Training Action 2

Santa Catarina, Brazil
August 22th – 26th, 2016

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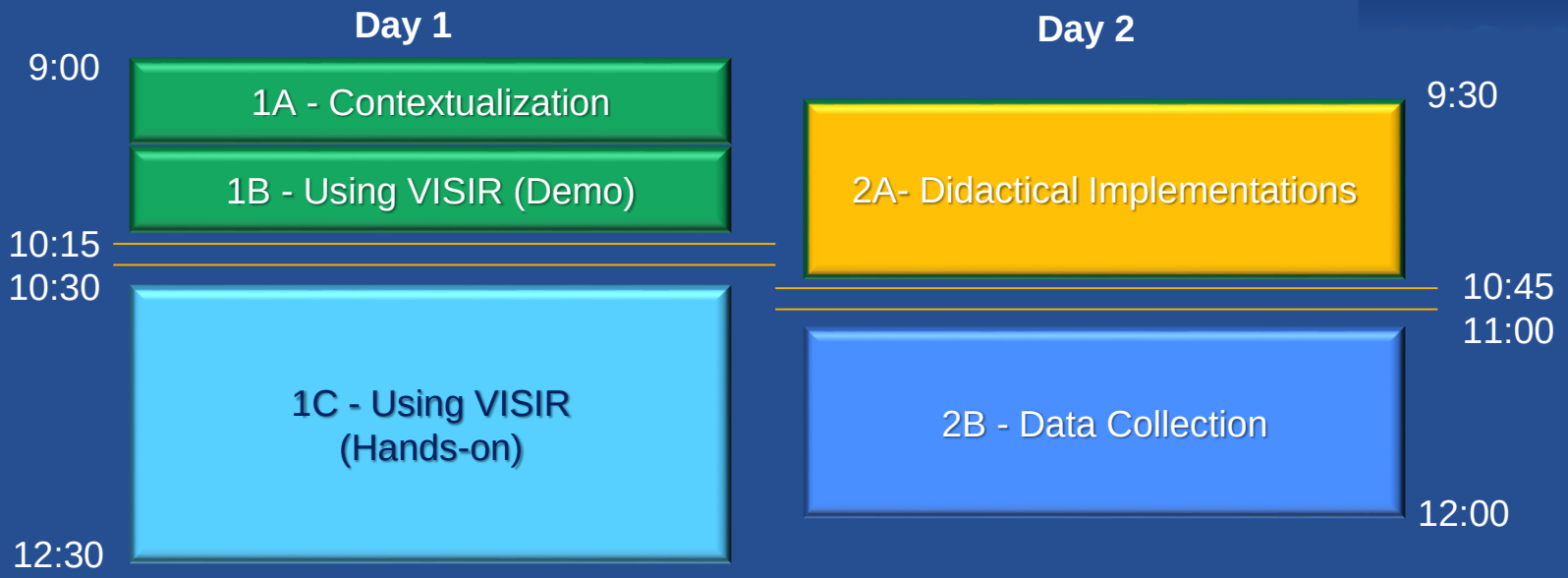
TA2 Structure



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VISIR Didactical Implementation

Day 2 – Session 2A

POLITÉCNICO DO PORTO

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Enquiry-Based Learning Methodology (EBL)

Definition

forms of learning driven by a process of enquiry (includes PBL); the learning process is more student-centred and inludes: small-group tutorials, **problem-based lectures**, large-group method discussion, **problem-based laboratories**, etc.

Advantages

applicable to **diferent learning environments**, suitable to develop **thinking skills**, **experimental competences,** relevant to lifelong learning and suitable for meeting the requirements of industry [1].

[1] Deignan, T. (2009) “Enquiry-Based Learning: perspectives on practice” *Teaching in Higher Education,* vol 14, (1) pp.13-28.

Using Simultaneous Resources

Advantages

- each resource allows development of different competences;
- due to their different learning styles, teachers can reach more students;
- students get extended access to learning resources, which allows them to organize their own learning activities, according to the perception of their learning needs.

VISIR@ISEP

2010-11 — 1st Phase

One large course (~500 students)

Several teachers

2011-12 — 2nd Phase

Several small courses (~1000 students)

Several teachers

Different pedagogical approaches

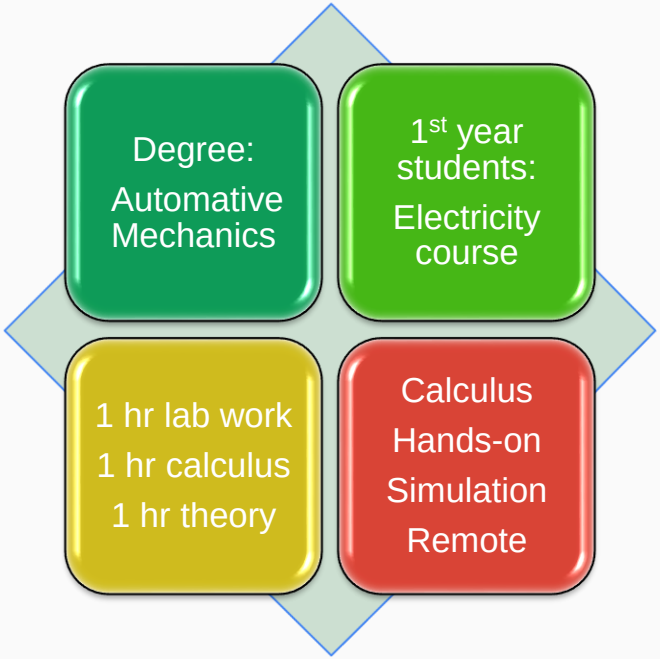
2013-14 — 3rd Phase

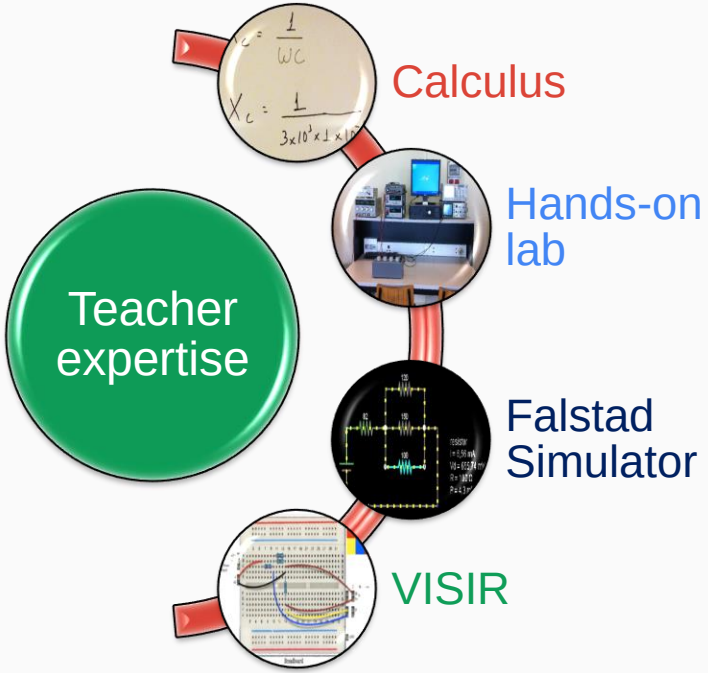
One small course (~80 students)

