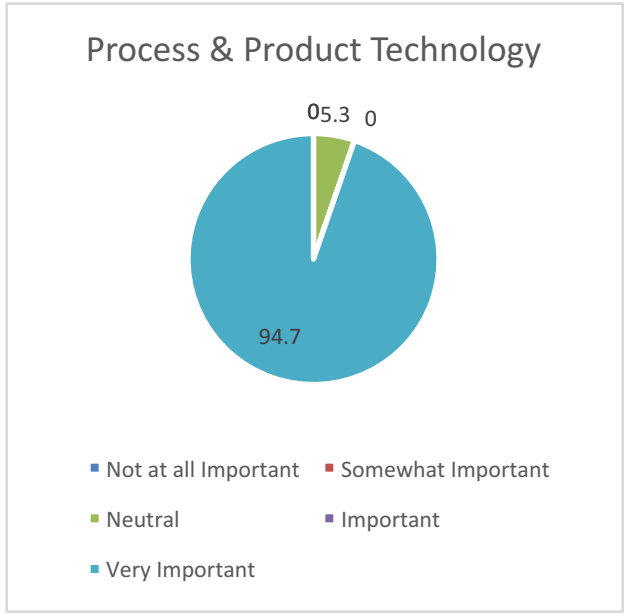

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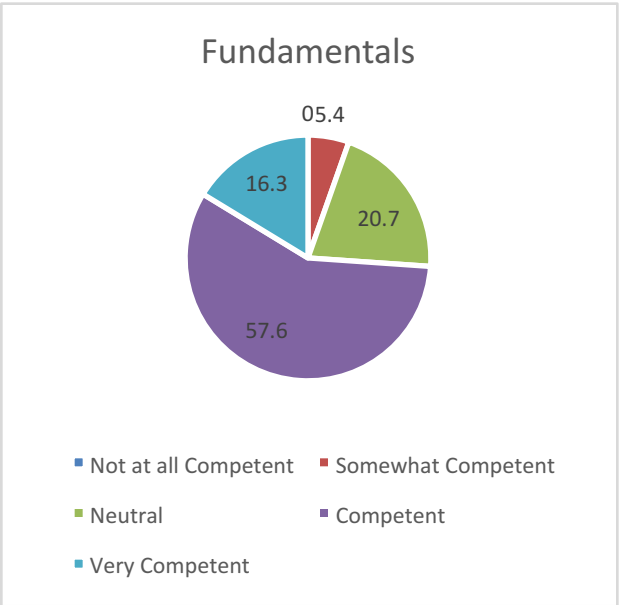

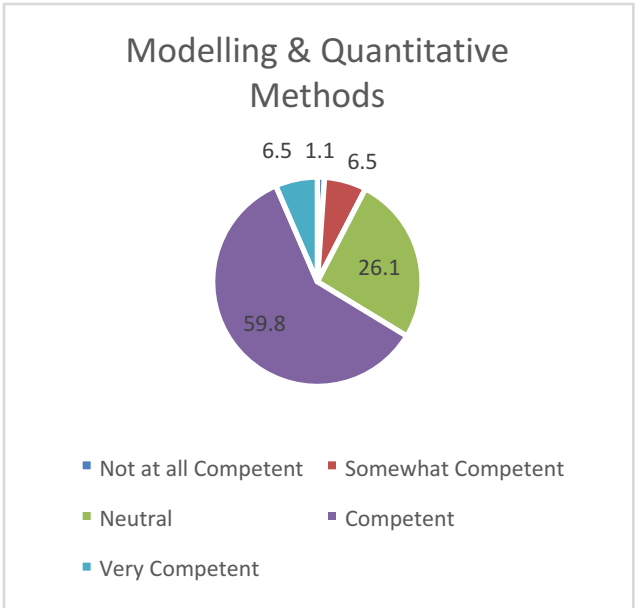

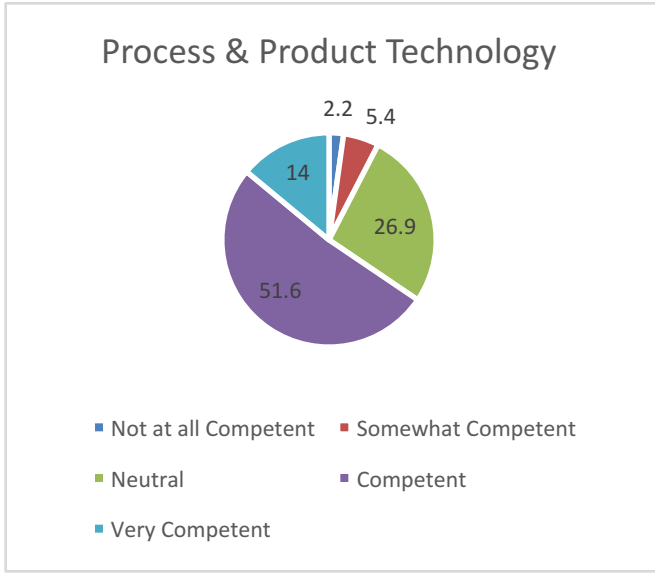

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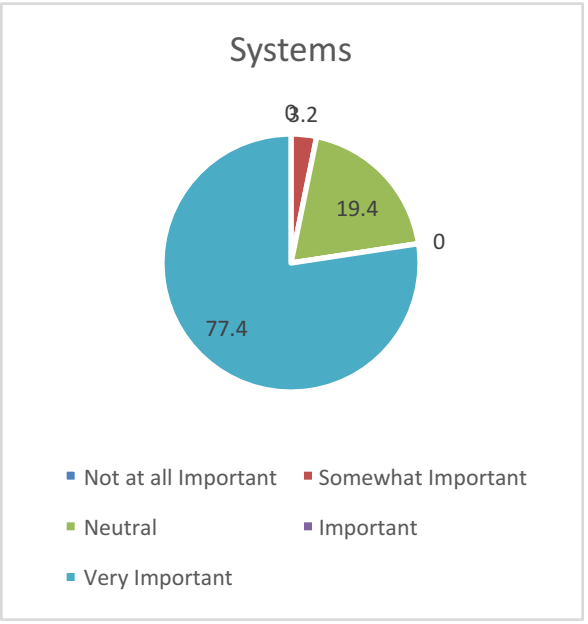

