

Co-funded by the  
Erasmus+ Programme  
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# MicroElectronics Cloud Alliance

## Project 562206-EPP-1-2015-1-BG-EPPKA2-KA

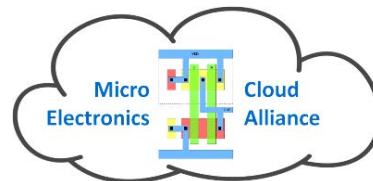
# Need Analysis

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02-03 June  
INSA-Toulouse

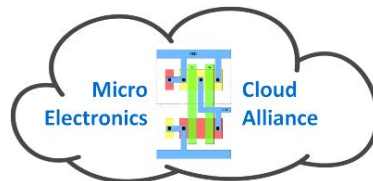
# Objective

- To analyse user needs in shared IT infrastructure, teaching materials, learning resources in micro- nanoelectronics relevant for the labour market.



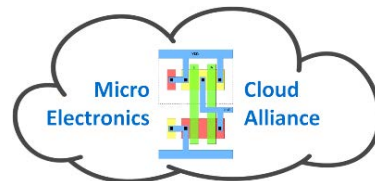
# Questions

- What knowledge and skills should provide the courses in micro- nanoelectronics?
- What skill levels of employees in the sector are the most important?
- What are the experiences with and attitudes towards the on-line learning, remote access to laboratories, virtual classroom?



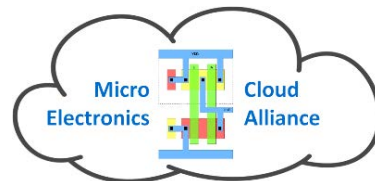
# Limitations

- The well known problem with questionnaires is the non-responsiveness.
- To overcome it, interviews with managers from academia and business (being too busy to answer the questionnaires) have been used as well.



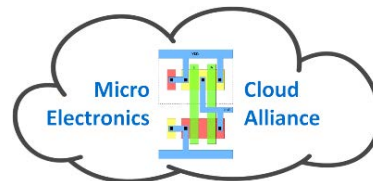
# Target Groups

- Students in micro- nanoelectronics engineering education;
- University teachers and trainers in HRD departments, universities and colleges;
- Professionals from the business;
- e-learning environment developers and administrators.



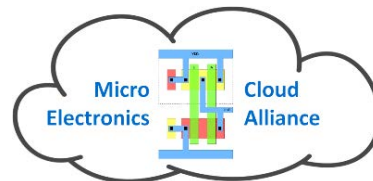
# Sample

- Students at POLITO, TUS, INSA, BMU, UNED, TUB, UKIM;
- Professionals and managers from enterprises in micro-nanoelectronics and microsystems, electronics packaging and communication from all participating countries;
- Teachers in micro- nanoelectronics from all participating countries;
- System administrators at the universities and enterprises involved.



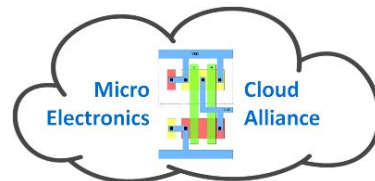
# Instruments

- Literature study;
- On-line survey:
  - 3 questionnaires for teaching/learning needs analysis developed by the experts in educational sciences at UNED with the support of OUN and TUS.
  - Questionnaires for teachers, students, managers and system administrators developed by eWorks for the analysis of feasibility of mClouds.
- Interviews.



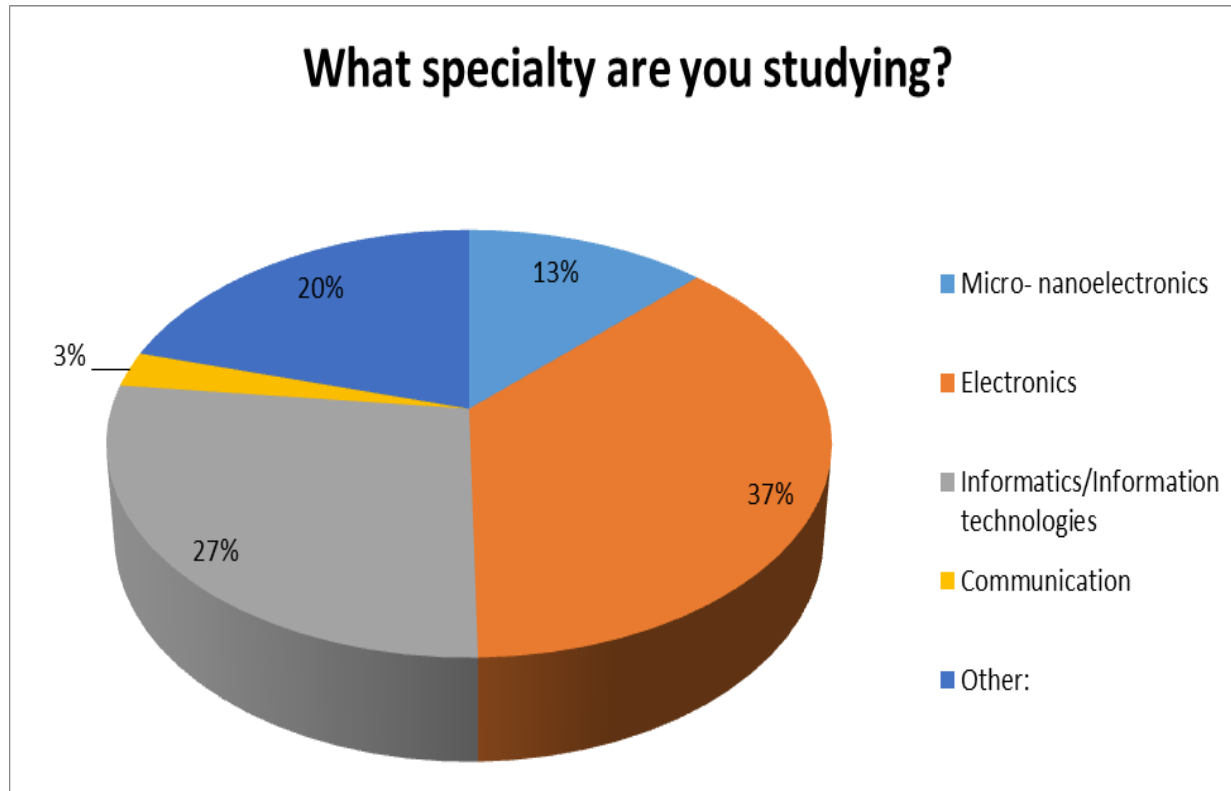
# Implementation

- On-line questionnaires with a link on the project Web site.
- We have collected
  - 152 answers from the students,
  - 59 – from teachers and
  - 23 – from the representatives of the industry.

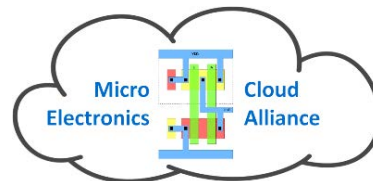




# Students' survey

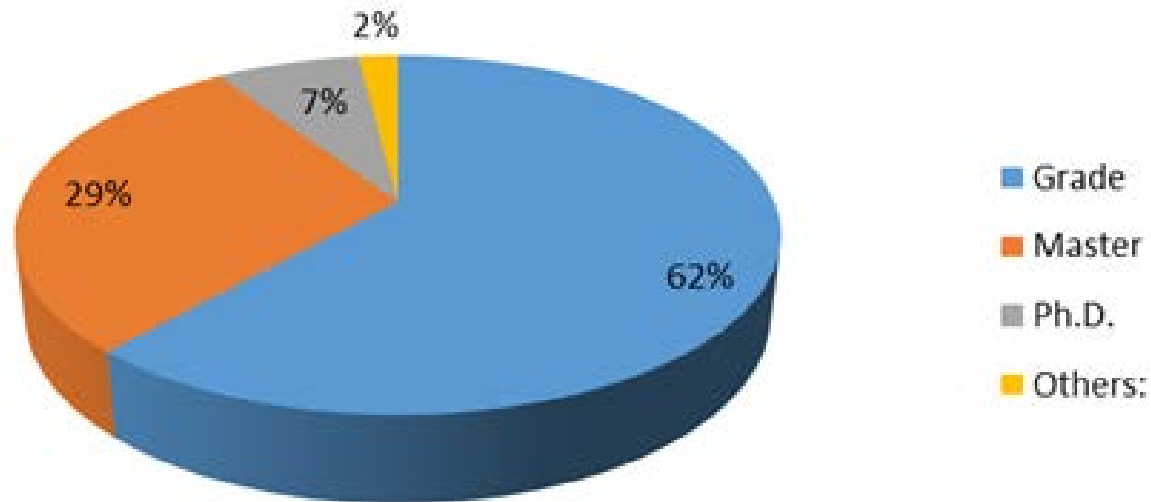


**Other:** automation and robotics; system engineering; biomedical engineering; computer system engineering.

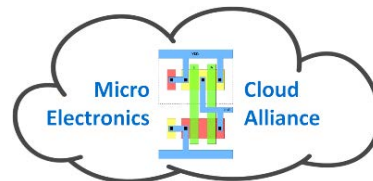


# Students' survey

At what educational level is your study?