One teacher

Combining learning tools: hands-on, remote labs and simulation

Phase 3: 1 course 1 teacher – Using simultaneous resources



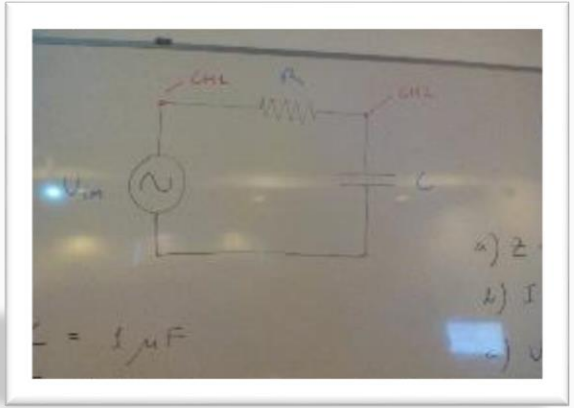


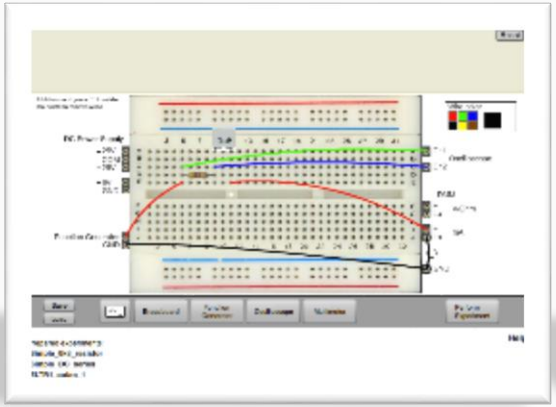
Didactical Design

Calculus Hands-on Simulation VISIR

week	Course Class Planning	
	Type	***Summary***
1	**T** Explanation and visualization in the *Falstad* circuit simulator	Introducing inductors (L) and capacitors (C). Analyzing RL and RC circuits in series, in DC mode: stable and transient responses. Time analysis of an RLC resonant circuit (response to a pulse voltage).
2	**PL** *Falstad* circuit simulator and VISIR remote lab Room: Computer room	Training with periodic signals (sine, triangular and square waves) and its most common parameters: frequency, period, positive and negative peak values, peak-to-peak, mean or DC component, duty-cycle, RMS, and form factor. Visualizing waves and performing measurements in VISIR and in the *Falstad* simulator, using the function generator and the oscilloscope. Defining the signal parameters with the function generator (VISIR) and in the simulator, and observing / measuring them with the oscilloscope (VISIR) and the oscilloscope channel viewer (simulator).
	T Recitation	Mesh and nodal analysis methods for DC linear electric circuits. The case of circuits with (voltage and current) controlled power sources.
	PL Hands-on lab	Hands-on with the function generator and the oscilloscope. Visualizing and performing measurements in an RC circuit in series (Ut, Ur, and Uc).
3	**T** Calculus and visualization in the *Falstad* circuit simulator	Characterization (calculus and simulation) of RL and RC circuits in series and parallel. Cross-comparison.
4	**PL** Calculus	Solving calculus exercises with RLC circuits in series, parallel, and mixed.
	T Demostration	Demonstrating in class how to perform and cross-compare results from calculus, simulation and remote experimentation of an RC circuit in series.
5	**PL** Hands-on lab	Hands-on with RC and RL circuits in series and parallel.
	T	Conclusion.
6	**Assessment**	Individual lab assessment.

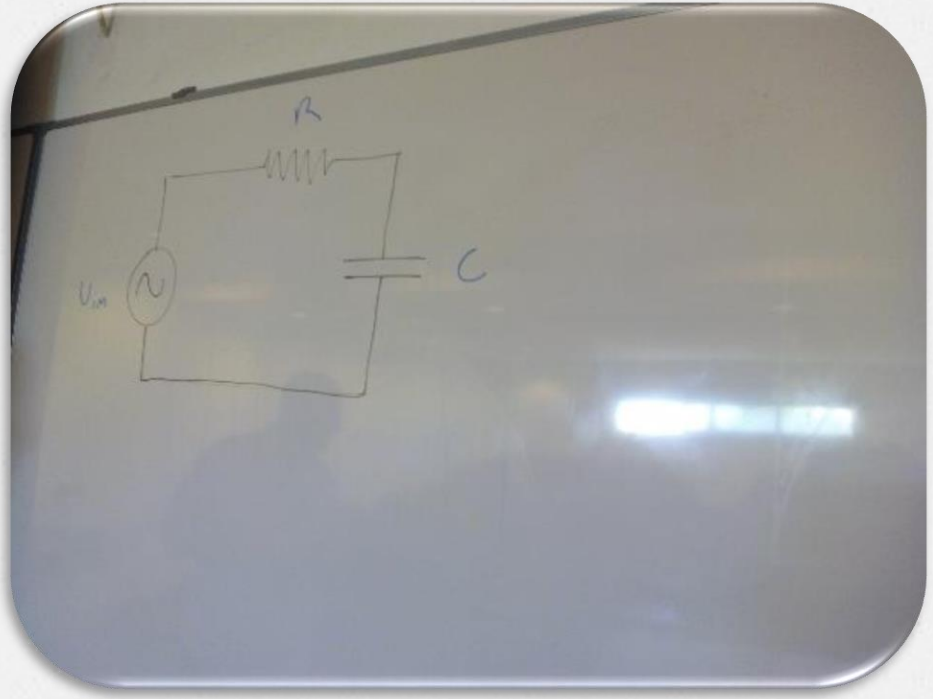
Using Several Complementary Resource in Class