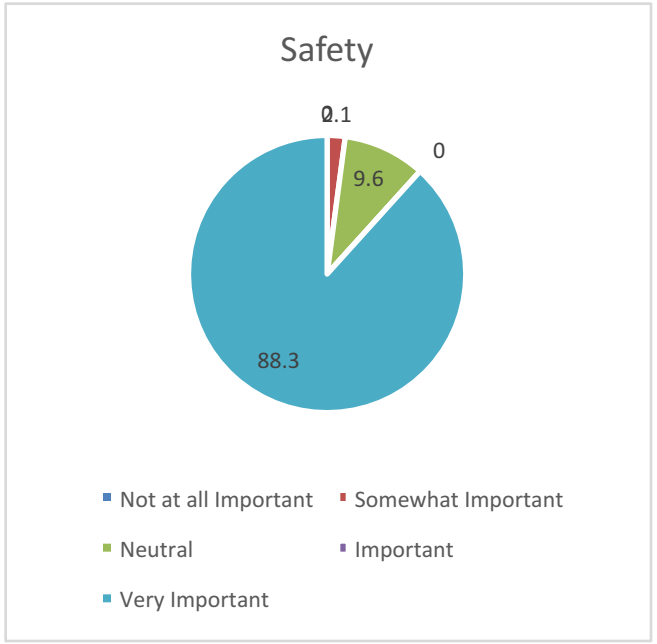

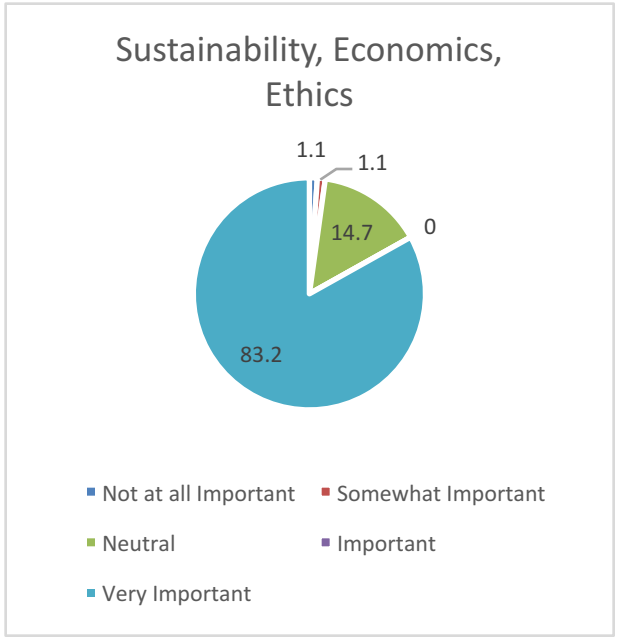

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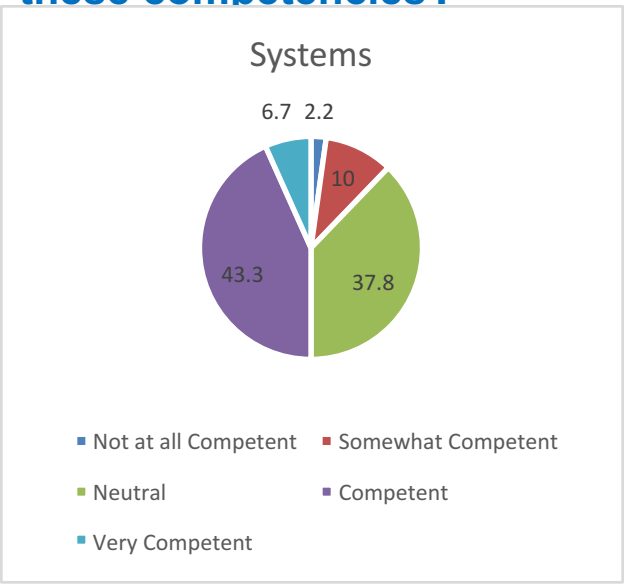
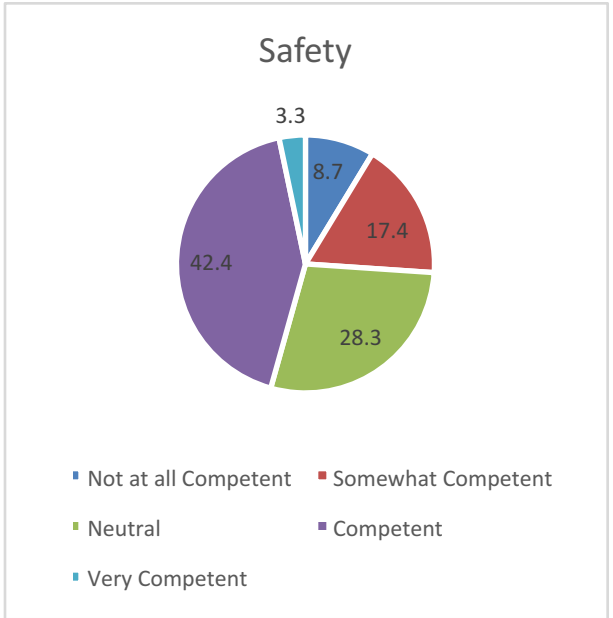
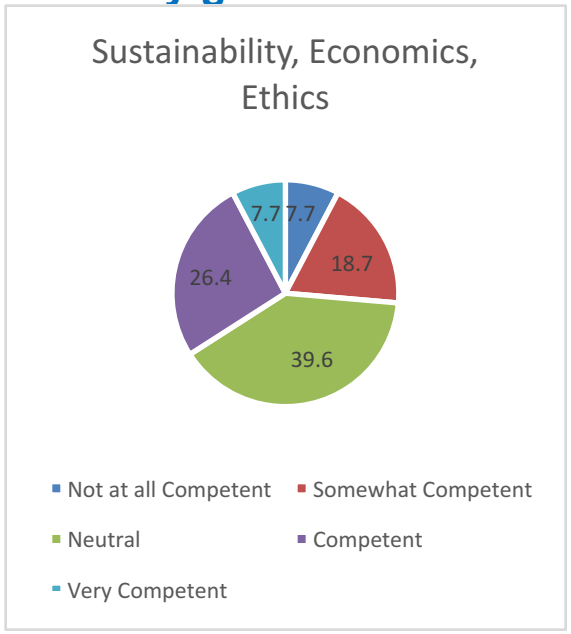
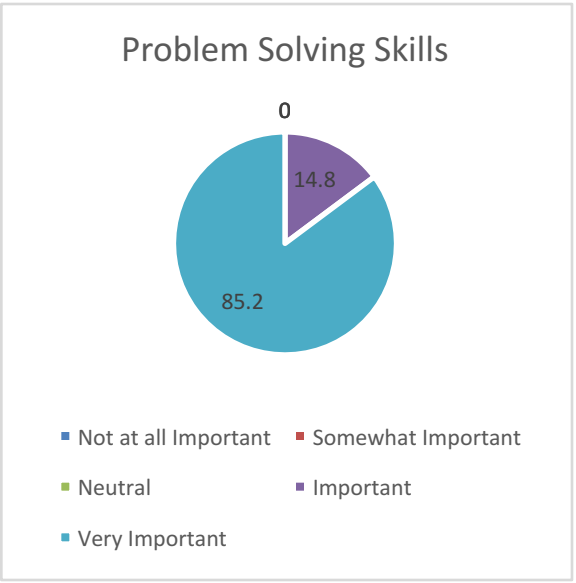


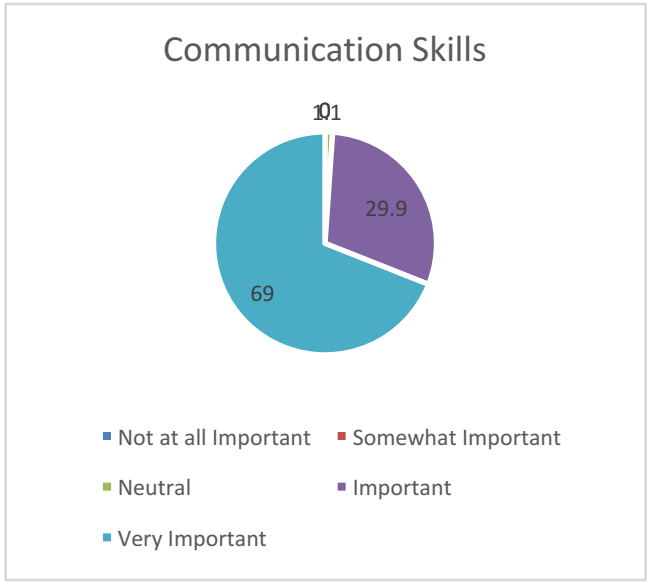


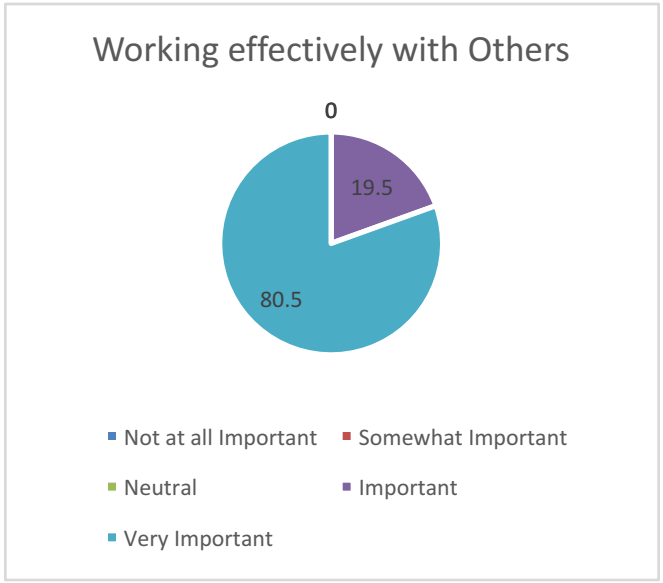


5. Employability

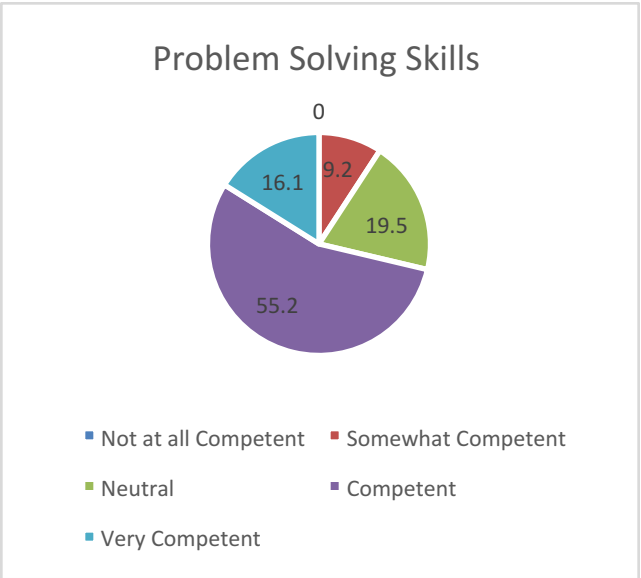
a. How important do you consider the following graduate attributes for your business?