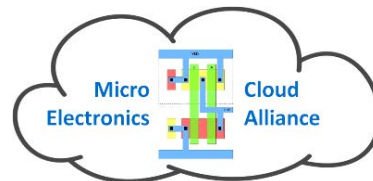
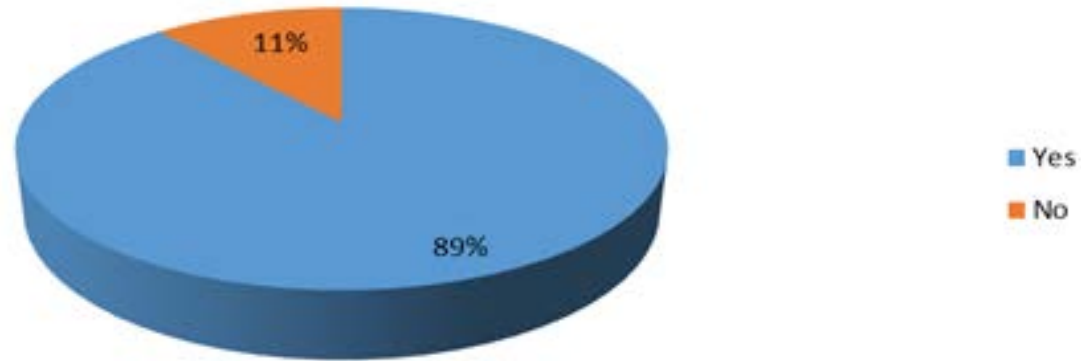


Other: undergraduate

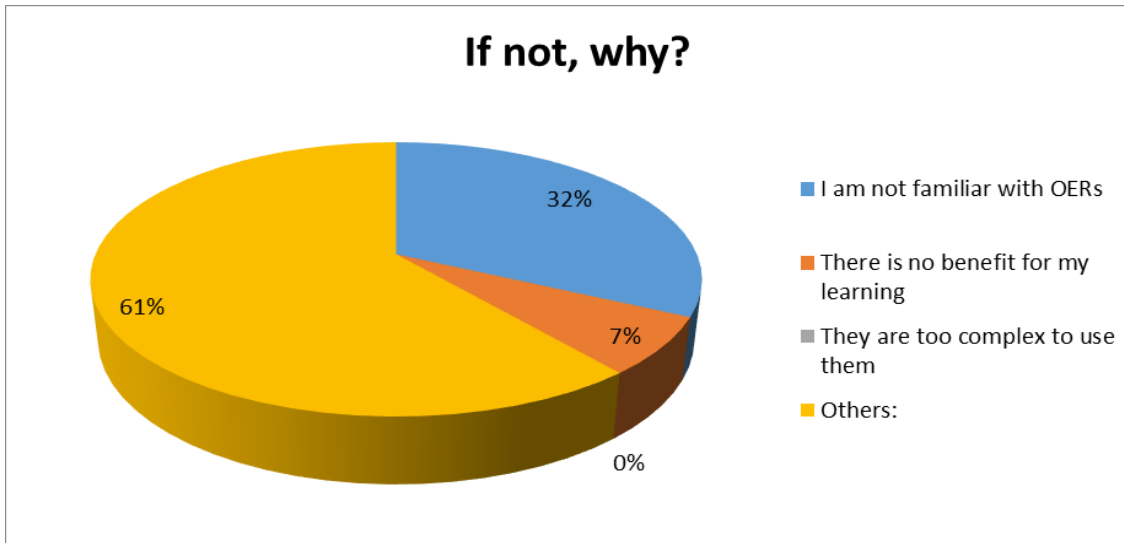


# Students' survey

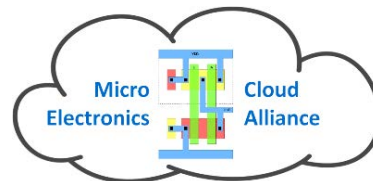
Do you use e-learning materials/Open Educational Resources (OERs)/ in your university?



# Students' survey

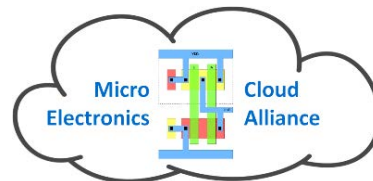
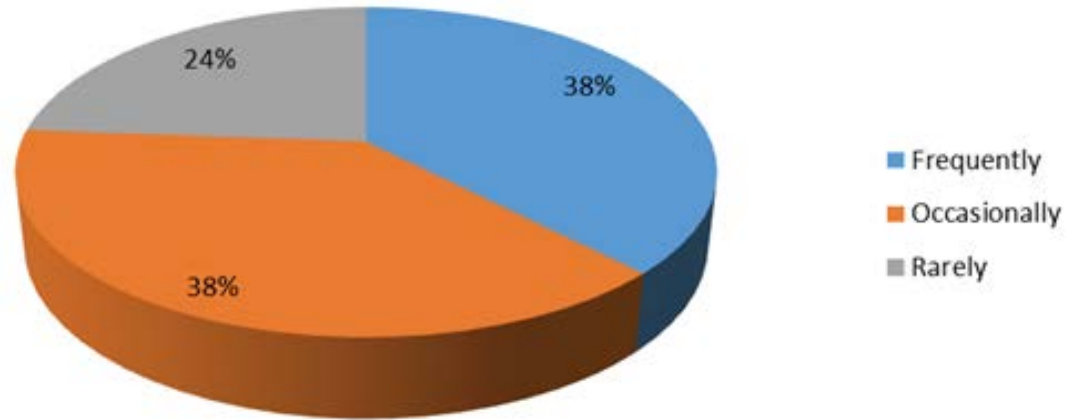


Others: I use e-learning materials and OERs; We use it; I do.

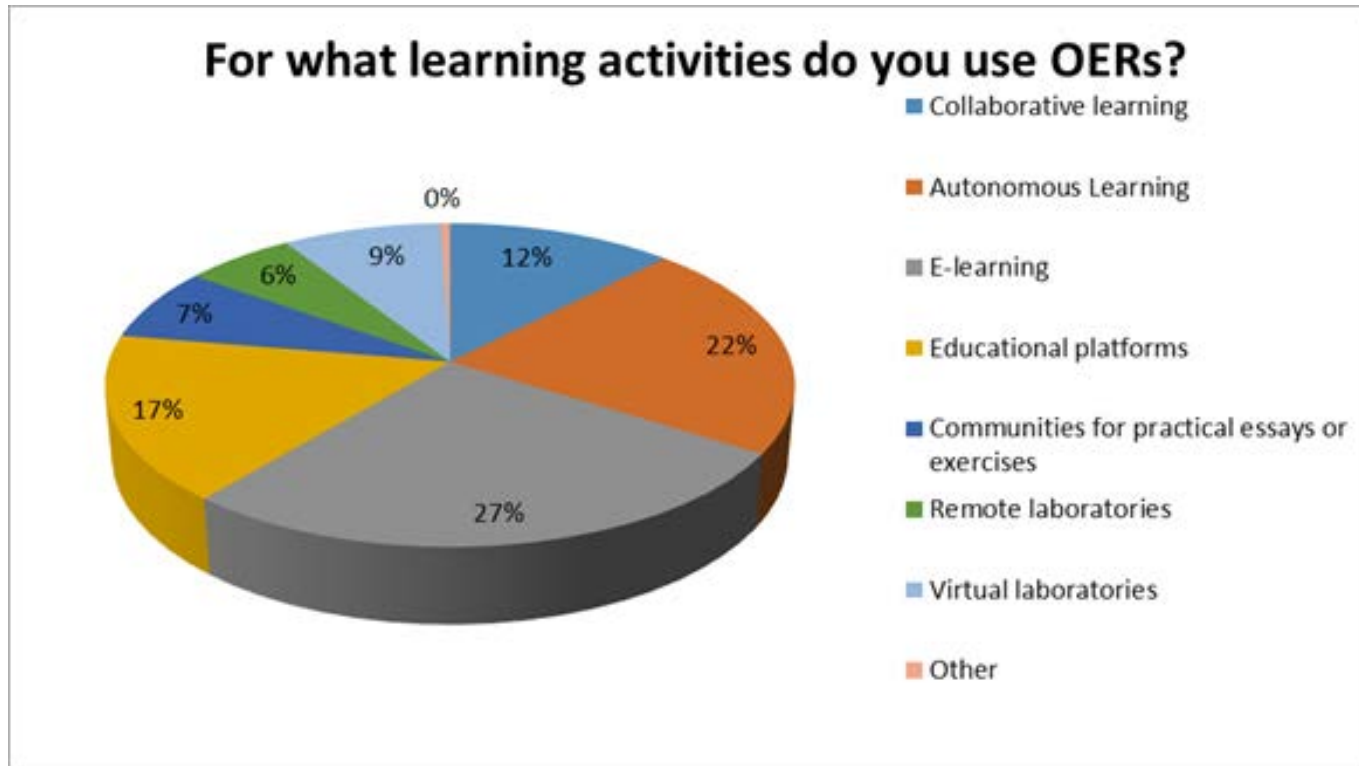


# Students' survey

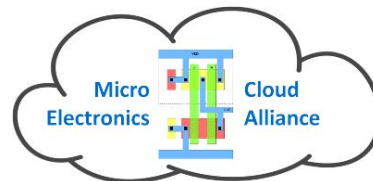
In case of using OERs, how often do you use them?



# Students' survey

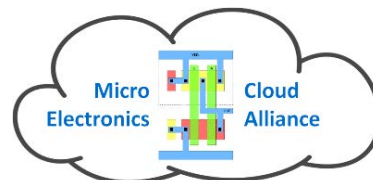


Other: I don't use OERs.



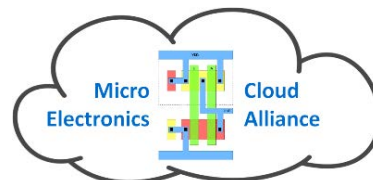
# How often have you been participating in the following learning activities in the past?