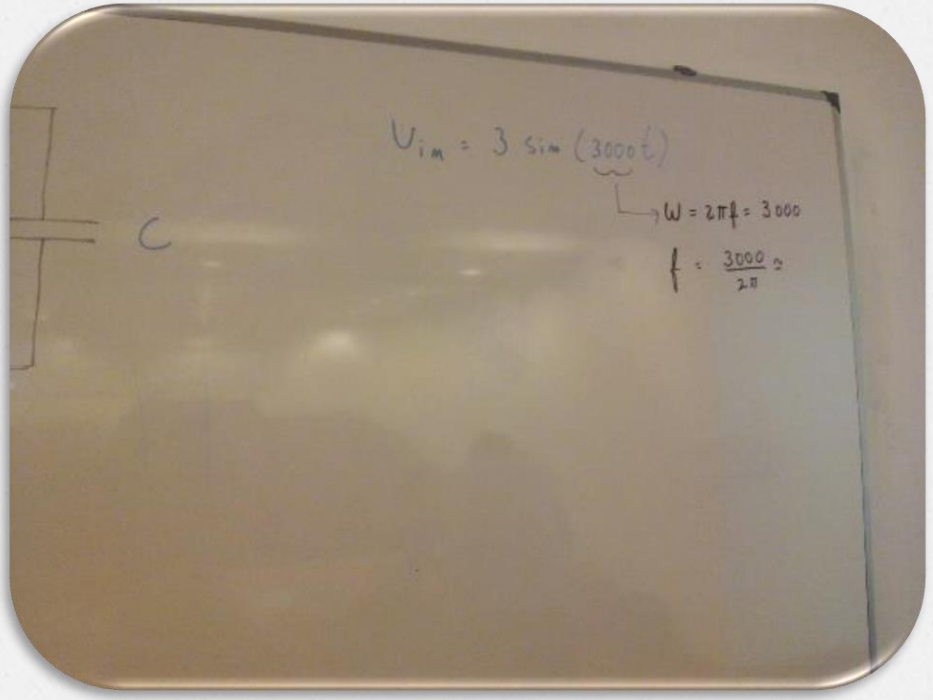
Exemplo de uma aula teórica…

Definição do circuito



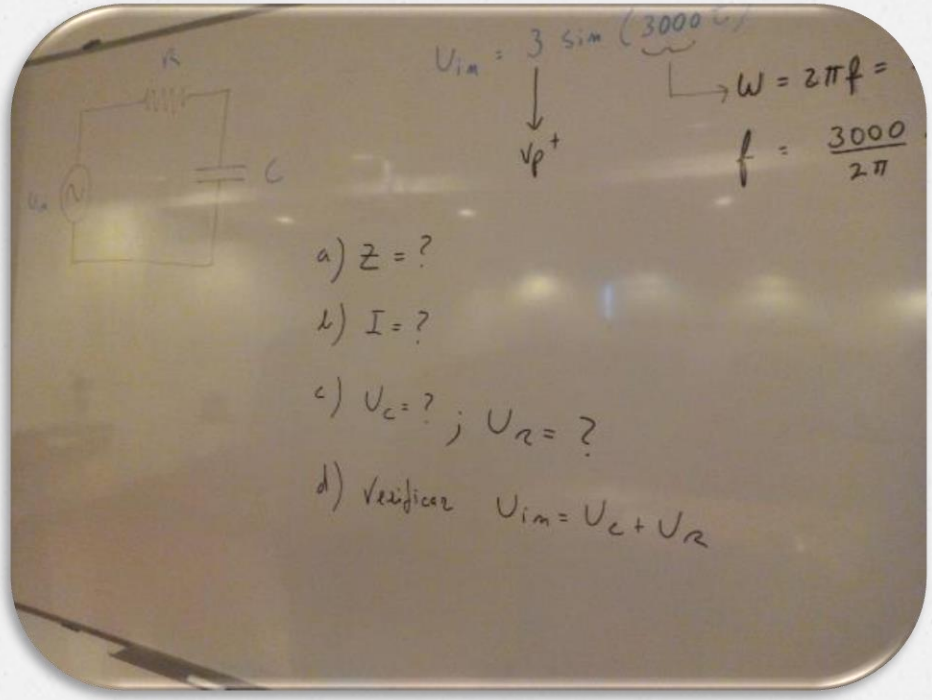
Exemplo de uma aula teórica…

Definição dos parâmetros de entrada



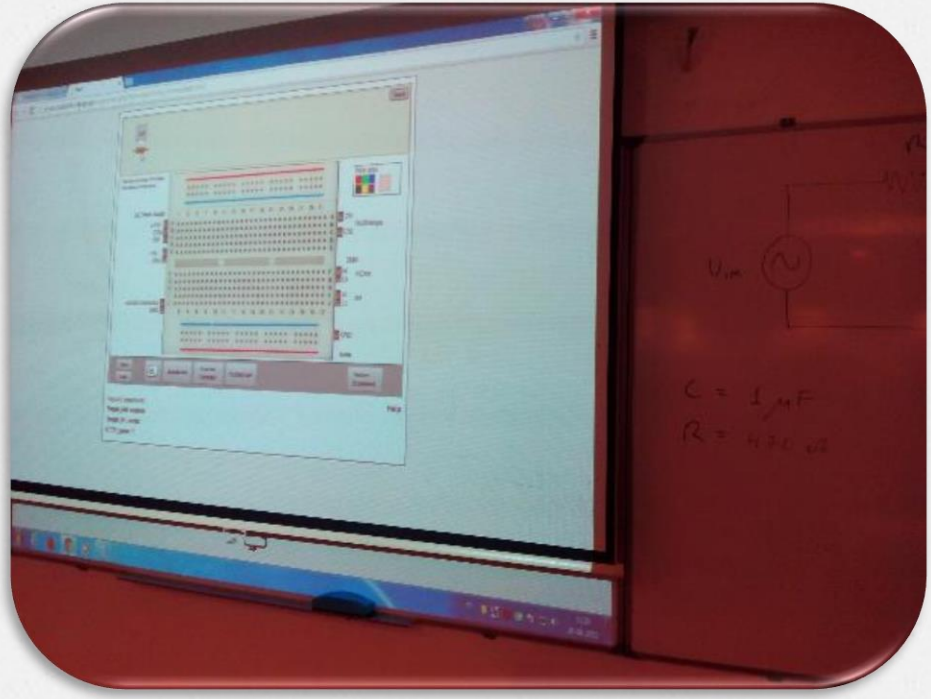
Exemplo de uma aula teórica…

Definição do objectivo da tarefa



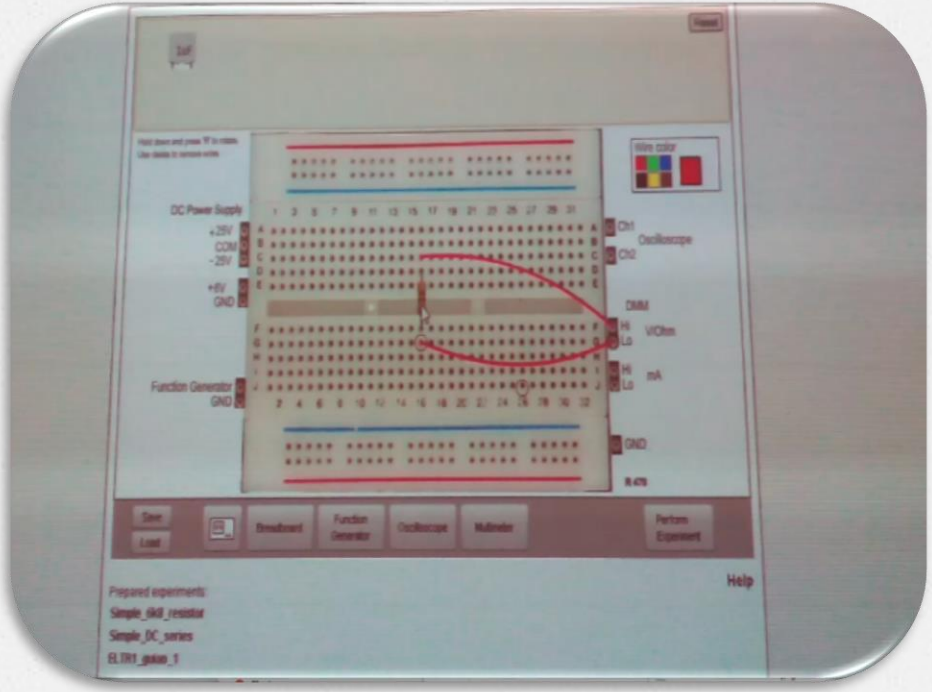