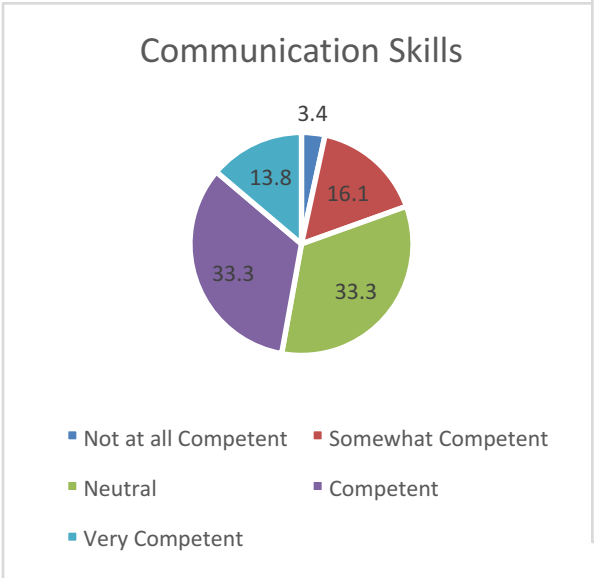


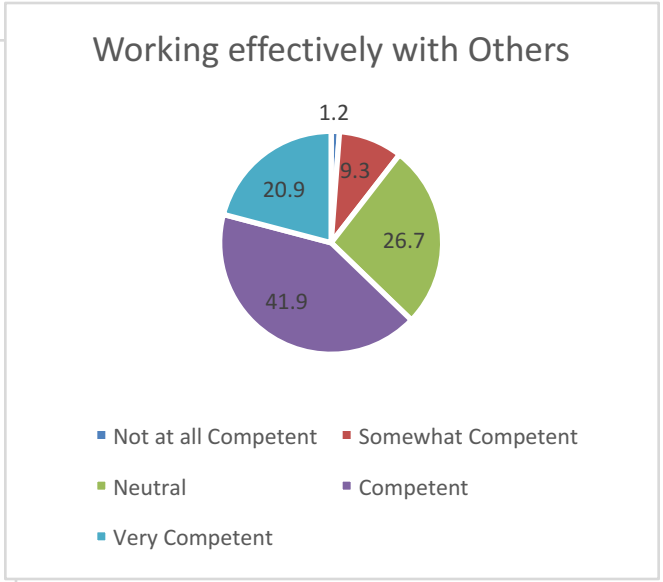




b. According to your experience, how would you rate recent university graduates on each of these competencies?







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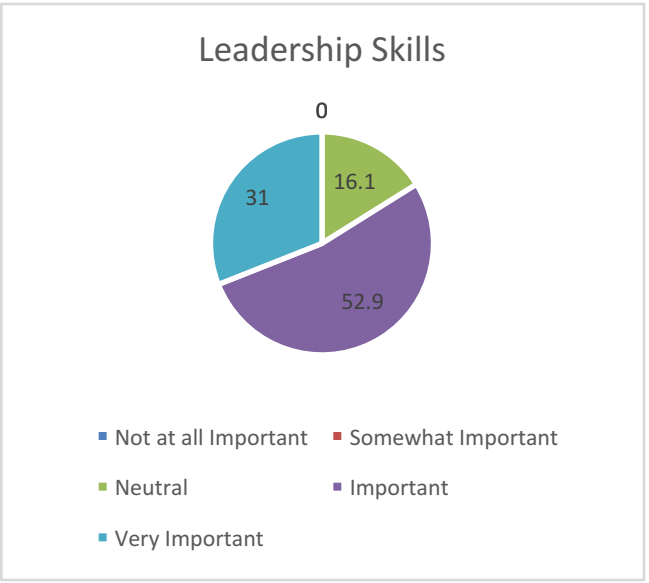

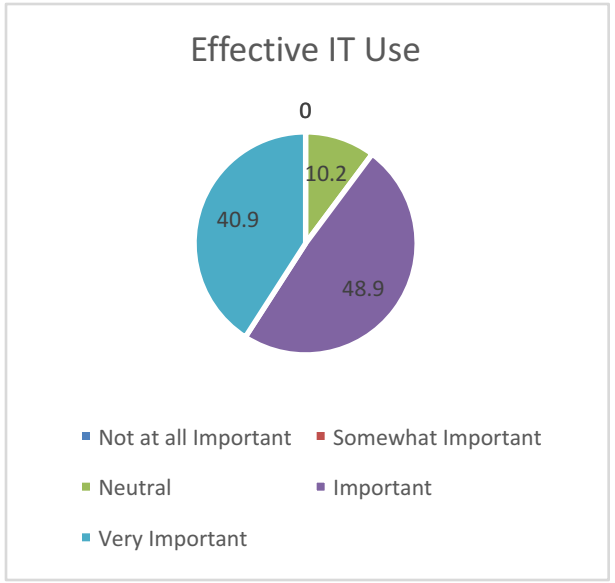

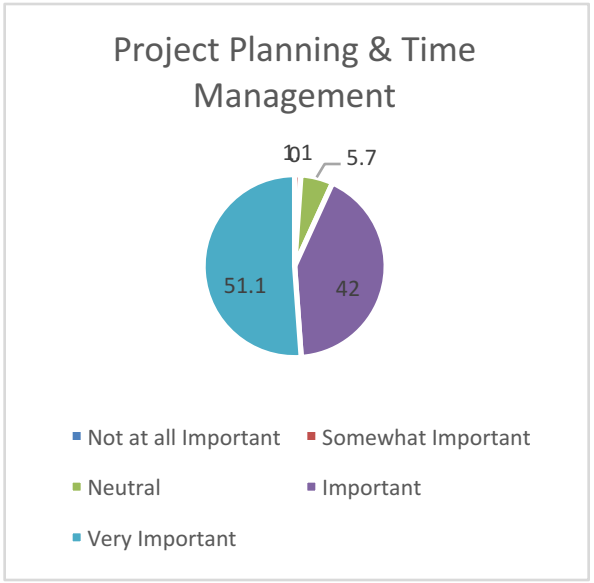

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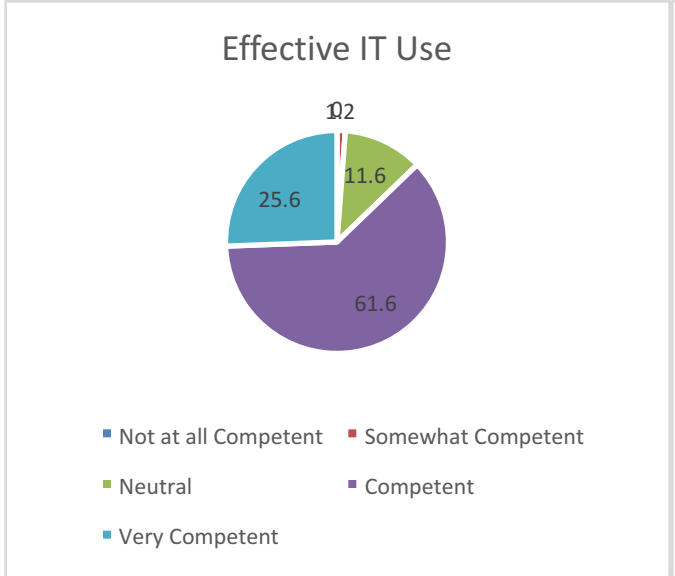
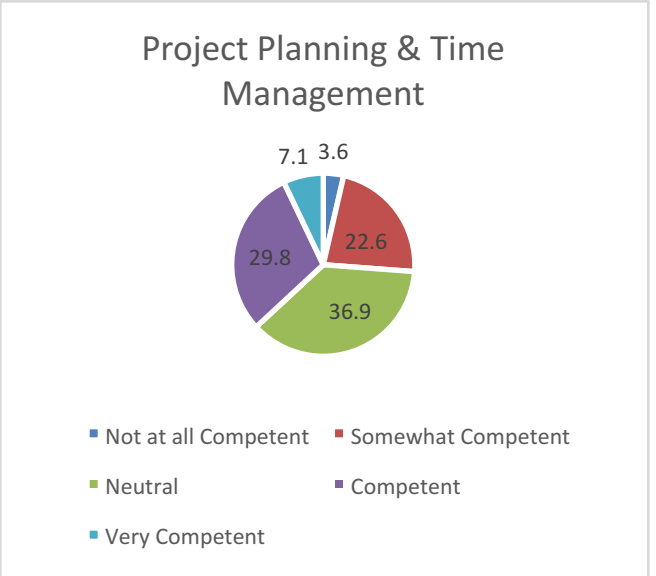
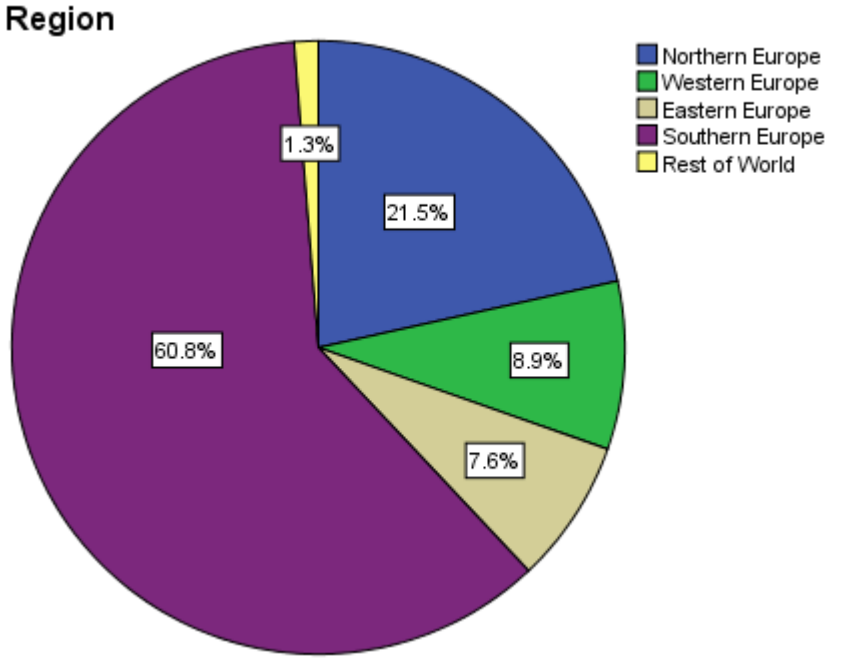
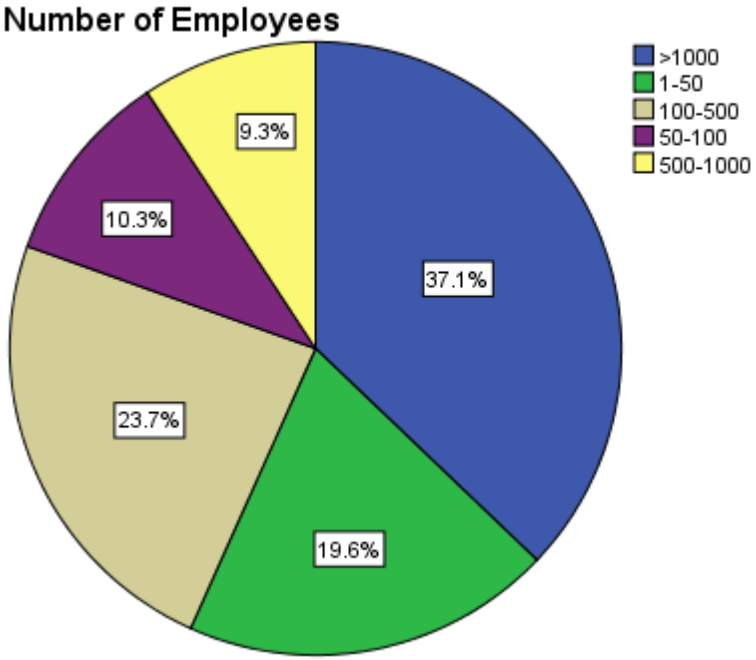
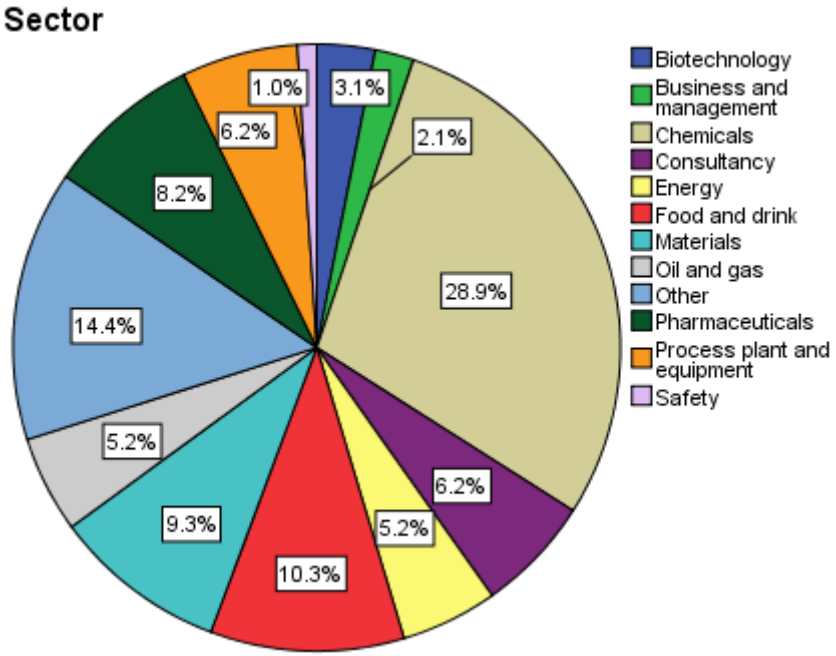