	<b>Frequently</b>	<b>Occasionally</b>	<b>Rarely</b>	<b>Never</b>
Studying additional e-learning materials given by the teacher	28,48%	45,70%	17,88%	7,95%
Searching for educational materials on Internet	58,28%	31,13%	8,61%	1,99%
Following Open Courseware(s) provided by other universities	13,91%	30,46%	33,11%	22,52%
Watching recorded lectures or presentations given by experts outside your institution	19,21%	33,77%	37,09%	9,93%
Working virtually with students from other universities internationally	1,32%	9,93%	21,19%	67,55%
Carrying out experiments within remote laboratories	3,97%	15,89%	30,46%	49,67%
Designing electronic/integrated circuits through remote access to the workstations	5,96%	17,88%	26,49%	49,67%



# Do you want to be involved in the activities, described below, in the near future?

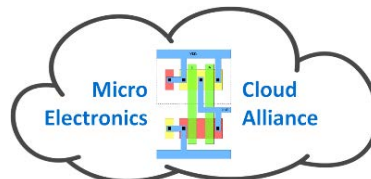
	<b>Frequently</b>	<b>Occasionally</b>	<b>Rarely</b>	<b>Never</b>
Studying additional e-learning materials given by the teacher	43,71%	39,07%	13,91%	3,31%
Searching for educational materials on internet	53,64%	34,44%	9,93%	1,99%
Following Open Courseware(s) provided by other universities	38,41%	32,45%	20,53%	8,61%
Watching recorded lectures or presentations given by experts outside your institution	38,41%	40,40%	17,22%	3,97%
Working virtually with students from other universities internationally	27,15%	37,09%	21,85%	13,91%
Carrying out experiments within remote laboratories	36,42%	31,79%	22,52%	9,27%
Designing electronic/ integrated circuits through remote access to the workstations	35,10%	33,77%	15,89%	15,23%





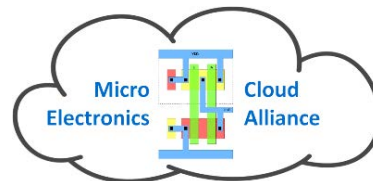
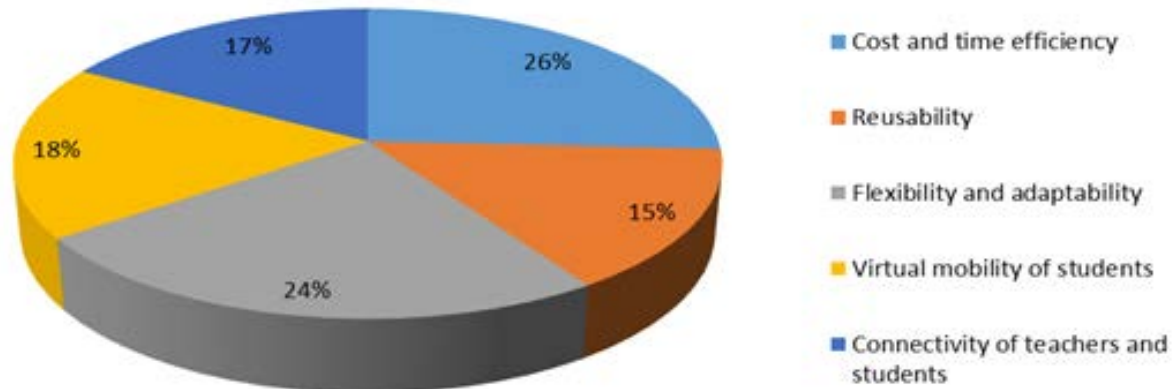
# How confident are you in your abilities to participate in the learning activities described below:

	<b>Very confident [%]</b>	<b>Somewhat confident [%]</b>	<b>Not confident at all [%]</b>
Studying additional e-learning materials given by the teacher	54,30	43,05	2,65
Searching for educational materials on internet	62,25	35,76	1,99
Following Open Courseware(s) provided by other universities	45,70	43,05	11,26
Watching recorded lectures or presentations given by experts outside your institution	49,01	45,70	5,30
Working virtually with students from other universities internationally	28,48	54,30	17,22
Carrying out experiments within remote laboratories	29,14	56,29	14,57
Designing electronic/integrated circuits through remote access to the workstations	31,79	49,01	19,21



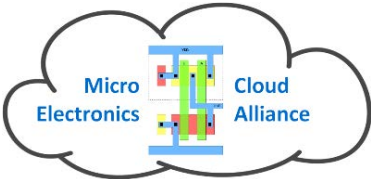
# Students' survey

What advantages do you consider that the use of OERs in practical education has?



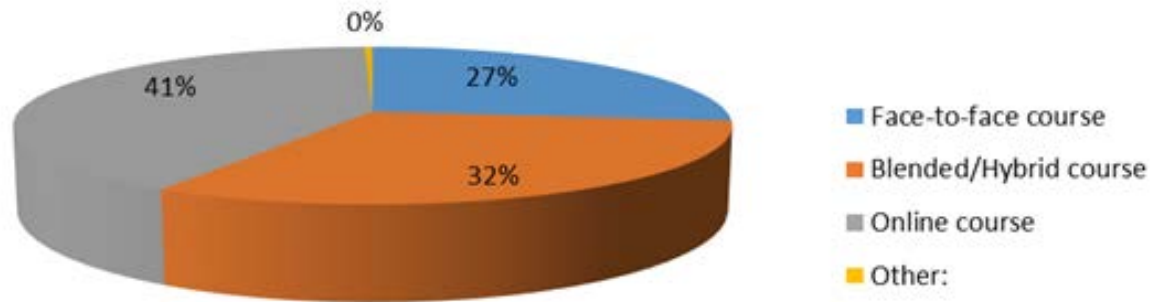
# What kind of OERs do you prefer to use?

	<b>Strongly agree</b>	<b>Agree</b>	<b>Undecided</b>	<b>disagree</b>	<b>Strongly disagree</b>
Electronic books (pdf files)	52,32%	38,41%	5,30%	3,31%	0,66%
Interactive HTML courses	42,38%	41,06%	12,58%	3,31%	0,66%
PowerPoint presentations	17,88%	45,03%	20,53%	14,57%	1,99%
Videorecorded lectures	54,30%	33,77%	6,62%	3,31%	1,99%

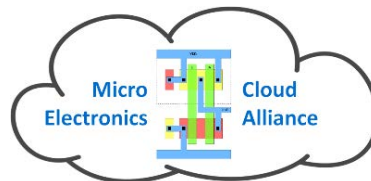


# Students' survey

In which of the following teaching mode do you prefer to use OERs?

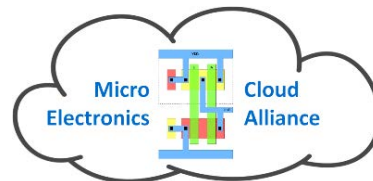
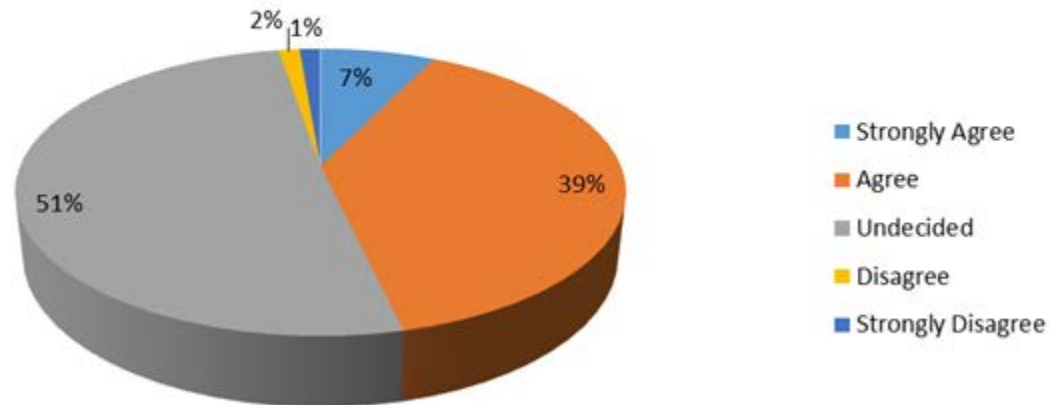


Other: offline (ex.downloading pdf).



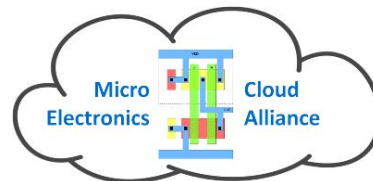
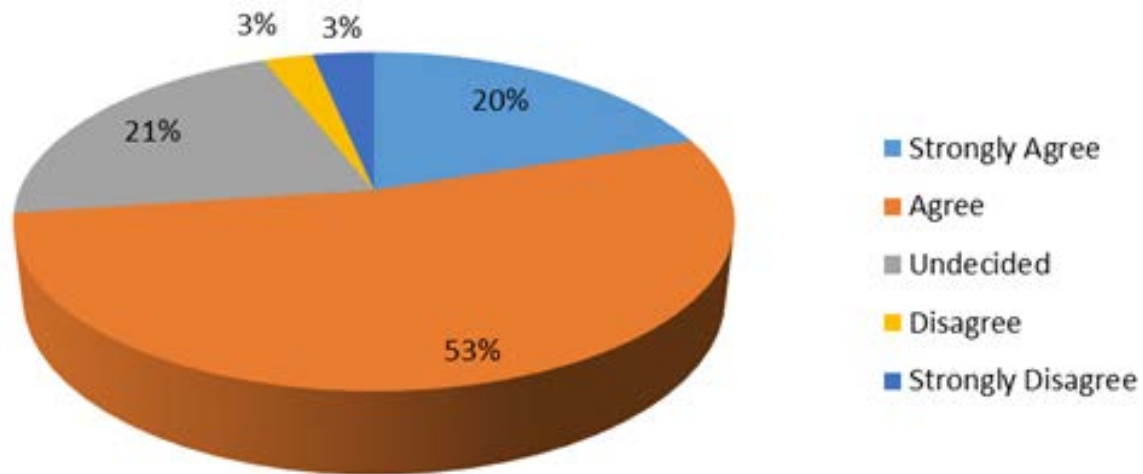
# Students' survey

Do you believe the following statements about Open Educational Resources (OER) are true?  
Use of OER leads to improvement in your learning.



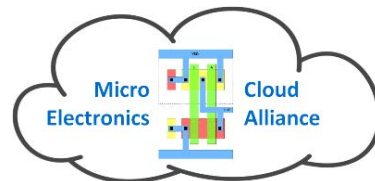
# Students' survey

Use of OER makes the learning content more attractive



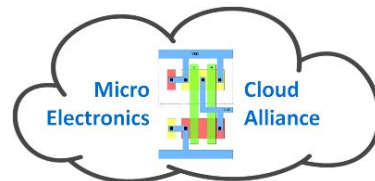
# *Summary of results of the students' survey*

- 89% of the students use open educational resources and those who do not use are willing to learn with OERs.
- Few students have experience with virtual laboratories and remote access to CAD systems but most of them would like to.



# *Summary of results of the students' survey*

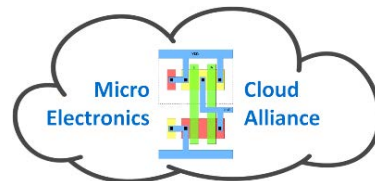
- It is very important and encouraging with regard to the project objectives that the students feel comfortable with using virtual laboratories and they are ready to these educational practices.
- Most of the students do not think that the use of OERs will improve their learning but 73% consider that the learning is more attractive with OERs.