Exemplo de uma aula teórica…

Aceder ao lab remoto…



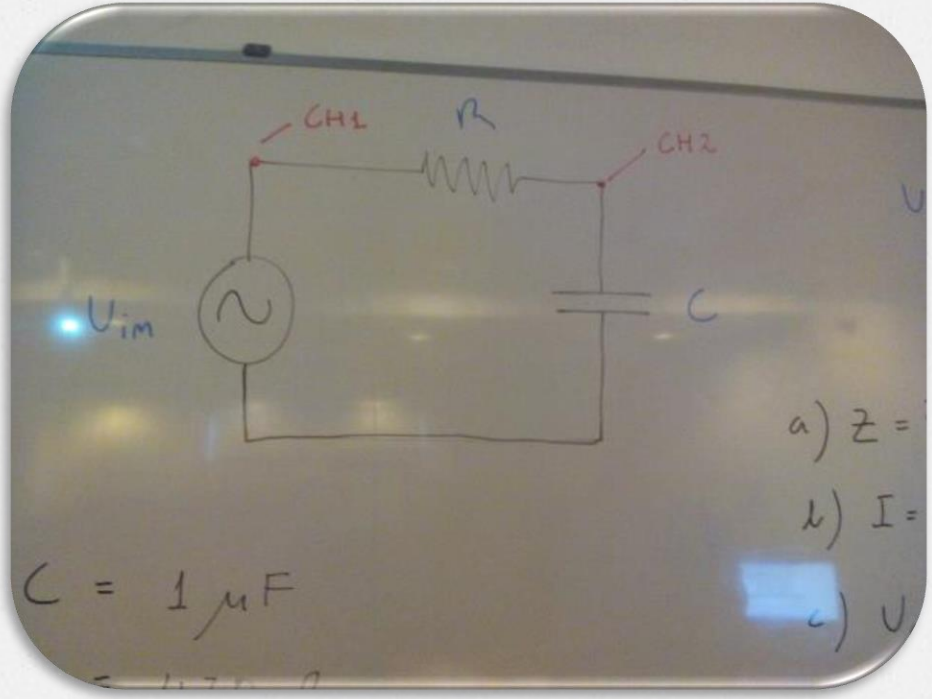
Exemplo de uma aula teórica…

… verificar o valor da resistência



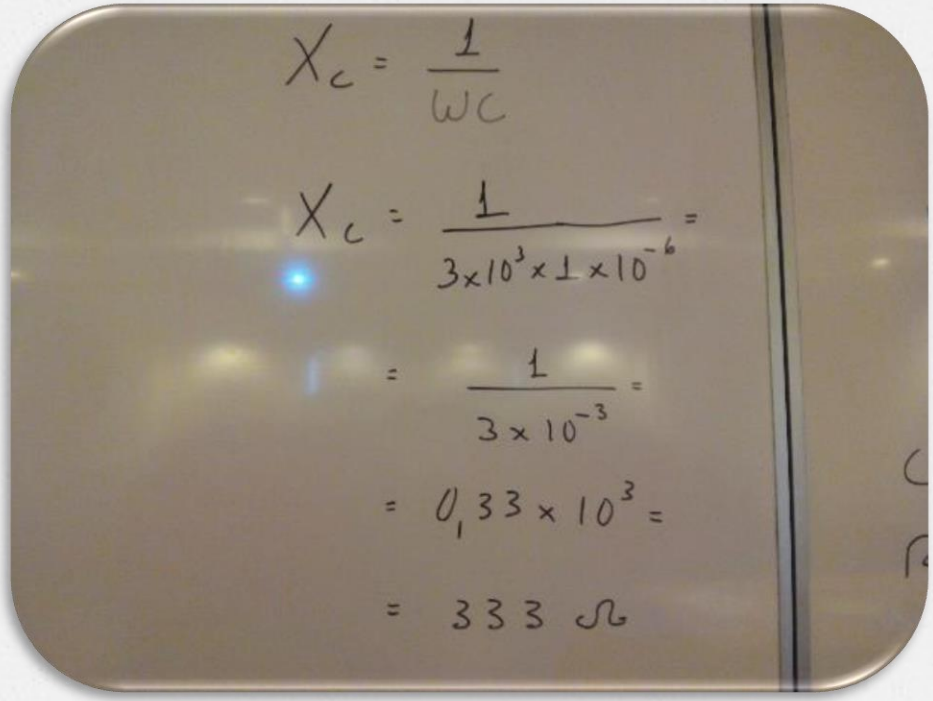
Exemplo de uma aula teórica…

Explicar o paralelo entre a visualização no lab remoto e o circuito no quadro



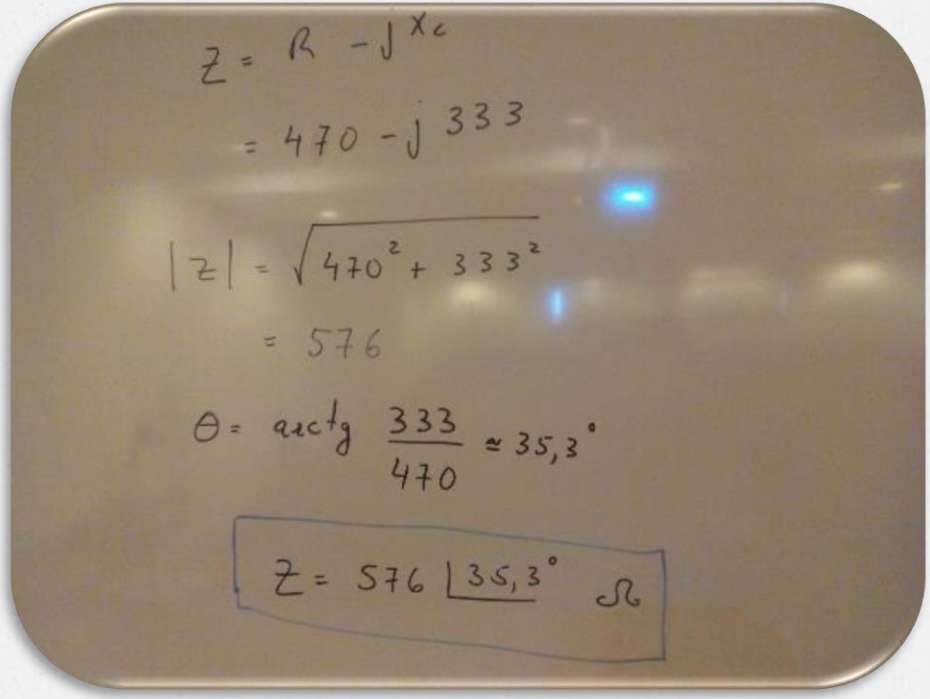
Exemplo de uma aula teórica…