Region
Northern Europe
Western Europe
Eastern Europe
Southern Europe
Rest of World
1.3%
21.5%
8.9%
7.6%
60.8%


Number of Employees
>1000
1-50
100-500
50-100
500-1000
9.3%
10.3%
37.1%
23.7%
19.6%


Sector
Biotechnology
Business and management
Chemicals
Consultancy
Energy
Food and drink
Materials
Oil and gas
Other
Pharmaceuticals
Process plant and equipment
Safety
1.0%
3.1%
6.2%
2.1%
8.2%
28.9%
14.4%
5.2%
6.2%
9.3%
5.2%
10.3%

Box 1. Significant differences between small and medium-sized companies

Underpinning

- Small companies rated ‘Physics’ as more important than medium-sized companies
- Medium-sized companies rather graduates as more competent in ‘Chemistry’ than small companies

Core

- Medium-sized companies rated ‘Safety’ as more important than small companies
- Medium-sized companies rated graduates as more competent in ‘Sustainability, Economics, Ethics’ than small companies

Practice & Design

- Medium-sized companies rated graduates as more competent on ‘Practical Skills’ than small companies

Box 2. Significant differences between medium-sized companies and large companies

Underpinning

- Large companies rated ‘Physics’ as more important than medium-sized companies

Core

- Large companies rated ‘Fundamentals’ as more important than medium-sized companies

Employability

- Large companies rated ‘Communication Skills’ as more important than medium-sized companies
- Medium-sized companies rated ‘Continuous Professional Development’ as more important than large companies

Box 3. Significant differences between small and large companies

Advanced

- Large companies rated ‘Limitations of Current Engineering Practice’ as more important than medium-sized companies

Employability

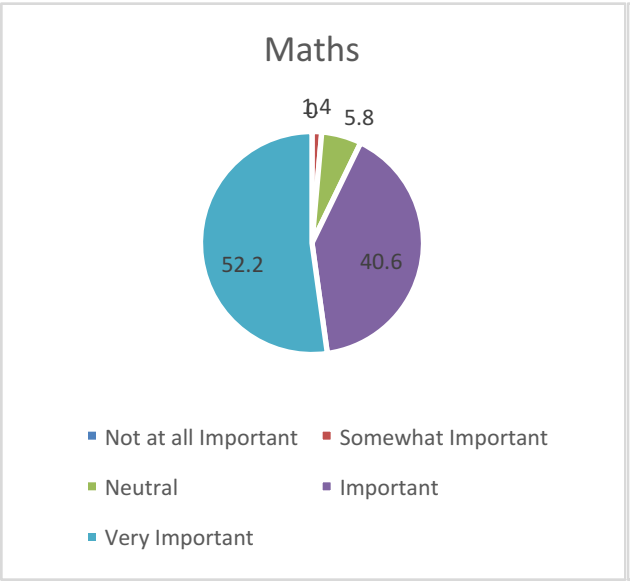
- Large companies rated ‘Communication Skills’ as more important than smaller companies