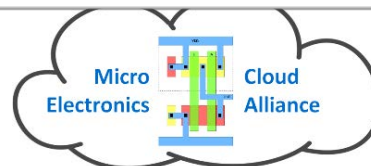
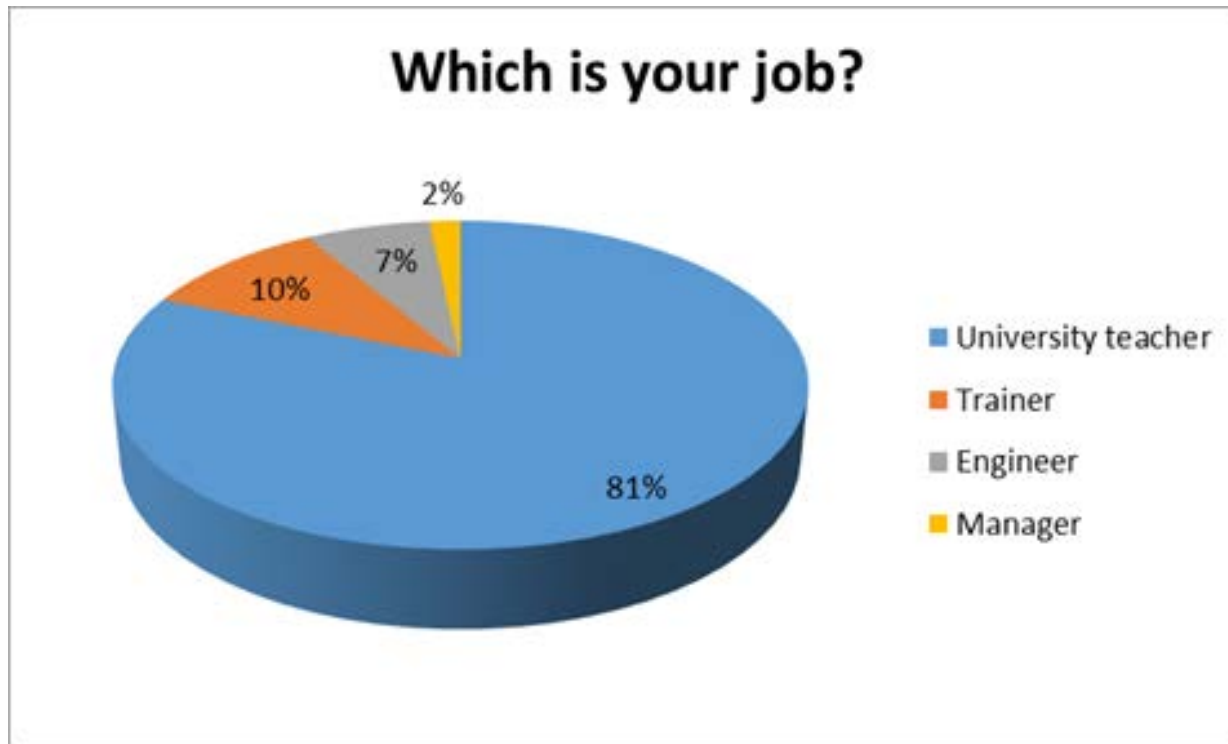
# *Summary of the students' survey*

- It is interesting that the learners prefer passive teaching methods: electronic books and videorecorded lecture to the interactive courses.
- PowerPoint presentations are not liked at all by the students and it might be because the content in the presentations is not sufficient for self learning.
- All advantages of OERs are appreciated: flexibility, reusability, virtual mobility of students, cost efficiency, connectivity with teachers.

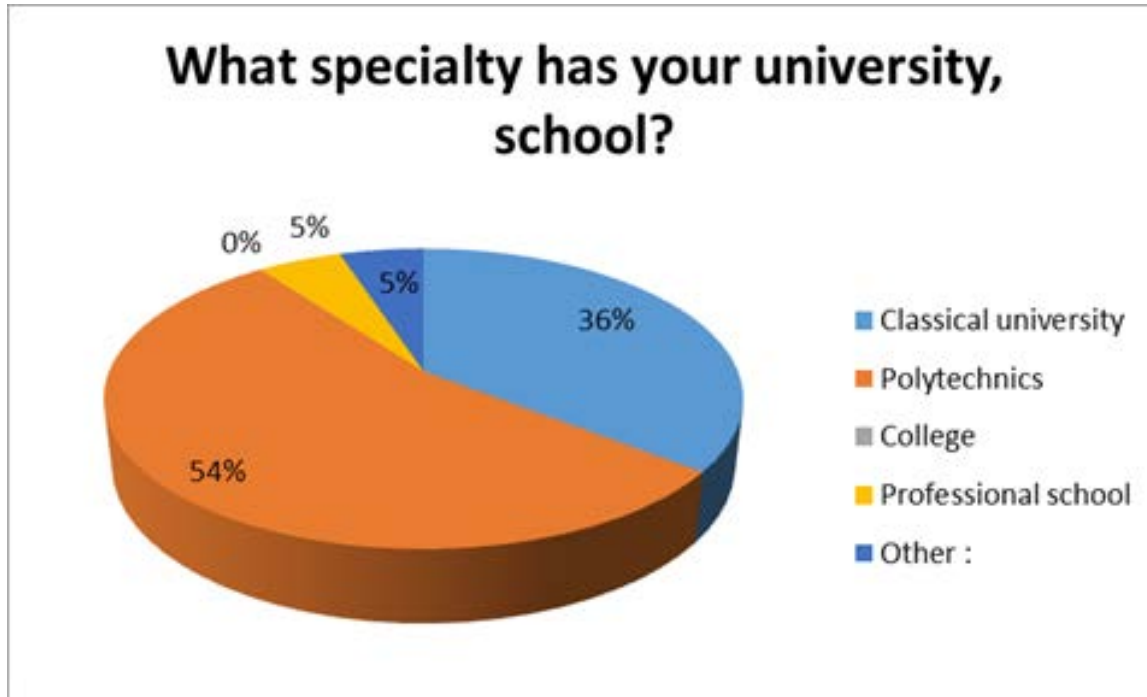


# *Teachers' survey*

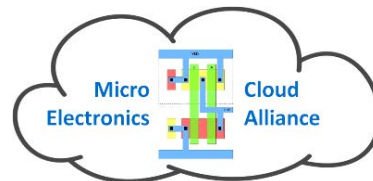
- 59 teachers from traditional and distance education universities and vocational education institutions answered the questionnaire.



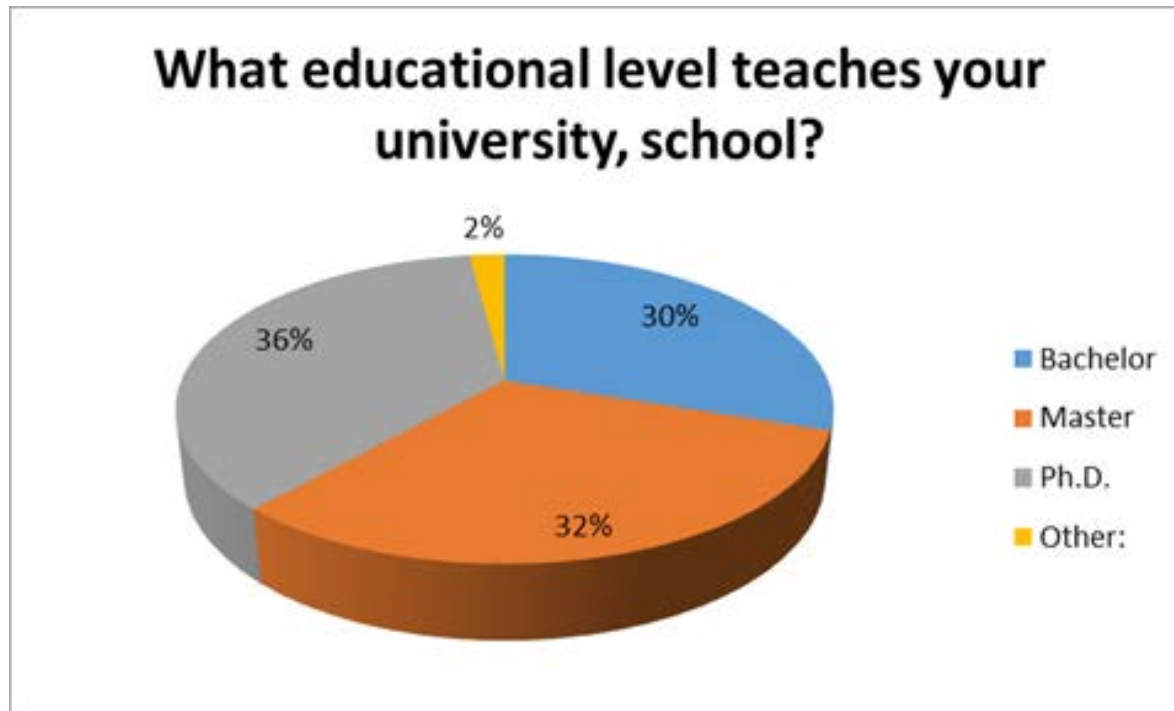
# Teachers' survey



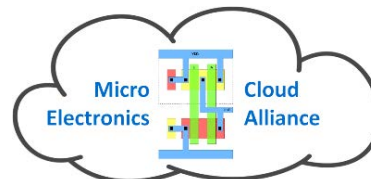
Other: Engineering School.