Cálculo de algumas grandezas



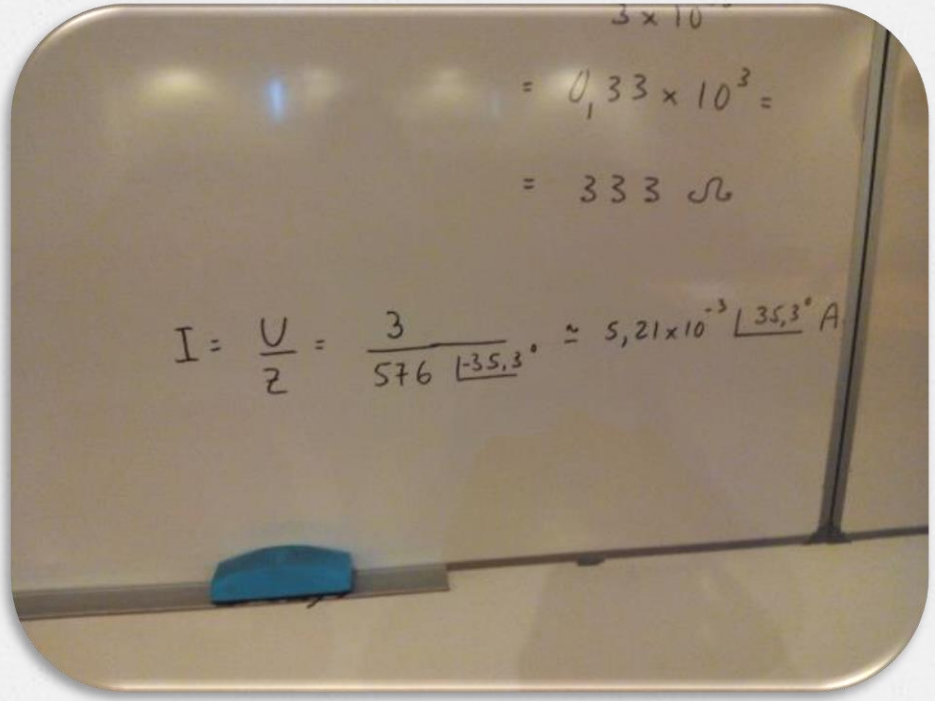
Exemplo de uma aula teórica…

Explicar o porquê de algumas grandezas só poderem ser obtidas por cálculo…



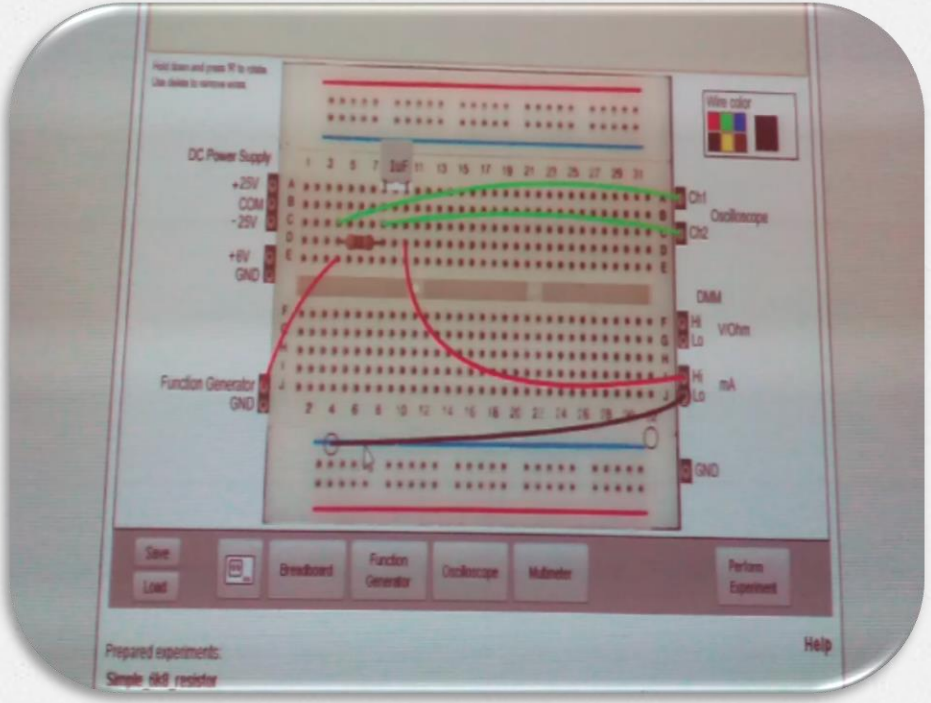
Exemplo de uma aula teórica…

Explicar o a diferença entre as grandezas calculadas e aquelas que podem ser visualizadas em laboratório…