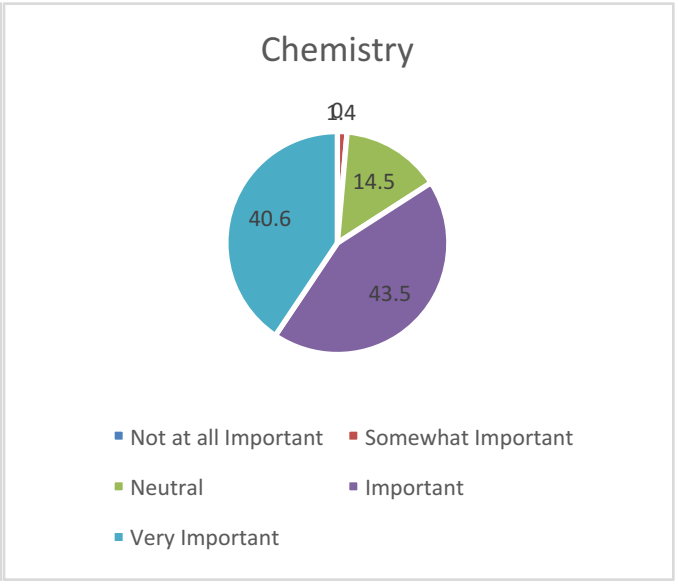
Initial Results –

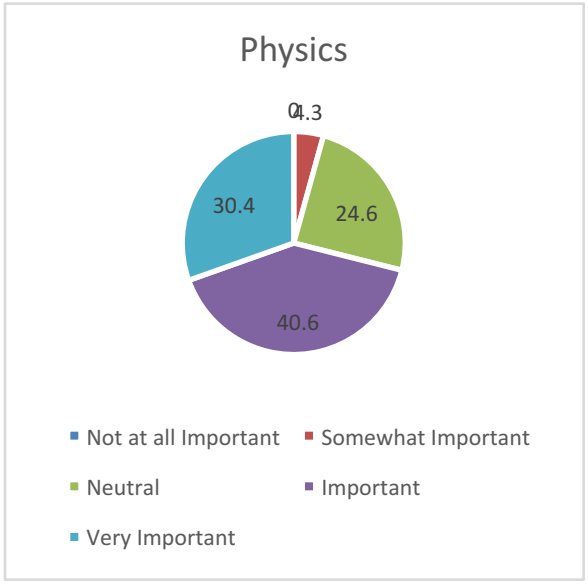
Graduate Opinion Survey

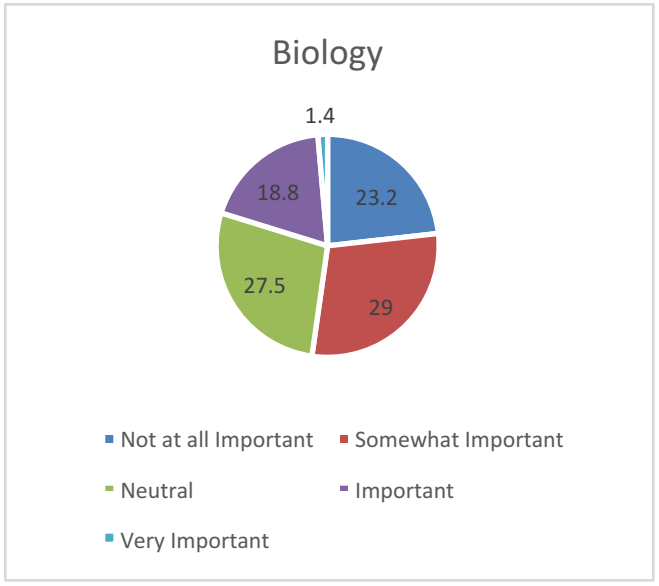
1. Underpinning

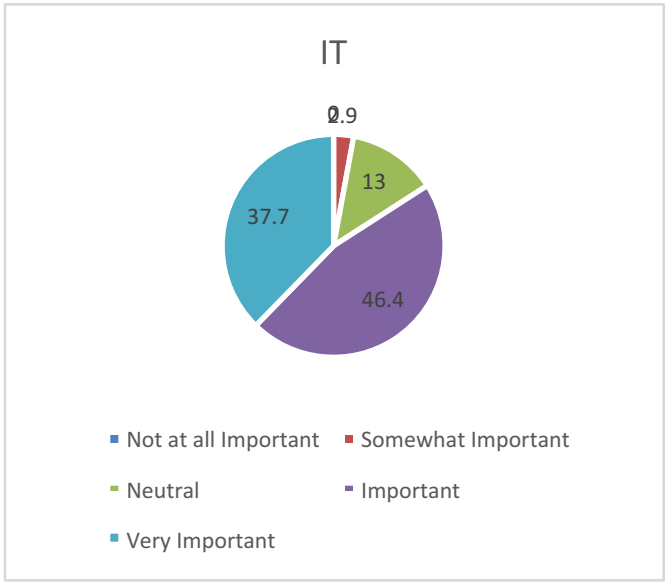
a. How important do you consider each of these competencies for your career?



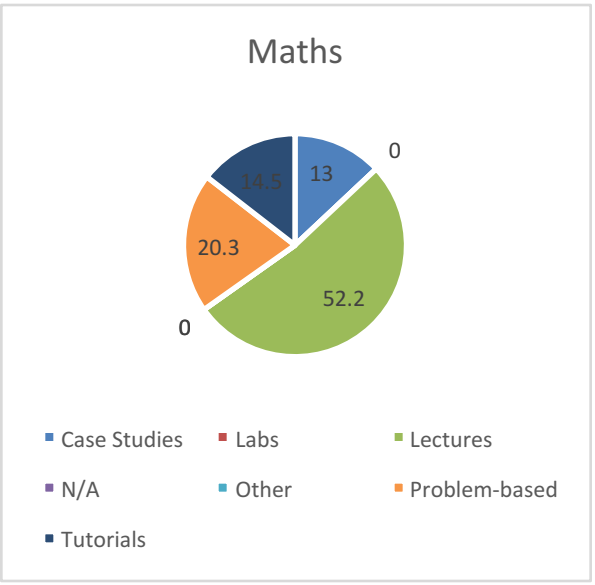


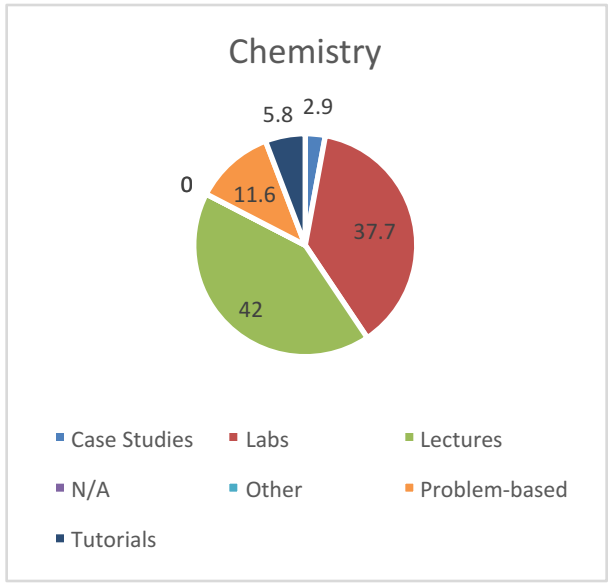


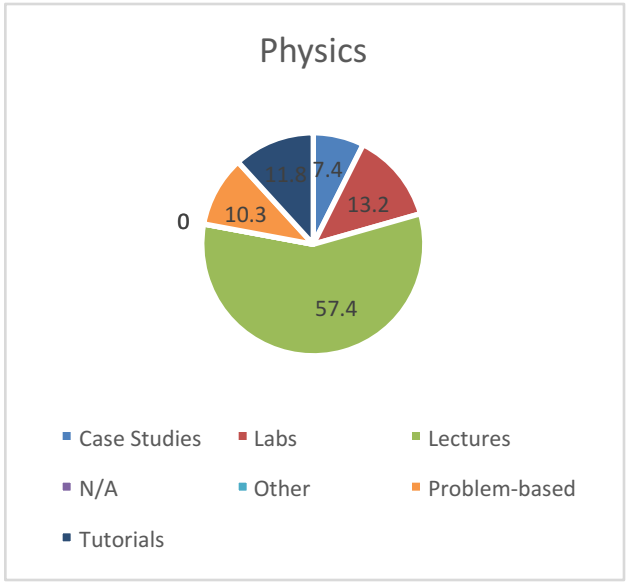


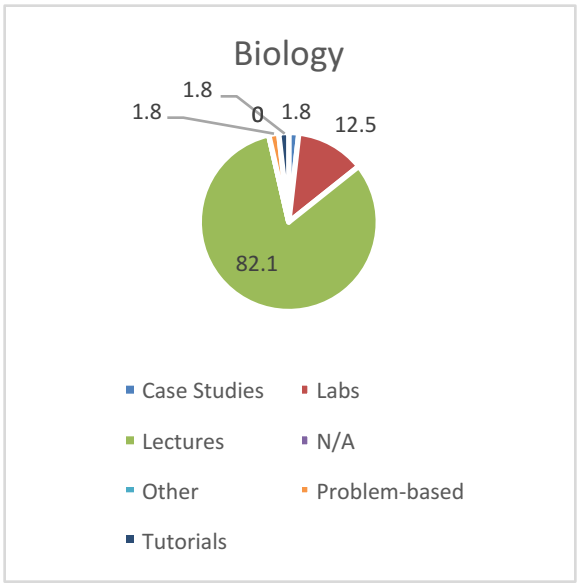


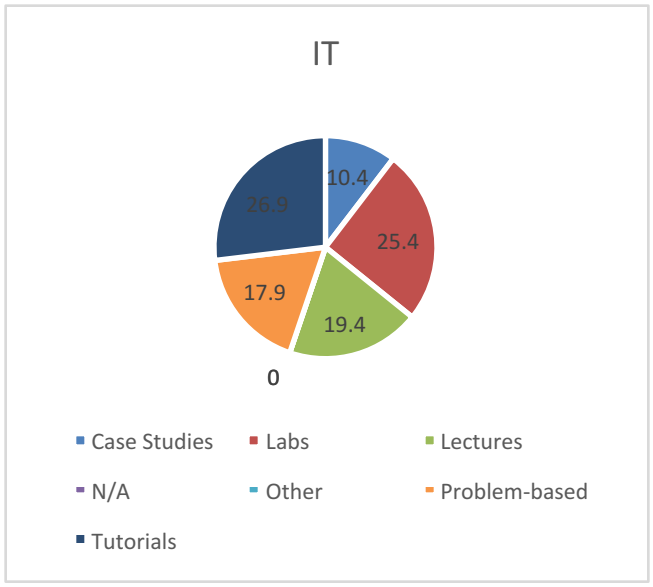
b. From your experience as a student, what was the predominant method of teaching for each competency?