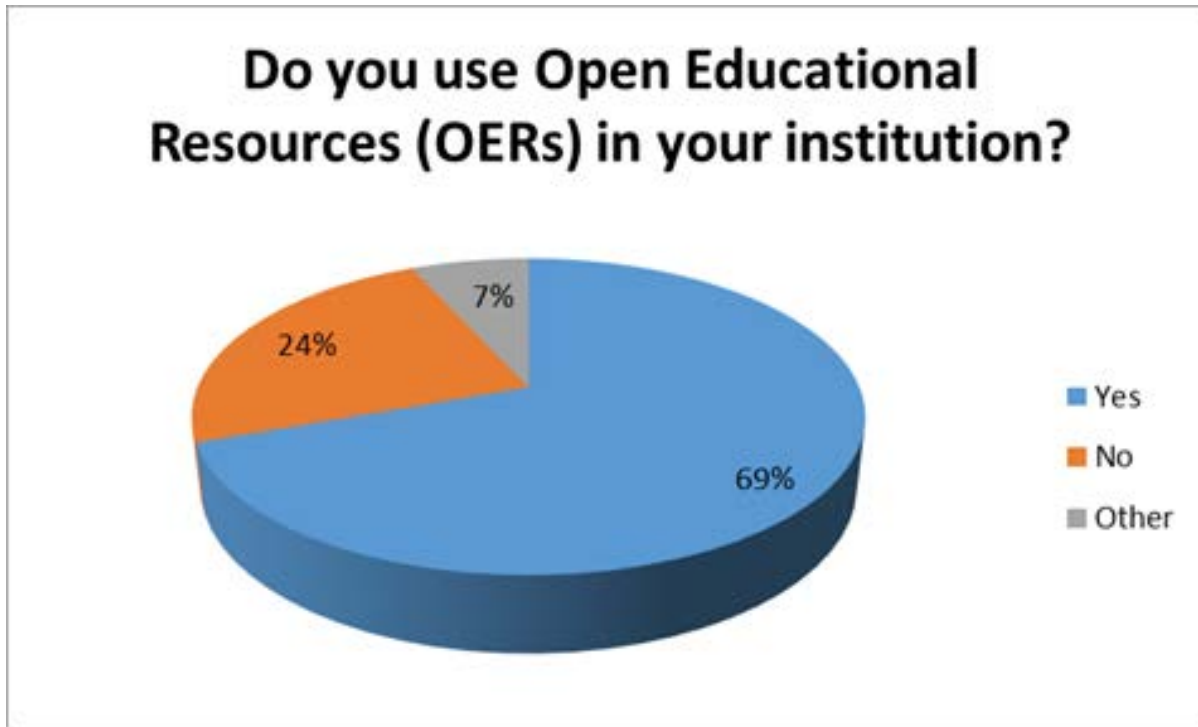
# Teachers' survey



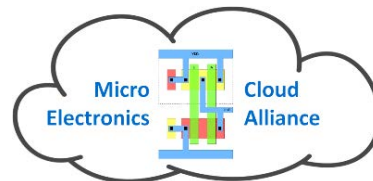
Other: vocational training; continuing training



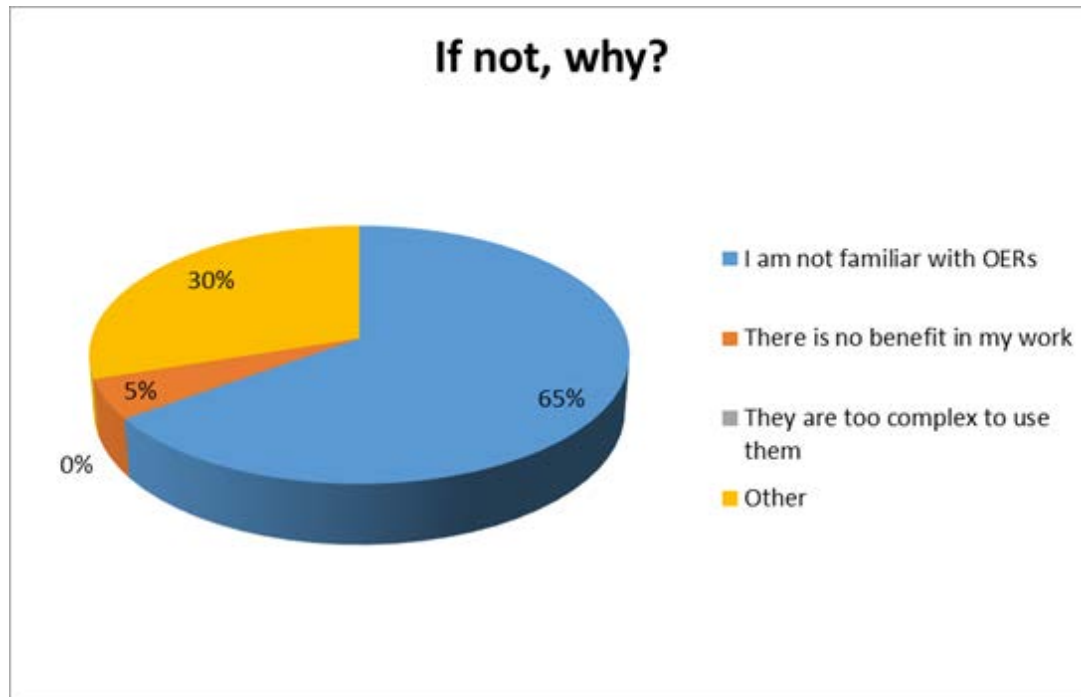
# Teachers' survey



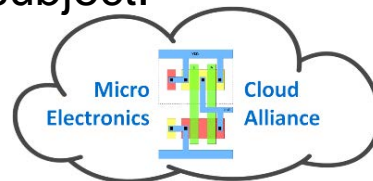
Other: Individual decision; I don't know; Partially; Me no, but maybe others.



# Teachers' survey

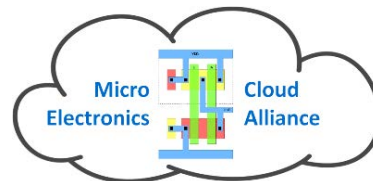
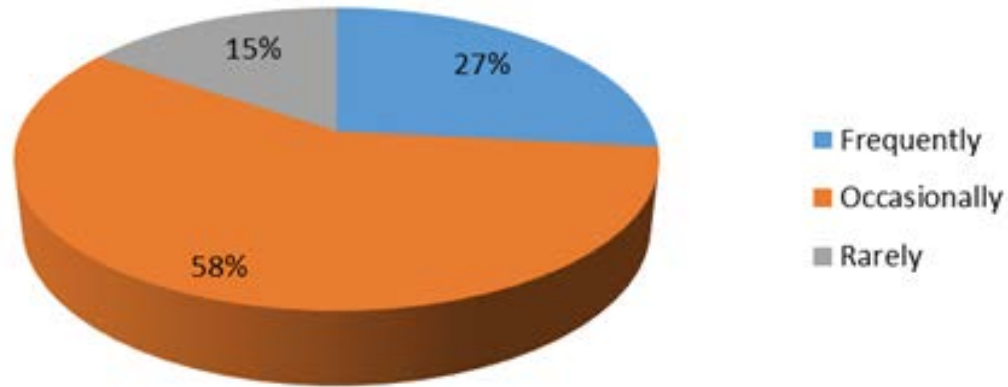


Other: Multimedia resources are available, but they are not open; I use OERs; I select and use Youtube videos and animations which I find useful. I mean, I decide myself if a content can be exploited for education of my students or not. I have never heard of Open Educational Resources.; Developed specifically for this subject.



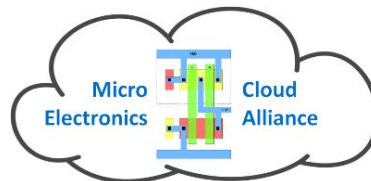
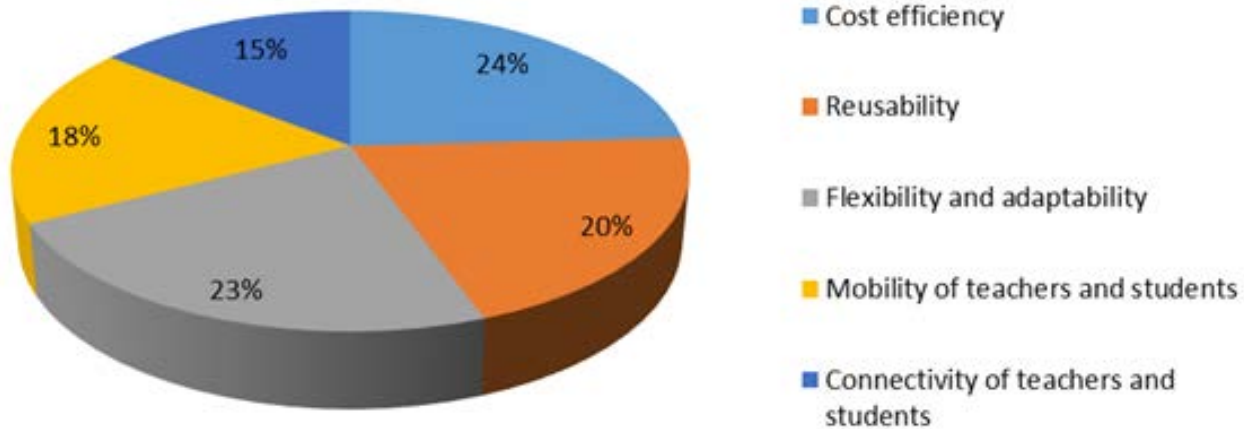
# Teachers' survey

In case of using OERs, how often do you use them?