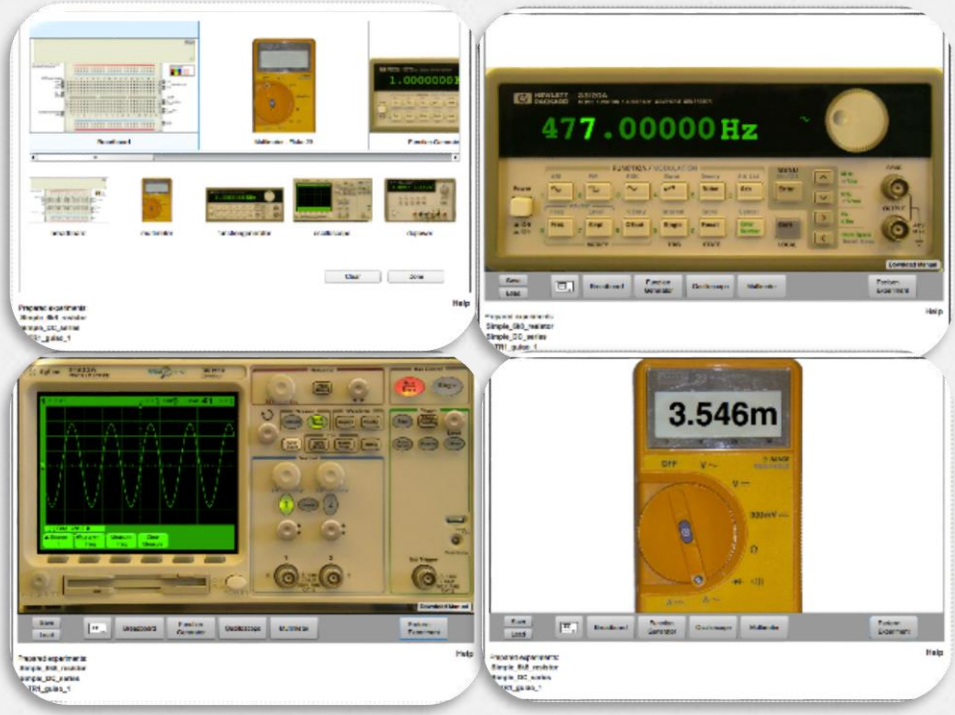
Exemplo de uma aula teórica…

Montar o circuito no lab remoto



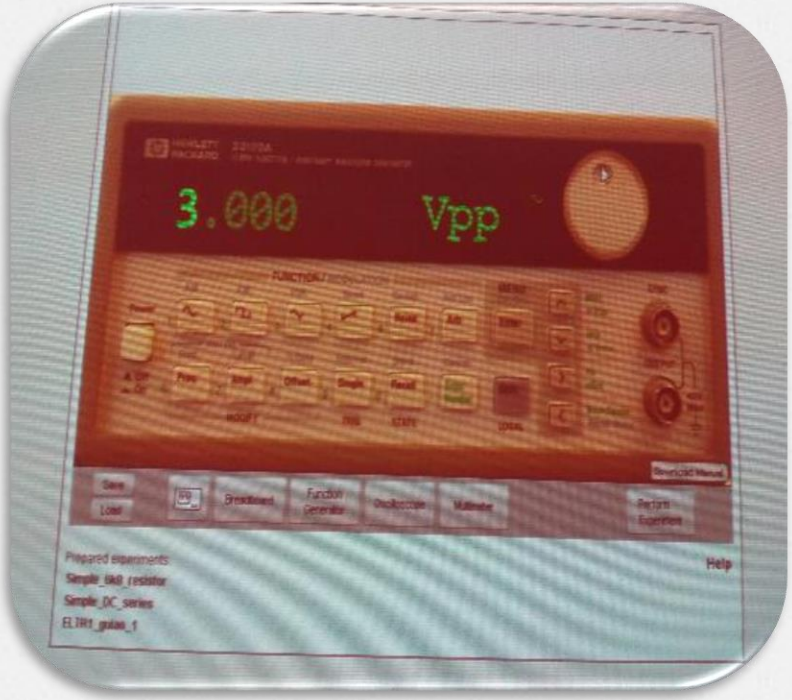
Exemplo de uma aula teórica…

Lab remoto: acesso aos aparelhos de medição

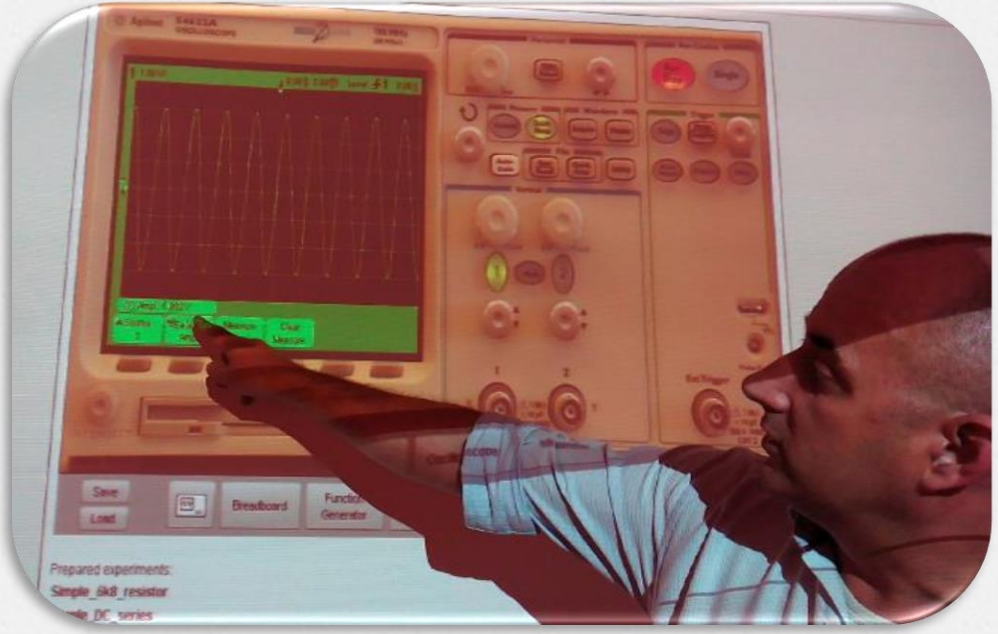


Exemplo de uma aula teórica…

Ajuste da tensão de entrada…

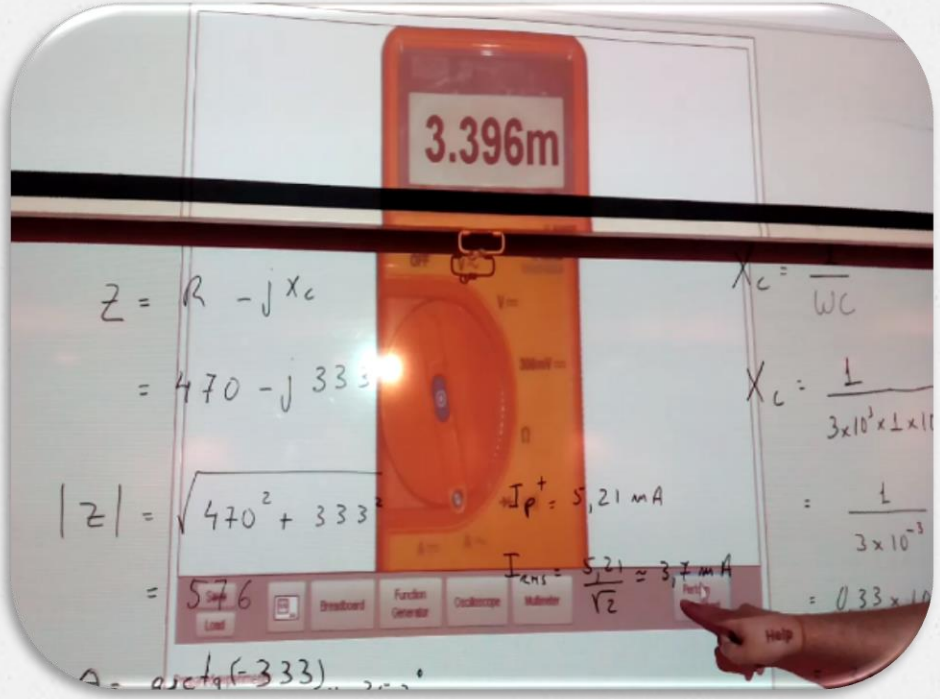


Exemplo de uma aula teórica…



Exemplo de uma aula teórica…

Comparação entre os diferentes resultados encontrados

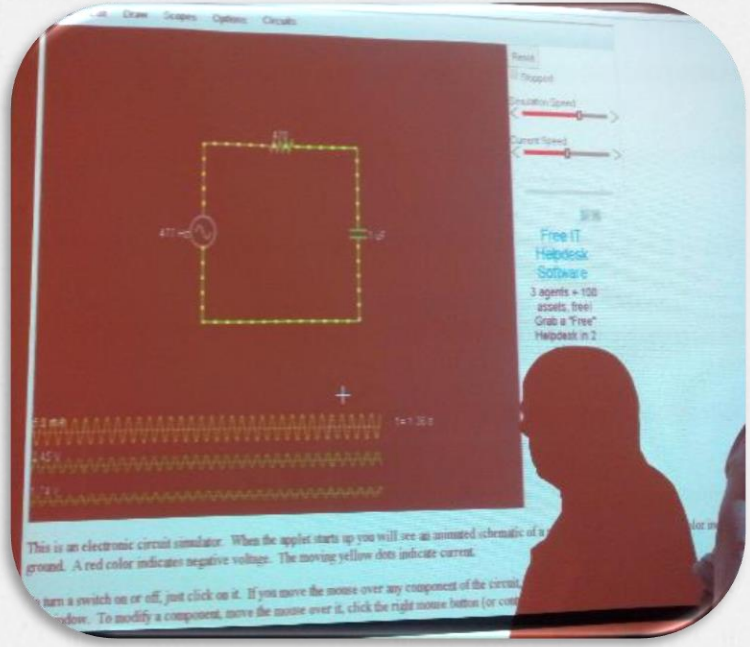


Exemplo de uma aula teórica…

Construção do circuito no simulador (Falstad)