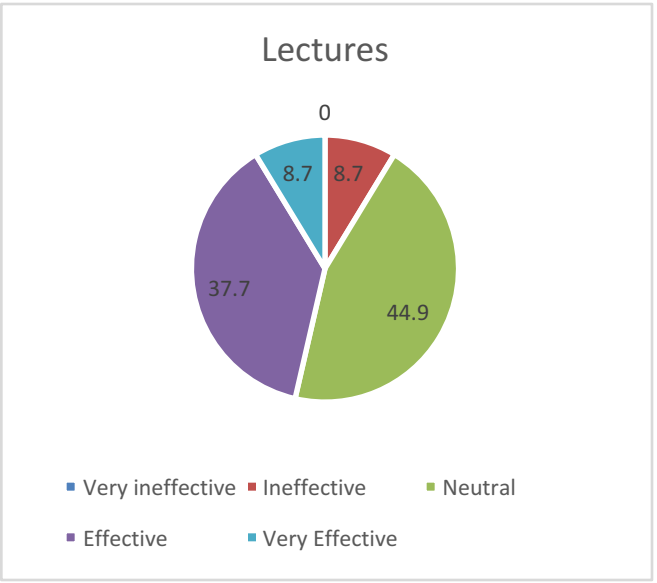


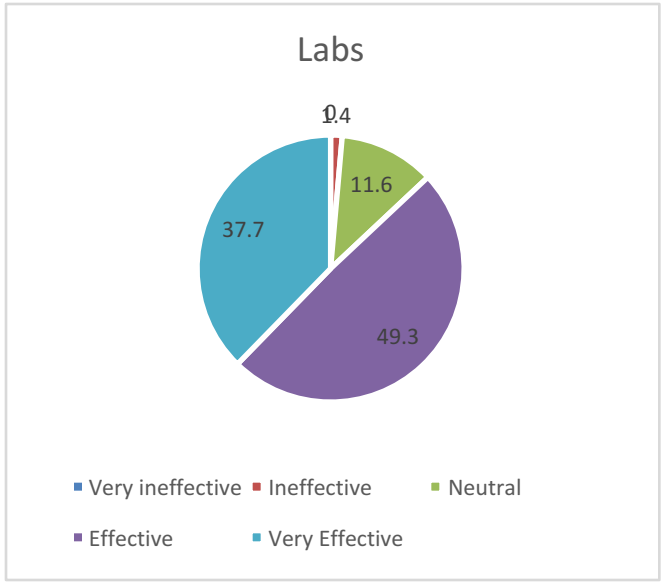


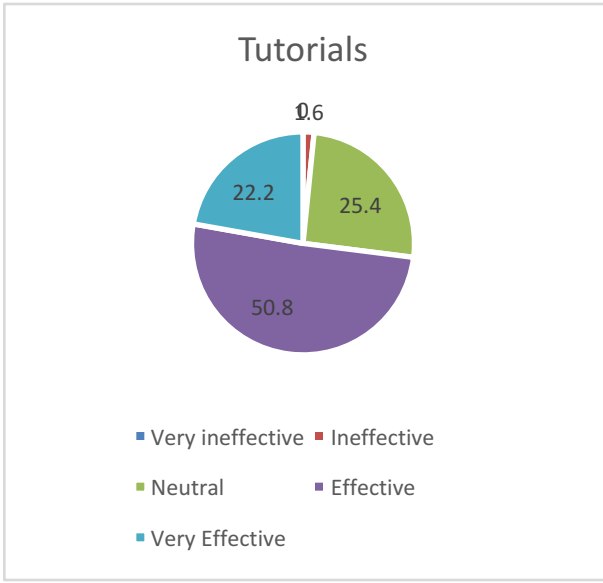


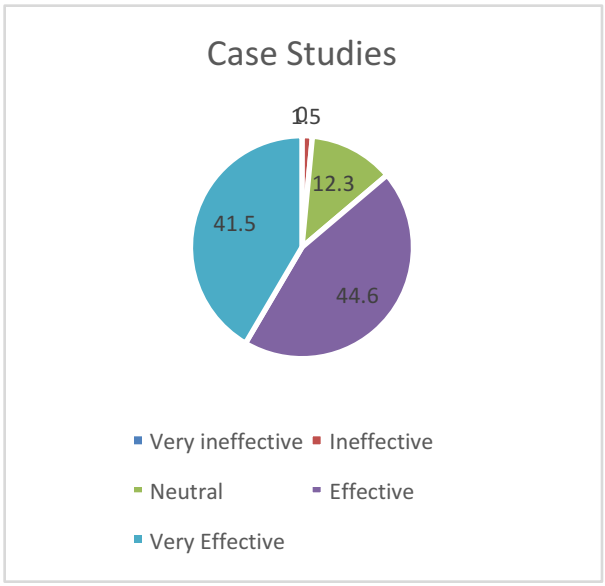


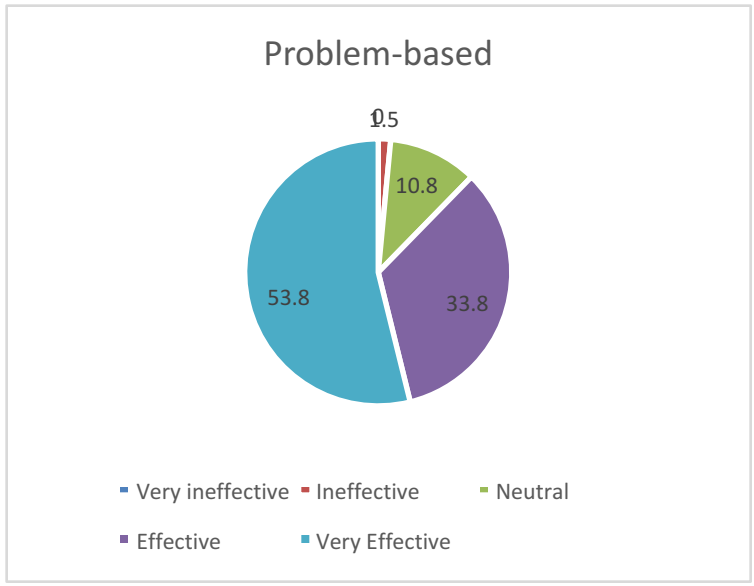
c. Overall, how effective were the methods of teaching that you experienced on your course?





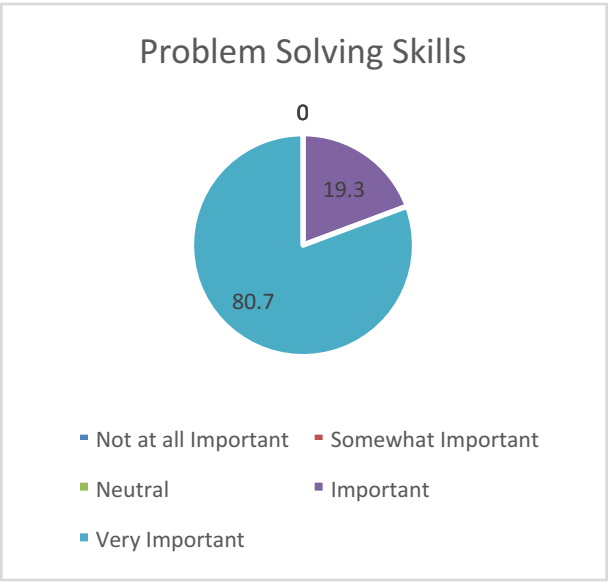


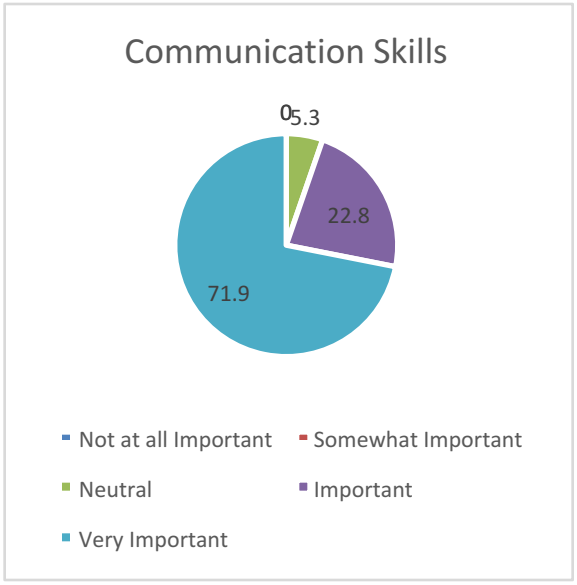


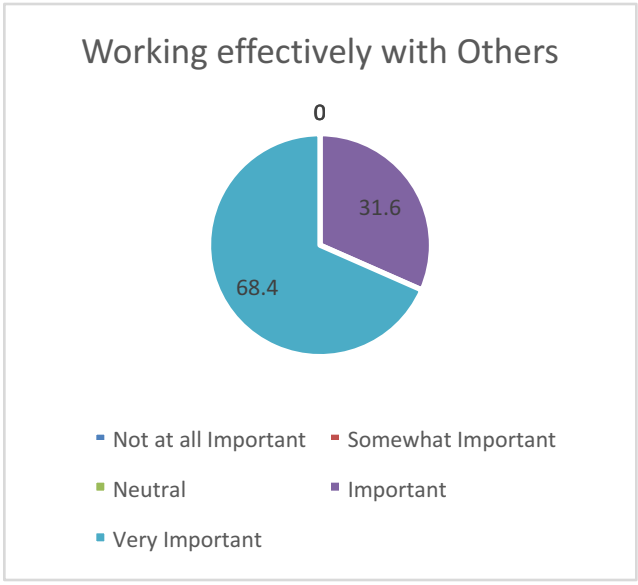


5. Employability
Graduates and Employers Point of View Comparison

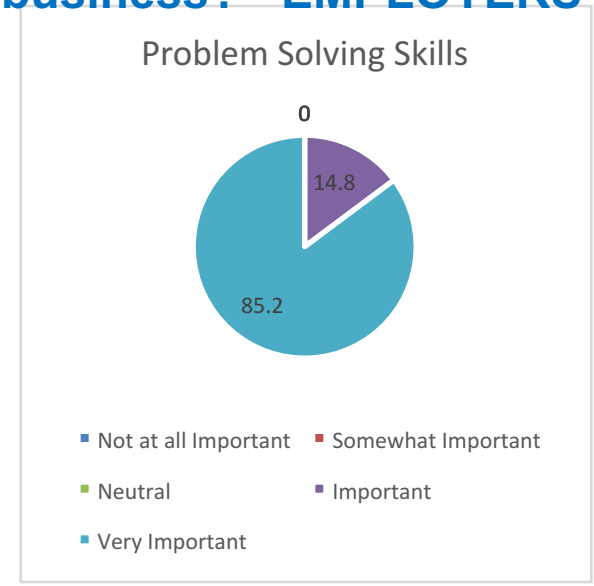
a. How important do you consider each of these competencies for your career - GRADUATES