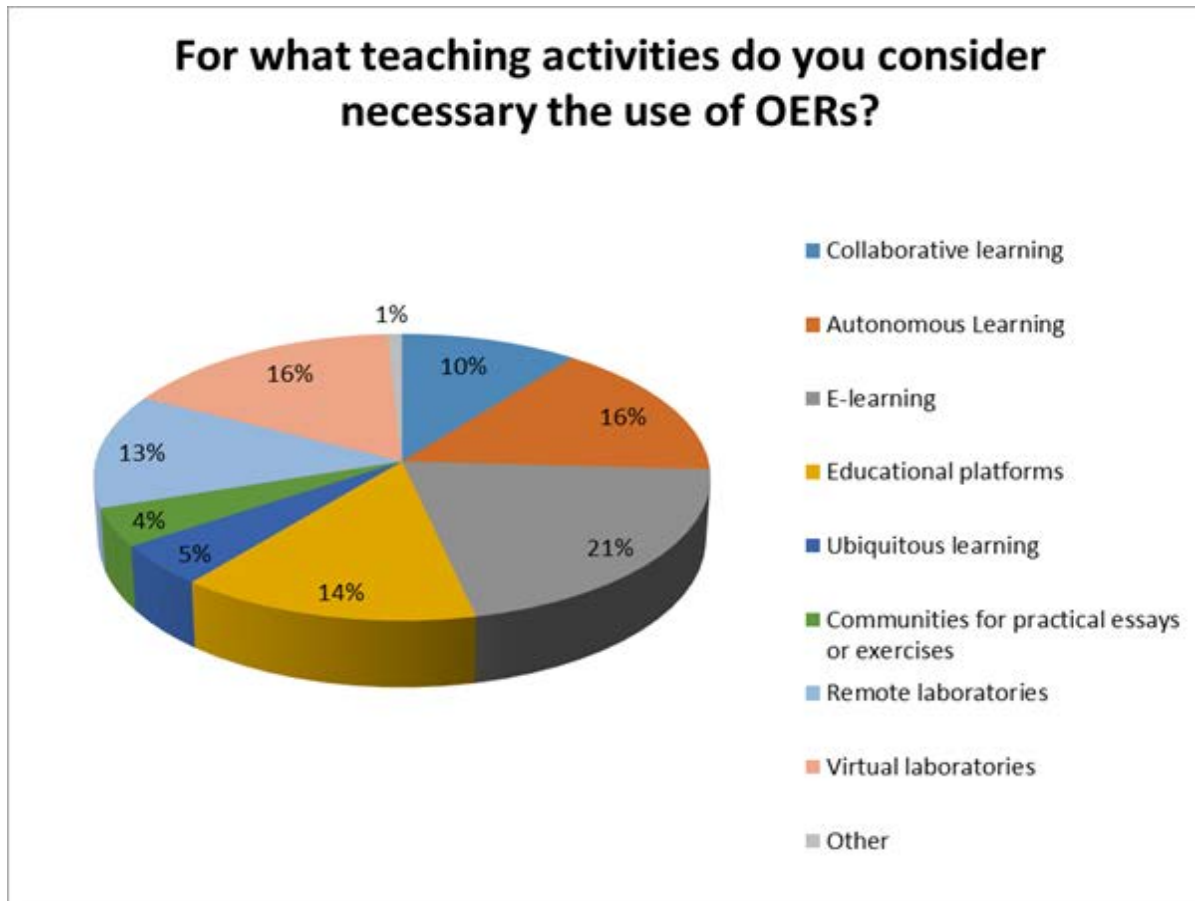
# Teachers' survey

What advantages do you consider that the use of OERs in practical education has?

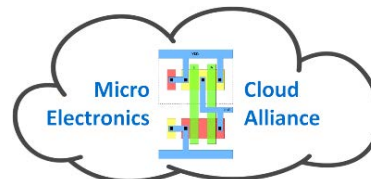




# Teachers' survey



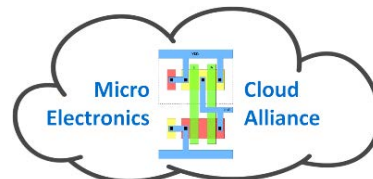
Other: Upgrading the level of the teaching material.



# What level of knowledge students of microelectronic may get with the use of OERs?

	<b>Very high</b>	<b>High</b>	<b>Average</b>	<b>Low</b>	<b>Not relevant to my field of expertise</b>
Evaluation and comparison the different types of integrated circuits	16,95%	47,46%	23,73%	8,47%	3,39%
Electronic devices	22,03%	37,29%	33,90%	6,78%	0,00%
Sensors and actuators	20,34%	40,68%	33,90%	5,08%	0,00%
Manufacturing technologies for integrated circuits	18,64%	37,29%	30,51%	11,86%	1,69%
MEMS manufacturing	15,25%	38,98%	33,90%	8,47%	3,39%
Methods for designing integrated circuits	18,64%	42,37%	25,42%	11,86%	1,69%
Design of MEMS	20,34%	42,37%	27,12%	8,47%	1,69%
Packaging technologies	16,95%	33,90%	35,59%	11,86%	1,69%
Nanomaterials for micro-electronics	23,73%	32,20%	32,20%	10,17%	1,69%

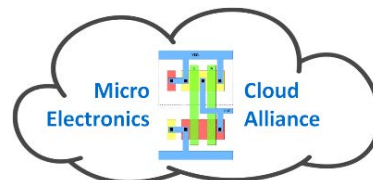
Other : For learning technological processes even for the knowledge some practical training is necessary.;



# What kind of generic (domain independent) skills and to what level do you believe that students should develop with the use of OERs in microelectronics?

	Very high	High	Average	Low	Not relevant to my field of expertise
Capacity of criticism and self-criticism	8,47%	33,90%	40,68%	15,25%	1,69%
Analytic and synthetic thinking	16,95%	44,07%	30,51%	6,78%	1,69%
Ability to apply knowledge in solving real problems	20,34%	30,51%	47,46%	1,69%	0,00%
Capability to work and learn by your own	44,07%	40,68%	13,56%	1,69%	0,00%
Research, planning and organizational skills	20,34%	25,42%	49,15%	5,08%	0,00%
Ability to learn new methods and technologies	16,95%	52,54%	28,81%	1,69%	0,00%
Ability to adapt to new situations	20,34%	30,51%	45,76%	3,39%	0,00%
Skill in use of information and communication technologies	27,12%	45,76%	23,73%	1,69%	1,69%
Ability to manage information	32,20%	35,59%	28,81%	3,39%	0,00%

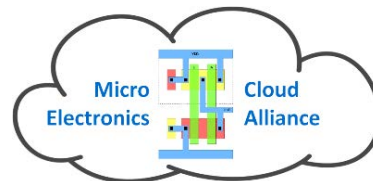
Other: All these skills depend on the teaching approach and methods. So, the above answers are for the convenient teaching methods used for OERs.



# What kind of specific skills do you believe that your students should develop with the use of OERs in microelectronics?

	Very high	High	Average	Low	Not relevant to my field of expertise
Compare different types of LSI circuits	18,64%	44,07%	30,51%	6,78%	0,00%
Evaluate different types of LSI circuits	11,86%	47,46%	30,51%	10,17%	0,00%
Understand the theory related to lithography, oxidation and deposition layers, diffusion and ion implantation, CMOS technology, and BICMOS integrated circuits	30,51%	42,37%	22,03%	5,08%	0,00%
Design of integrated circuits and microsystems	23,73%	33,90%	35,59%	5,08%	1,69%
Be able to implement the design of digital circuits and logic matrices	13,56%	40,68%	42,37%	1,69%	1,69%

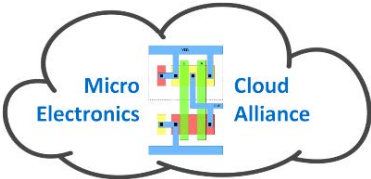
Other (please specify): Again the skills learned depend on the teaching methods, which should include exercises, problems for solving, project design.



# Which of the following have you taught during the most recent academic year?

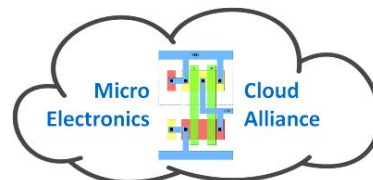
	<b>Face-to-face course</b>	<b>Blended/Hybrid course</b>	<b>Online Course</b>
Undergraduate level	64,41%	23,73%	11,86%
Graduate level	57,63%	35,59%	6,78%
PhD	55,93%	32,20%	11,86%

Other (please specify): In fact, the BSc and MSc courses were face-to-face but a lot of online resources were used.



When selecting open sharing resources (OER, remote access and sharing educational and professional software, and remote and practice-based learning facilities) for your teaching, which of the following factors would be most important to you?

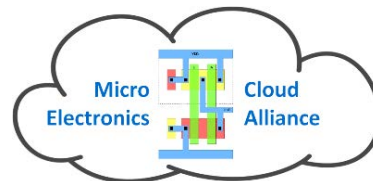
	<b>Open Educational Resources</b>	<b>Remote access and sharing of educational and professional software</b>	<b>Remote and practice-based learning facilities</b>	<b>Not applicable</b>
Cost	44,07%	30,51%	13,56%	11,86%
Proven to improve student performance	18,64%	32,20%	35,59%	13,56%
Saves time and efforts	54,24%	20,34%	16,95%	8,47%
Easy to find	66,10%	16,95%	6,78%	10,17%
Easy to use	59,32%	22,03%	10,17%	8,47%
Ready to use	57,63%	20,34%	16,95%	5,08%
Adaptable/editable	59,32%	18,64%	10,17%	11,86%



What would be the barriers to the use of open shared resources (OER, remote access and sharing educational and professional software, and remote and practice-based learning facilities) in your courses?

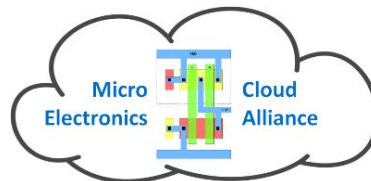
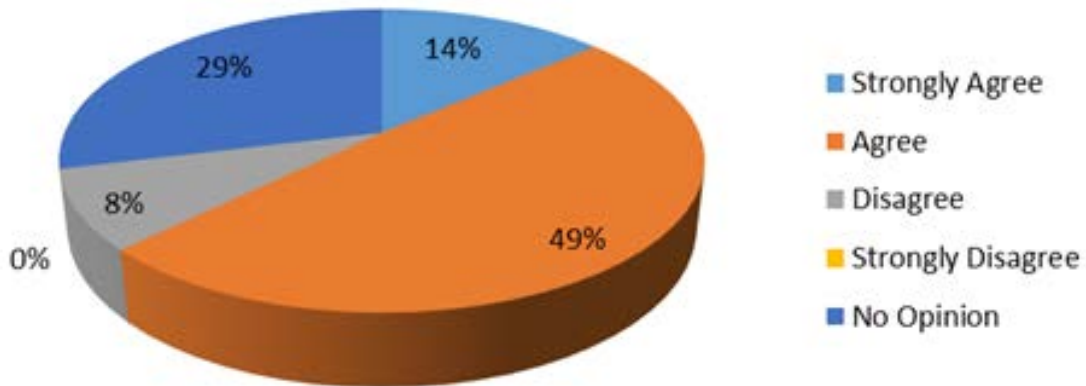
	<b>Open Educational Resources</b>	<b>Remote access and sharing of educational and professional software</b>	<b>Remote and practice-based learning facilities</b>	<b>Not applicable</b>
Too difficult to use	13,56%	10,17%	18,64%	57,63%
Too hard to find what I need	22,03%	13,56%	22,03%	42,37%
Not relevant to my local context	13,56%	13,56%	13,56%	59,32%
Too difficult to change/edit	23,73%	20,34%	8,47%	47,46%
Too difficult to integrate into technology I use	10,17%	18,64%	13,56%	57,63%
Not effective at improving student performance	6,78%	13,56%	15,25%	64,41%
No support by my organisation	10,17%	13,56%	10,17%	66,10%

Comments: The engineering education requires real practice also.