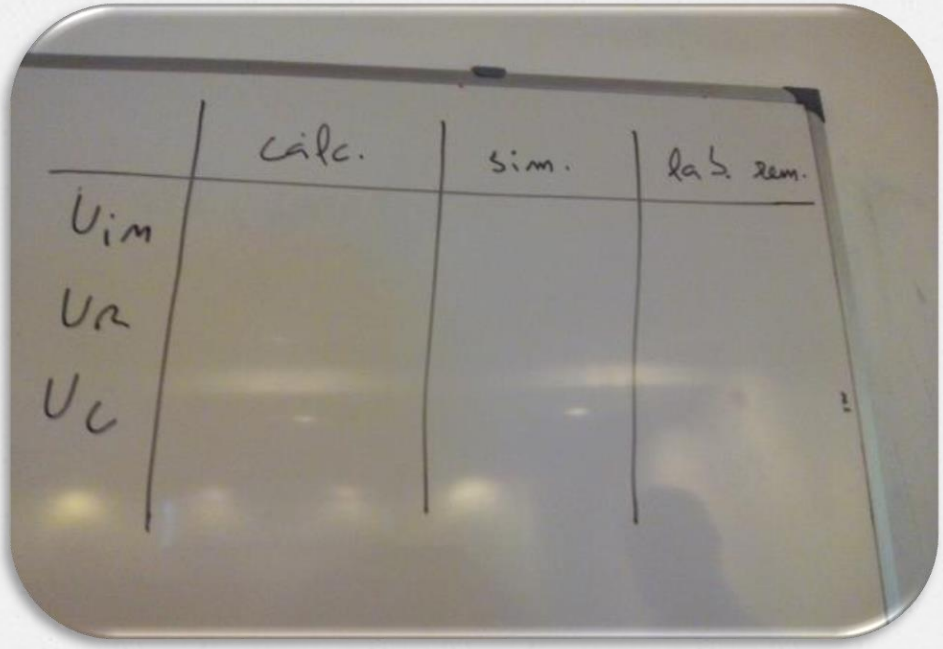
Exemplo de uma aula teórica…

Visualização dos resultados no simulador



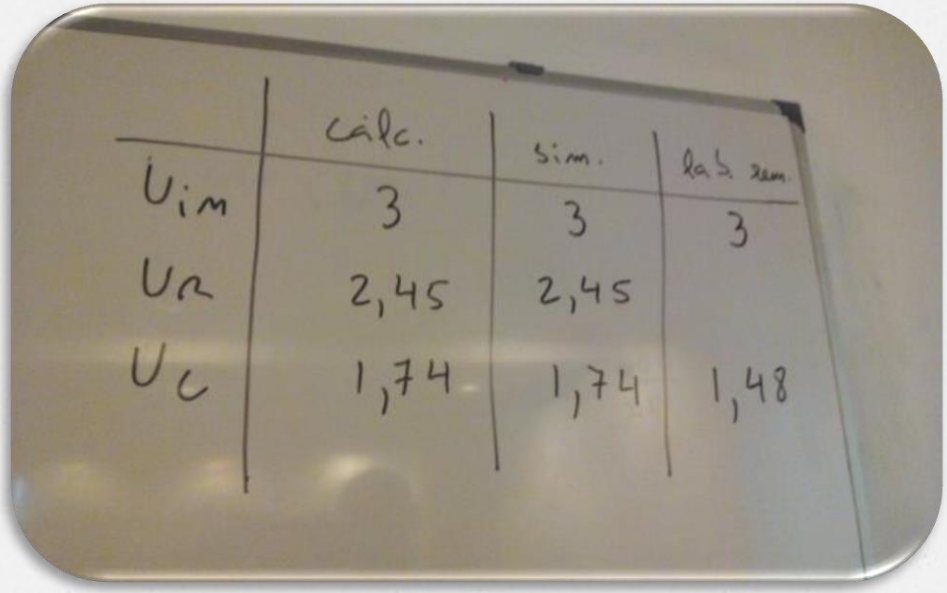
Exemplo de uma aula teórica…

Comparação entre os diferentes resultados encontrados



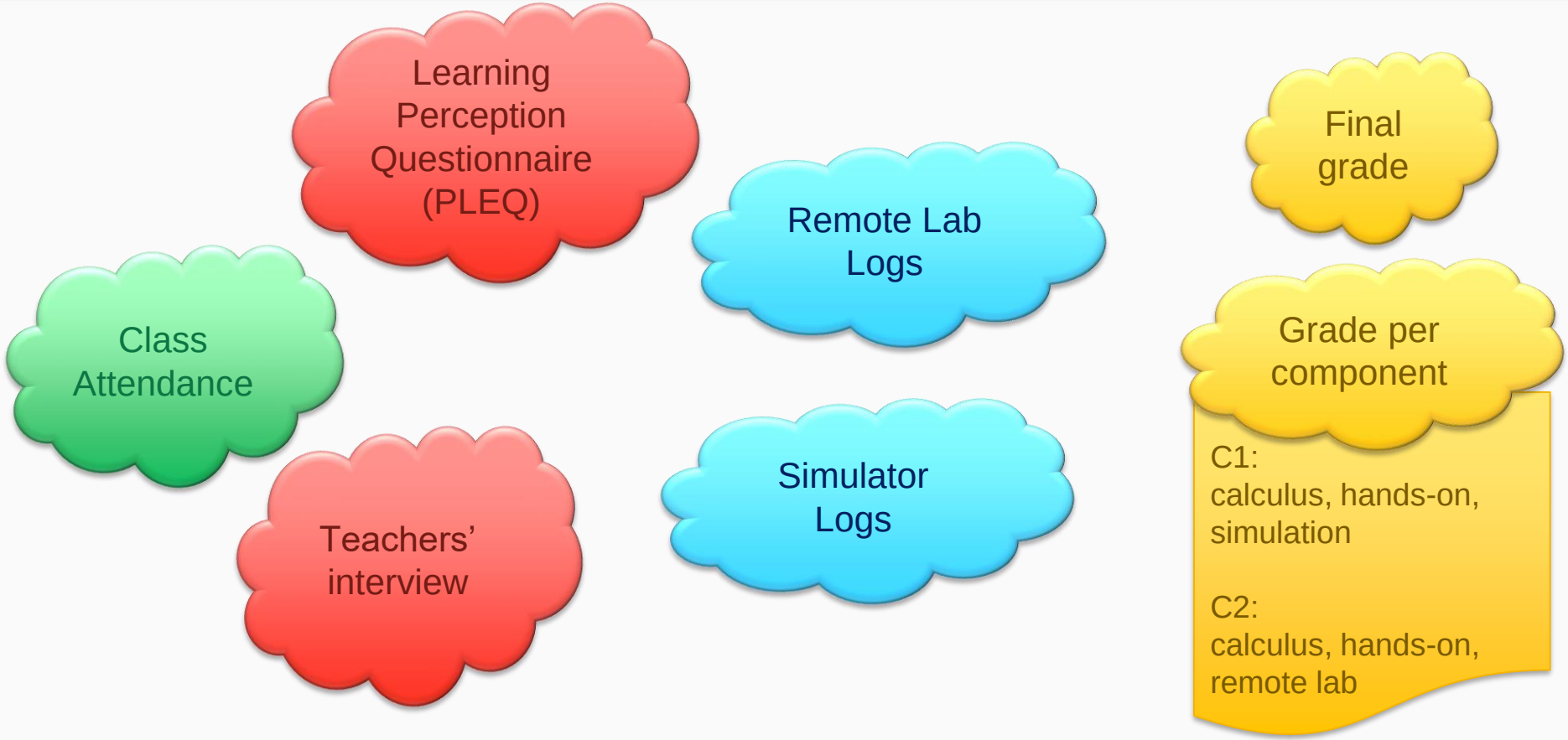
Exemplo de uma aula teórica…

Comparação entre os diferentes resultados encontrados



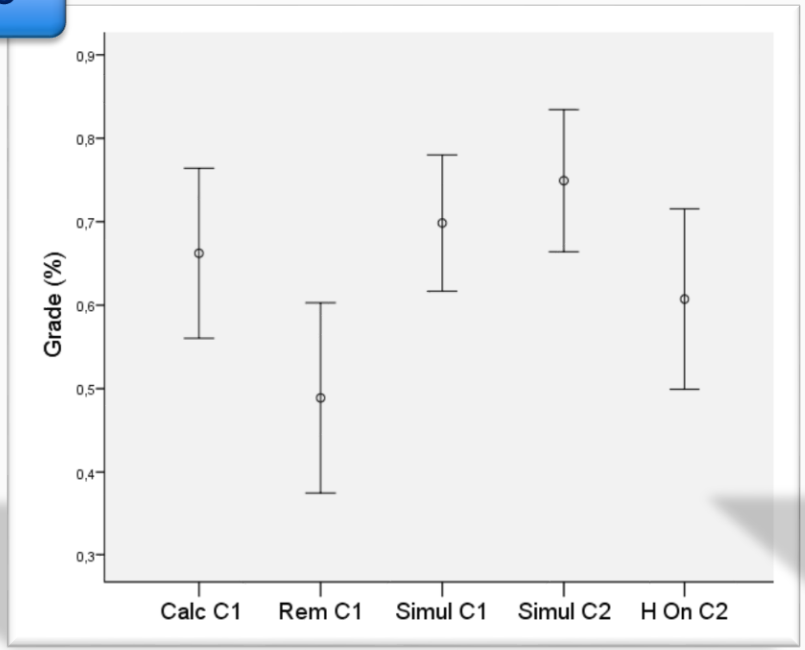
	calc.	sim.	lab sem.
U_{im}	3	3	3
U_R	2,45	2,45	
U_C	1,74	1,74	1,48