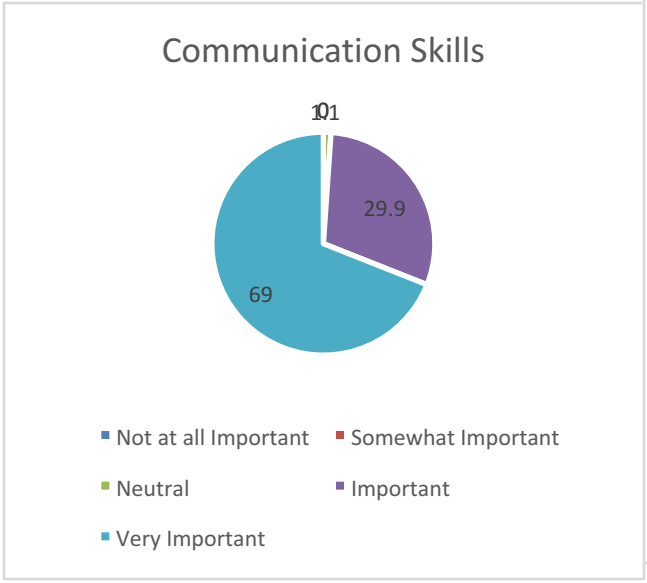


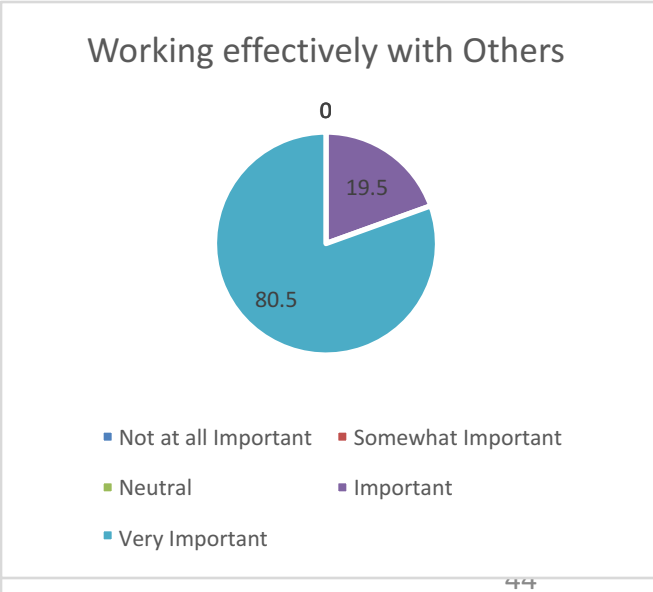




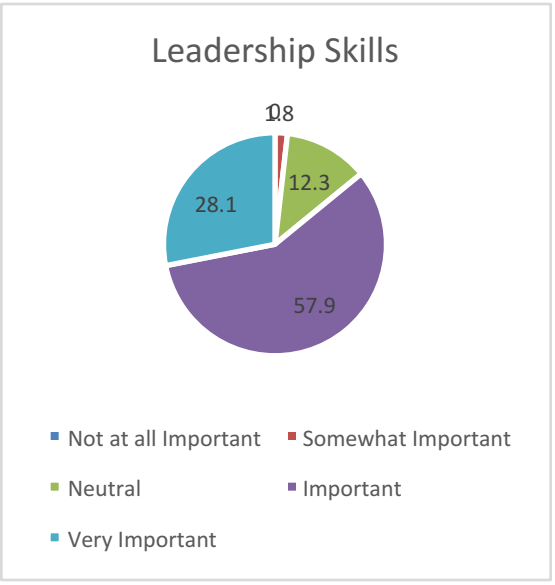
a. How important do you consider the following graduate attributes for your business? - EMPLOYERS

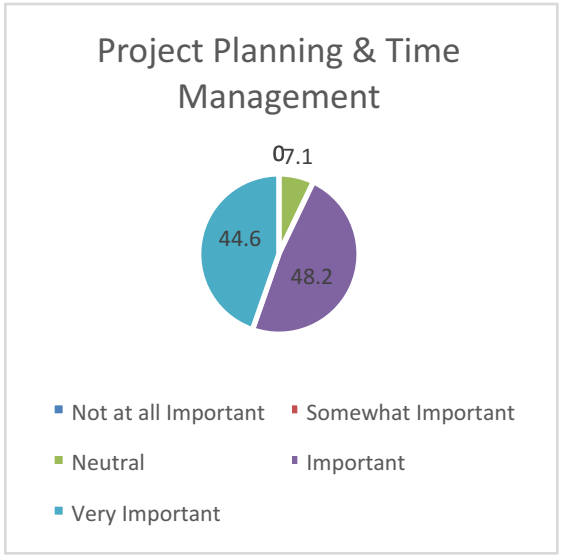


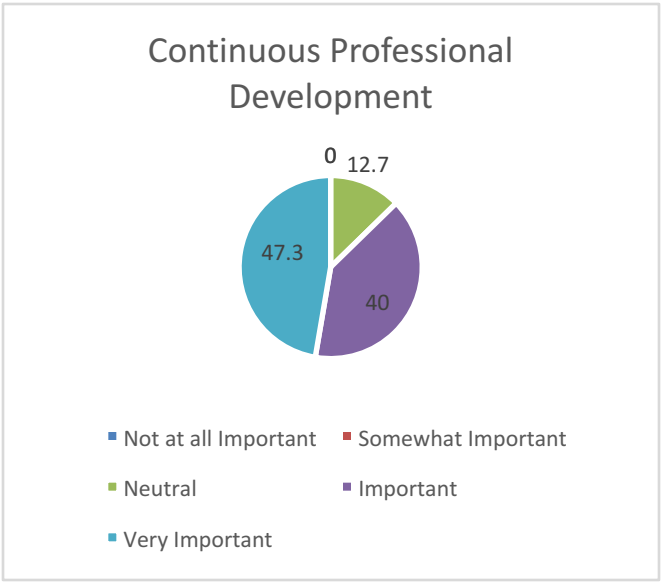




a. How important do you consider each of these competencies for your career? - GRADUATES







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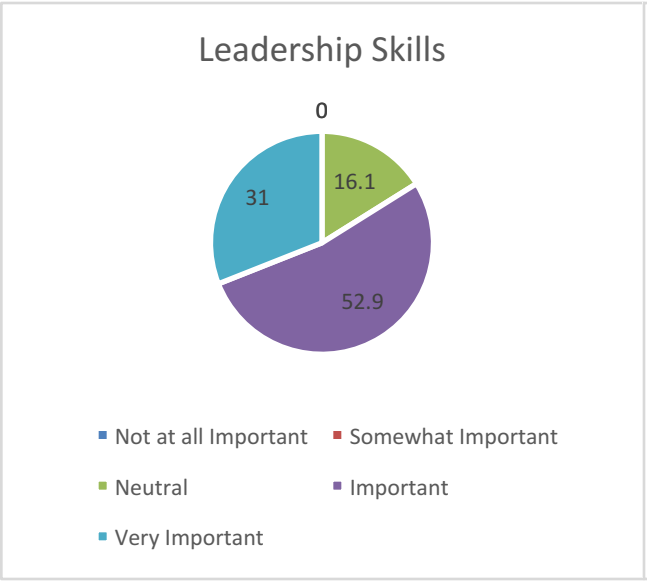
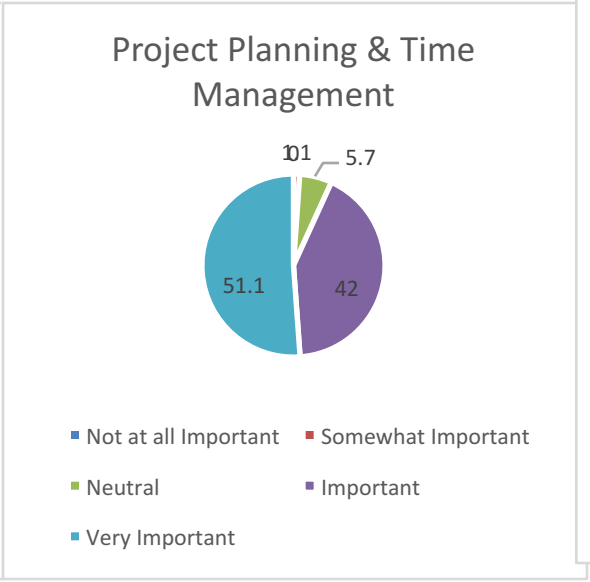
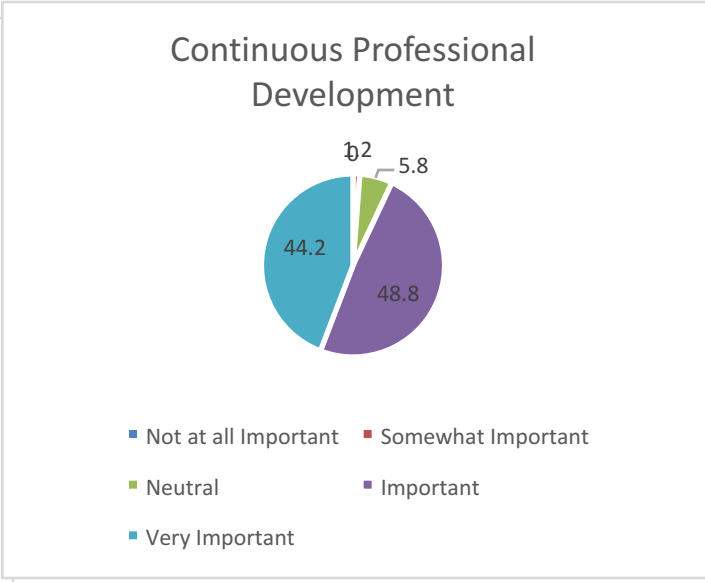
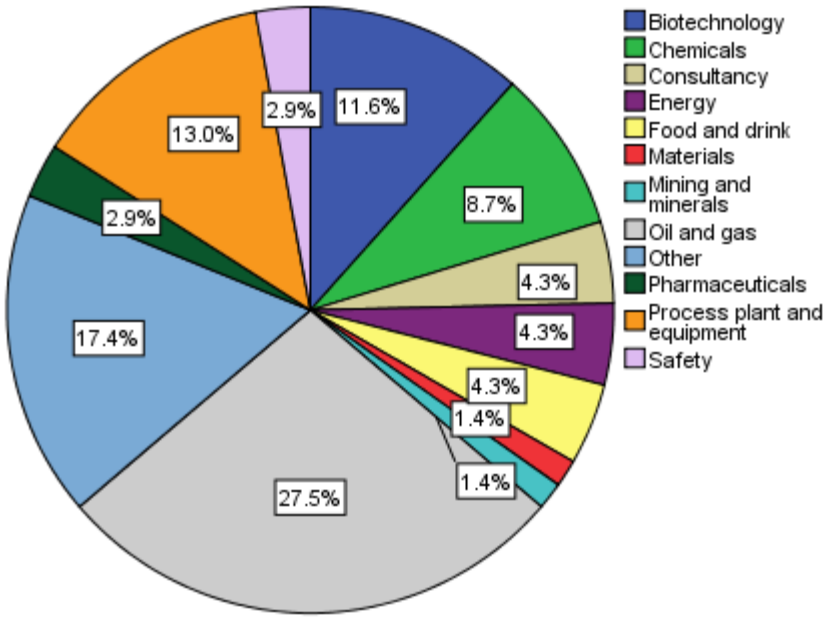