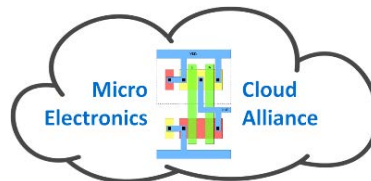
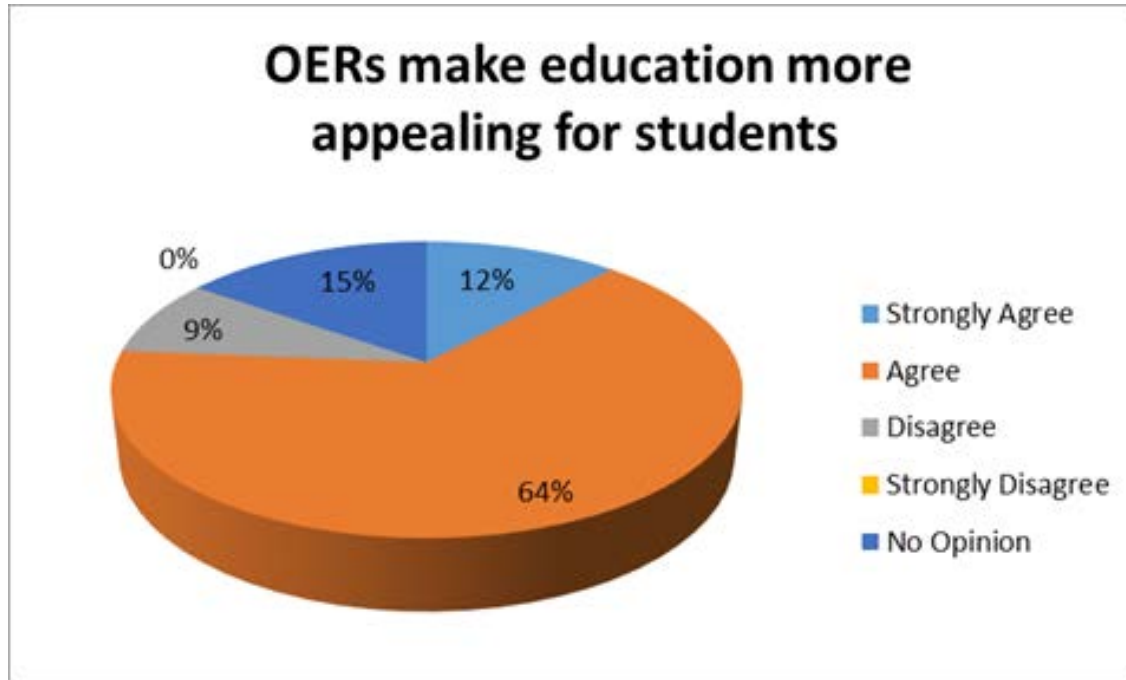
# Teachers' survey

Use of OER leads to improvement in student performance



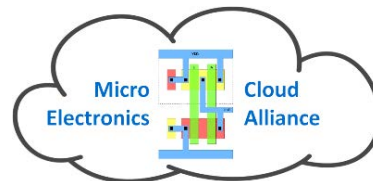
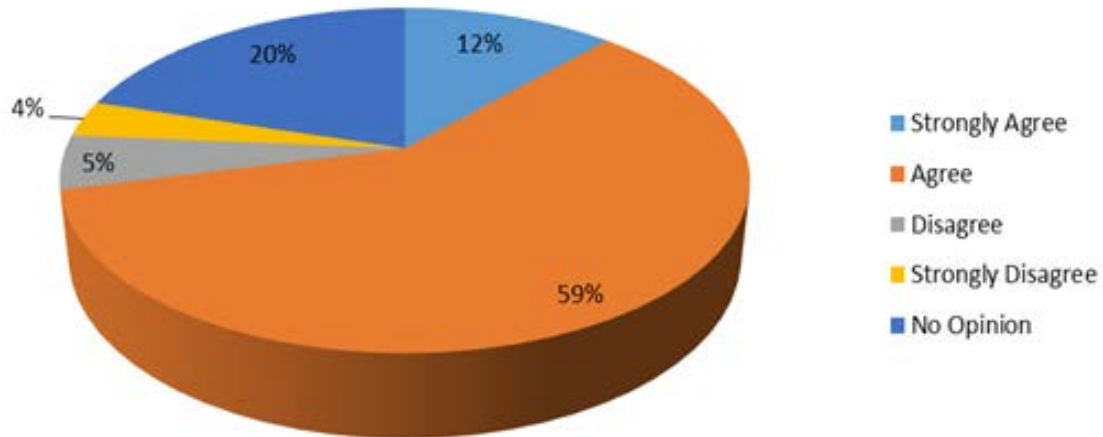


# Teachers' survey



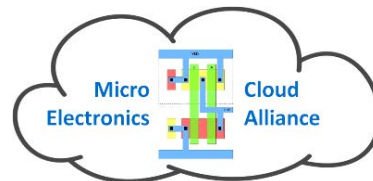
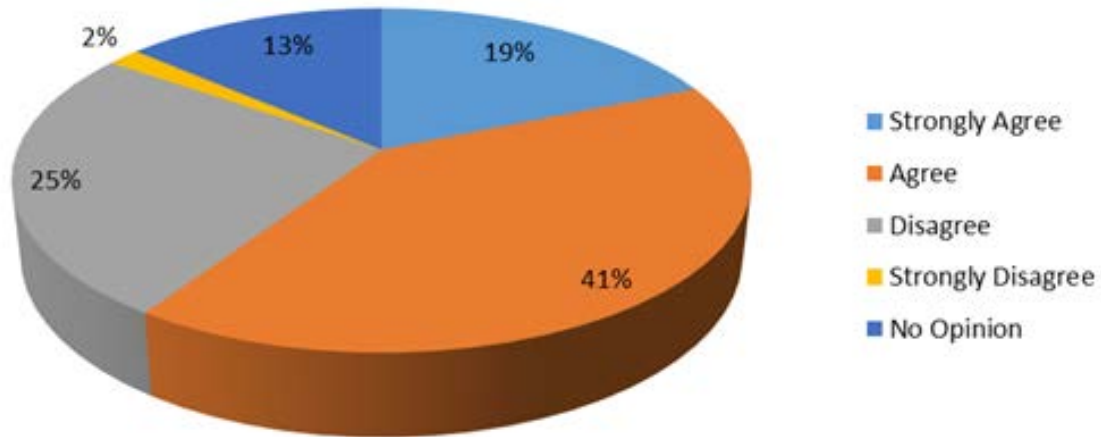
# Teachers' survey

Use of OER leads to critical reflection by educators, with evidence of improvement in their practice.



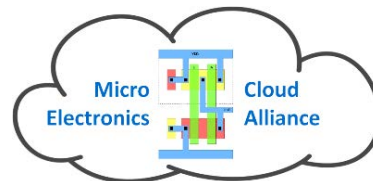
# Teachers' survey

Use of OER leads to reducing efforts and time for teachers



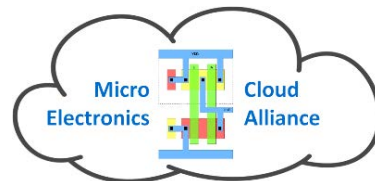
# *Summary of teachers' survey*

- If 89% of the students use open educational resources the teachers using OERs are only 69% and most of them use them occasionally.
  - It is not surprising because probably most of the teachers are from traditional universities with face-to-face education.
- All advantages of OERs are appreciated: flexibility, reusability, virtual mobility of teachers and students, cost efficiency, connectivity with students.



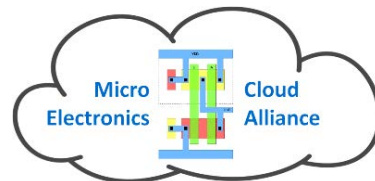
# *Summary of teachers' survey*

- Logically, the teachers consider that it is less likely that OERs provide high level of knowledge for the subject matters in technology.
- With regard to the generic skills it is considered that the abilities for independent learning and working, managing information, using ICT are favoured and the capacity of criticism and self-criticism and the adaptation to new situations – not so much.



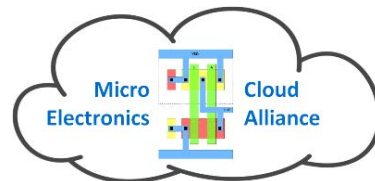
# *Summary of teachers' survey*

- Important comments:
  - “All taught skills depend on the teaching approach and methods. So, the above answers are for the convenient teaching methods used for OERs.”
  - “The skills learned depend on the teaching methods, which should include exercises, problems for solving, project design.”