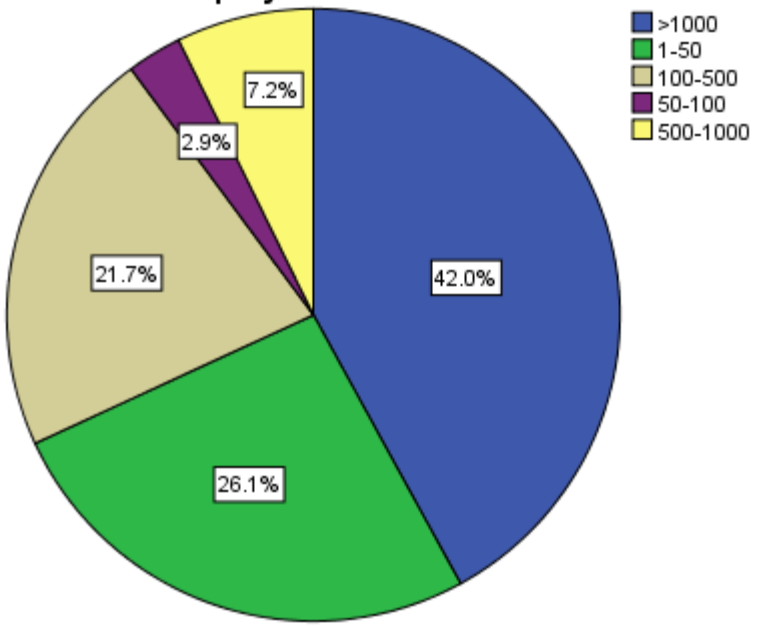




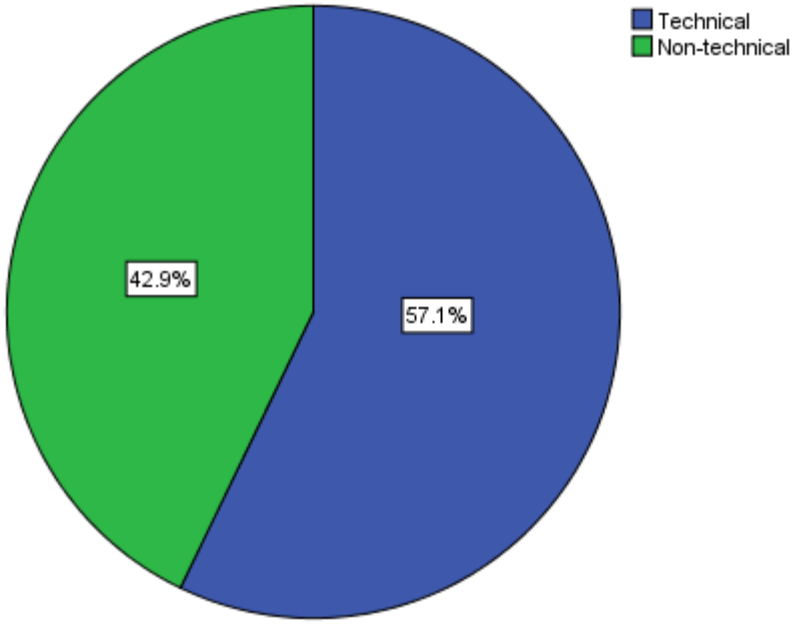
Sector



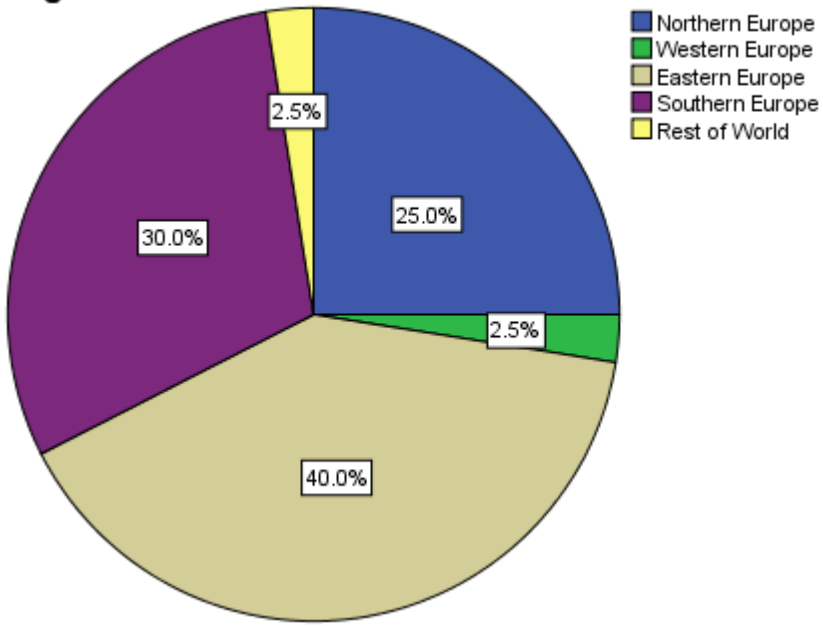
Number of employees



Position



Region



Group Comparisons

- **Company Size**

Very few group differences between companies of different sizes:

  - Graduates in smaller companies rated 'Labs' more effective for Core than graduates in medium-sized companies

- **Position**
  - No statistically significant differences
- **Region**
  - Very few statistically significant differences between Southern and Northern Europe, and between Eastern and Southern Europe.
  - More significant differences between Northern and Eastern Europe.

Underpinning

- Graduates from Southern Europe rated ‘Case Studies’ as more effective than graduates from Northern Europe
- Graduates from Northern Europe rated ‘Maths’ as more important than graduates from Eastern Europe
- Graduates from Northern Europe rated ‘Lectures’ as more effective than graduates from Eastern Europe
- Graduates from Eastern Europe rated ‘Case Studies’ as more effective than graduated from Northern Europe
- Graduates from Southern Europe rated ‘Maths’ as more important than graduates from Eastern Europe

Core

- Graduates from Northern Europe rated ‘Systems’ as more important than graduates from Eastern Europe
- Graduates from Northern Europe rated ‘Sustainability, Economics, Ethics’ as more important than graduates from Eastern Europe
- Graduates from Eastern Europe rated ‘Problem-based’ as more effective than graduated from Northern Europe

Practice & Design

- Graduates from Northern Europe rated ‘Industrial Standards and Quality Assurance’ as more important than graduates from Eastern Europe

- Graduates from Northern Europe rated ‘Technical Rigour in Design’ as more important than graduates from Eastern Europe

- Graduates from Northern Europe rated ‘Awareness of Health, Safety and Environment Issues as more important than graduates from Eastern Europe .

for your attention

http://www.iteach-chemeng.eu/questionnaires/