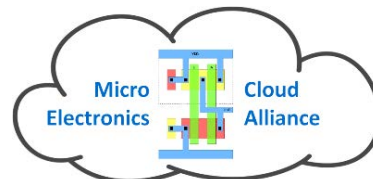
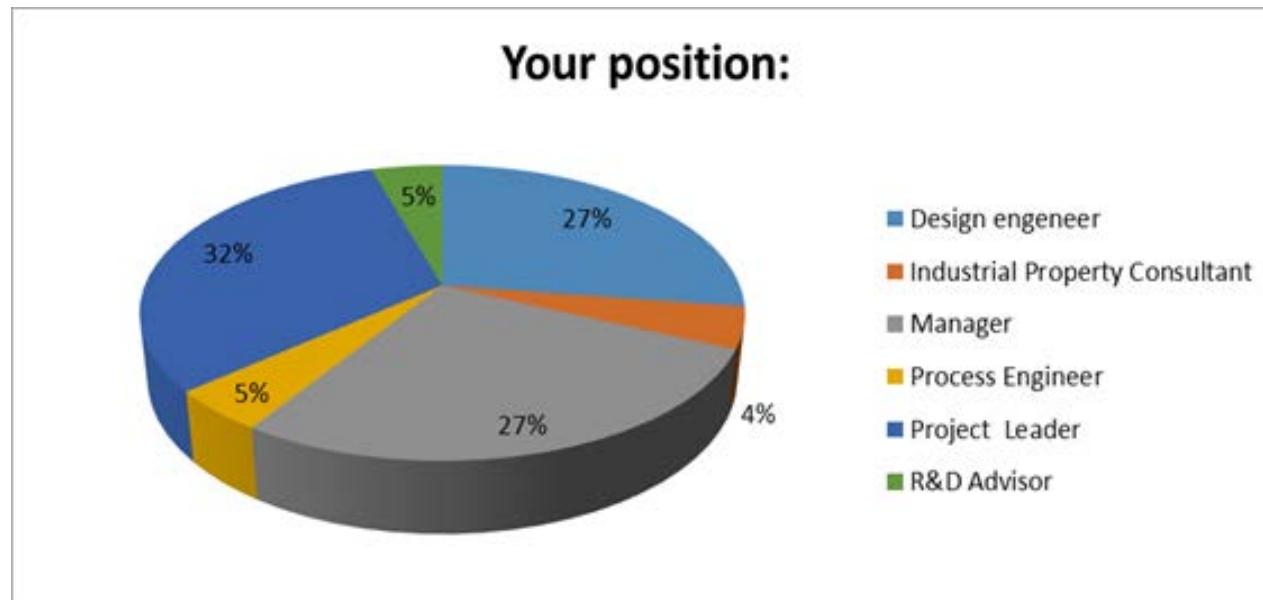
# *Summary of teachers' survey*

- The teachers consider that e-learning does not improve students' performance as the student also think about but it makes learning more appealing.
- Most of the educators believe that the use of OERs would improve their practice and reduce their efforts and time used for teaching.



# *Survey on the knowledge and skills necessary for the business*

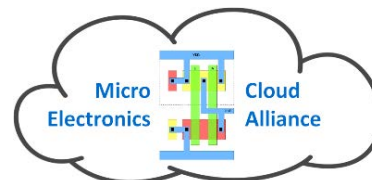
- Learning outcomes were defined and in May the questionnaire was distributed to the companies in the sector.
- 23 representatives of the business answered the questionnaire about the importance of different learning contents.





In your opinion, what are the needs for the industry in the following domains, on a short term point of view (within 3 years):

	High or Mandatory	Average	Low	Not relevant to my field of expertise
Design of nanoscale MOS ICs	45,45%	36,36%	18,18%	0,00%
Nanomaterials	54,55%	27,27%	18,18%	0,00%
Microelectronics literacy and technologies	54,55%	27,27%	18,18%	0,00%
Integrated circuits and design	59,09%	36,36%	4,55%	0,00%
Superconductive materials	40,91%	18,18%	40,91%	0,00%
Survival in labour market	59,09%	31,82%	9,09%	0,00%
Project management	50,00%	50,00%	0,00%	0,00%
Effective communication with groups, presentation techniques	68,18%	27,27%	4,55%	0,00%
Modelling and design of ULSI circuits and systems	50,00%	40,91%	9,09%	0,00%
Design and realisation of micro-nano-bio sensors	59,09%	27,27%	13,64%	0,00%
Electromagnetic compatibility of integrated circuits	54,55%	36,36%	9,09%	0,00%
Design for manufacturing of microsystems	54,55%	40,91%	4,55%	0,00%
Electronic packaging and assembling technologies of microsystems	68,18%	27,27%	4,55%	0,00%
PV Power electronics maintenance	54,55%	31,82%	13,64%	0,00%
Technology of electronics products	54,55%	36,36%	9,09%	0,00%
Virtual laboratory support for microelectronics packaging education	45,45%	40,91%	13,64%	0,00%
Multi-media enhancement of teaching sensors and MEMS	50,00%	40,91%	9,09%	0,00%
Assembling and inspection technologies	59,09%	36,36%	4,55%	0,00%
Design, prototype fabrication and applications of silicon microsystems with piezoresistive feedback	45,45%	40,91%	13,64%	0,00%
MEMS Sensors, Actuators, and Control Techniques	59,09%	36,36%	4,55%	0,00%
Semiconductor Device Modeling	40,91%	36,36%	18,18%	4,55%
Other	13,64%	27,27%	4,55%	54,55%

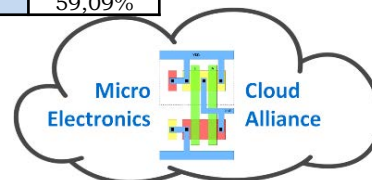


In your opinion, what are the needs for the industry in the following domains, on a long term point of view (more than 3 years):

	High or Mandatory	Average	Low	Not relevant to my field of expertise
Design of nanoscale MOS ICs	72,73%	18,18%	9,09%	0,00%
Nanomaterials	86,36%	13,64%	0,00%	0,00%
Microelectronics literacy and technologies	77,27%	22,73%	0,00%	0,00%
Integrated circuits and design	77,27%	18,18%	4,55%	0,00%
Superconductive materials	63,64%	18,18%	18,18%	0,00%
Survival in labour market	54,55%	36,36%	4,55%	4,55%
Project management	63,64%	36,36%	0,00%	0,00%
Effective communication with groups, presentation techniques	81,82%	13,64%	4,55%	0,00%
Modelling and design of ULSI circuits and systems	54,55%	36,36%	9,09%	0,00%
Design and realisation of micro-nano-bio sensors	72,73%	27,27%	0,00%	0,00%
Electromagnetic compatibility of integrated circuits	72,73%	22,73%	4,55%	0,00%
Design for manufacturing of microsystems	63,64%	27,27%	9,09%	0,00%
Electronic packaging and assembling technologies of microsystems	68,18%	27,27%	4,55%	0,00%
PV Power electronics maintenance	63,64%	22,73%	13,64%	0,00%
Technology of electronics products	63,64%	31,82%	4,55%	0,00%
Virtual laboratory support for microelectronics packaging education	72,73%	18,18%	9,09%	0,00%
Multi-media enhancement of teaching sensors and MEMS	72,73%	22,73%	4,55%	0,00%
Assembling and inspection technologies	72,73%	22,73%	4,55%	0,00%
Design, prototype fabrication and applications of silicon microsystems with piezoresistive feedback	81,82%	13,64%	4,55%	0,00%
MEMS Sensors, Actuators, and Control Techniques	86,36%	13,64%	0,00%	0,00%
Semiconductor Device Modeling	86,36%	13,64%	0,00%	0,00%
Other	27,27%	13,64%	0,00%	59,09%

If other, please specify:

- Distributed power generation
- Power electronics
- Graphene synthesis technology
- Graphene synthesis and applications
- System Integration

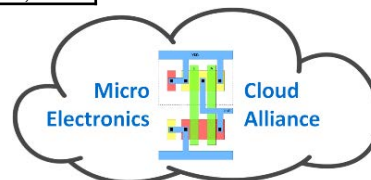


What would be the skill level you expect to find among your employees/students. You may give a ratio for each topic, i.e. None 50%, Basic 30%, Advanced 15%, Expert 5%., or just check one column (will be considered as 100%)

	Expert	Advanced knowledge	Basic knowledge	Not relevant to my field of expertise
Design of nanoscale MOS ICs	4,55%	27,27%	50,00%	18,18%
Nanomaterials	9,09%	22,73%	54,55%	13,64%
Microelectronics literacy and technologies	4,55%	54,55%	40,91%	0,00%
Integrated circuits and design	9,09%	63,64%	18,18%	9,09%
Superconductive materials	9,09%	4,55%	68,18%	18,18%
Survival in labour market	13,64%	4,55%	63,64%	18,18%
Project management	9,09%	36,36%	54,55%	0,00%
Effective communication with groups, presentation techniques	13,64%	45,45%	36,36%	4,55%
Modelling and design of ULSI circuits and systems	13,64%	22,73%	36,36%	27,27%
Design and realisation of micro-nano-bio sensors	9,09%	18,18%	63,64%	9,09%
Electromagnetic compatibility of integrated circuits	22,73%	31,82%	36,36%	9,09%
Design for manufacturing of microsystems	9,09%	36,36%	54,55%	0,00%
Electronic packaging and assembling technologies of microsystems	4,55%	40,91%	45,45%	9,09%
PV Power electronics maintenance	9,09%	40,91%	40,91%	9,09%
Technology of electronics products	0,00%	54,55%	45,45%	0,00%
Virtual laboratory support for microelectronics packaging education	4,55%	31,82%	45,45%	18,18%
Multi-media enhancement of teaching sensors and MEMS	0,00%	22,73%	50,00%	27,27%
Assembling and inspection technologies	0,00%	50,00%	50,00%	0,00%
Design, prototype fabrication and applications of silicon microsystems with piezoresistive feedback	9,09%	36,36%	50,00%	4,55%
MEMS Sensors, Actuators, and Control Techniques	9,09%	40,91%	45,45%	4,55%
Semiconductor Device Modeling	13,64%	18,18%	63,64%	4,55%
Other	18,18%	4,55%	18,18%	59,09%

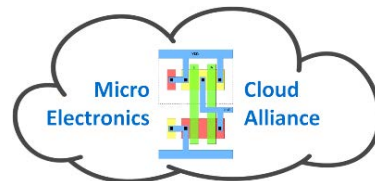
If other, please specify:

Distributed power generation  
 Power conditioning equipment  
 Graphene synthesis technology  
 Graphene synthesis and applications  
 System Integration



# ***Conclusions of the survey with the business***

- All the proposed courses are considered to fulfill a more than average need in short term.
- In long term the industry will needs even more skills and competences in the proposed topics.
- We can conclude that the university world is close to the industry needs.



# *Conclusions of the survey with the business*

- Effective communication with groups, presentation techniques, project management and survival on the labour market are considered as highly important by almost all respondents.
- Additional topics are suggested in power electronics, graphene technologies and system integration.