Collected Data and Analysis



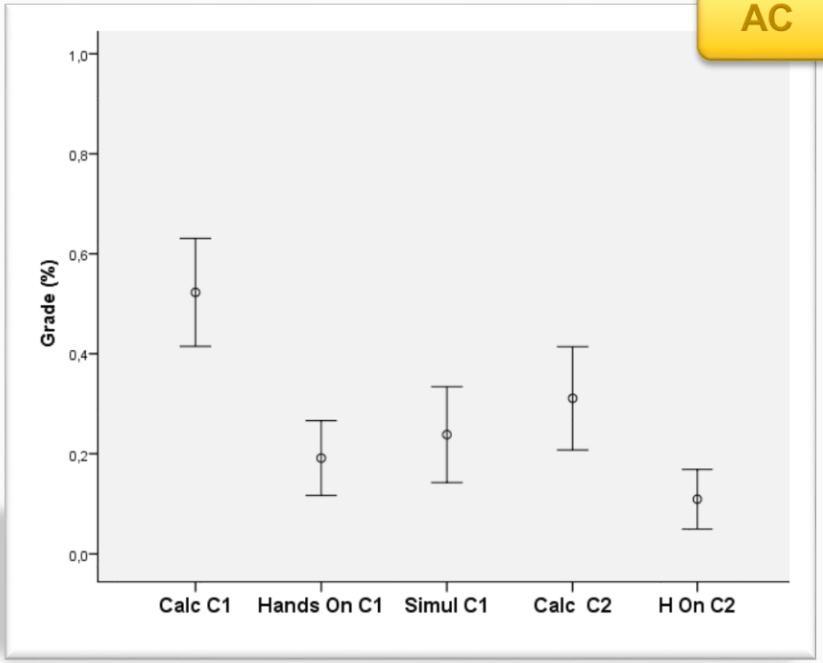
Results: Students Performance

DC



Simulation Logs	478
Remote Lab Logs	292

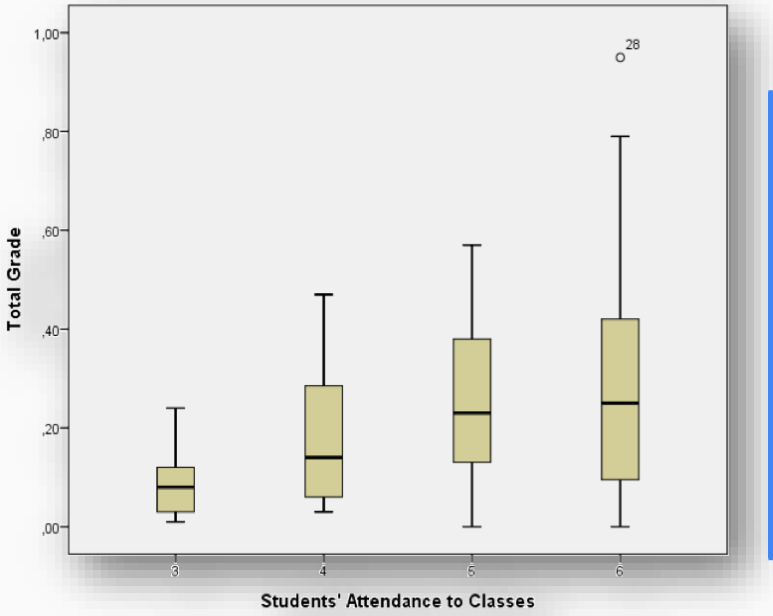
AC



Simulation Logs	206
Remote Lab Logs	100

Results: Students Performance

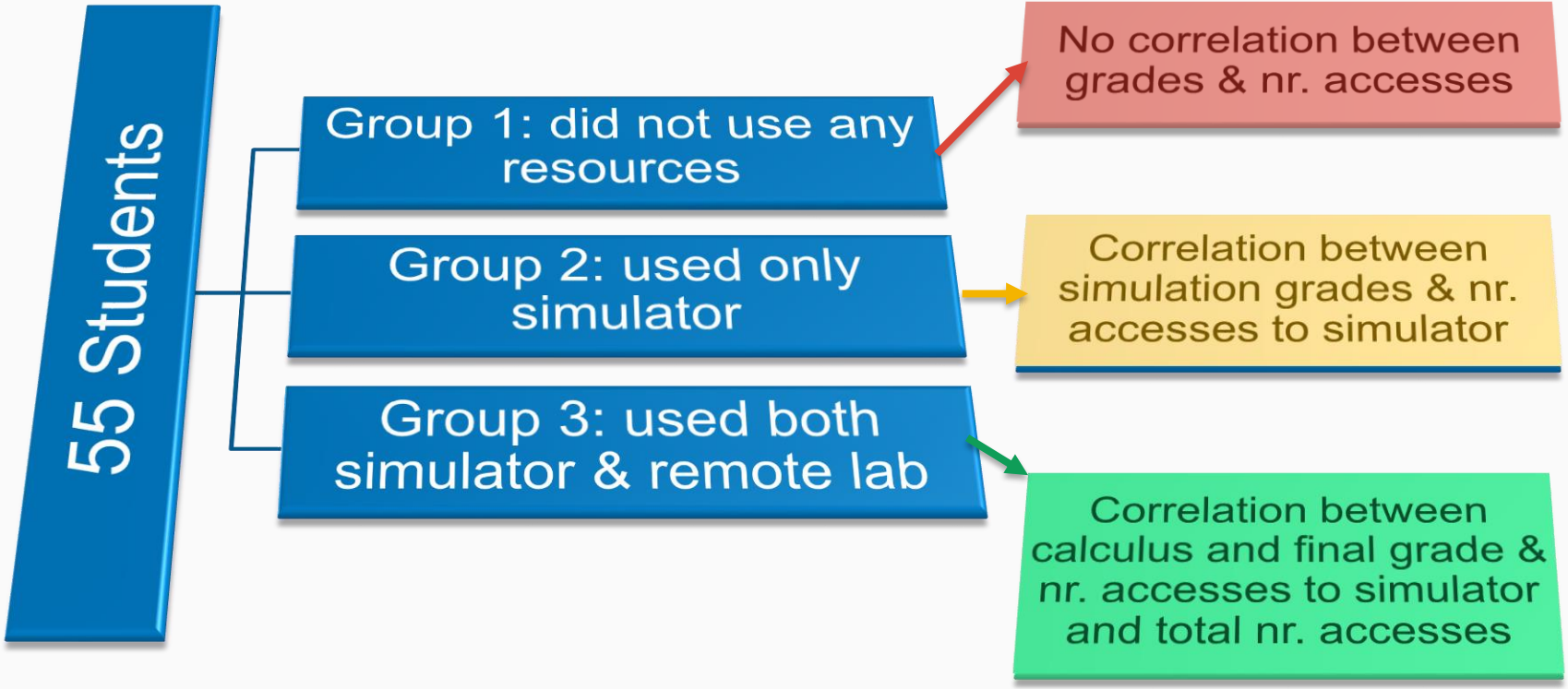
- Students attending most achieved better results.



- Significant correlation between calculus and final grades with the simulator and with online resources (remote & simulator).

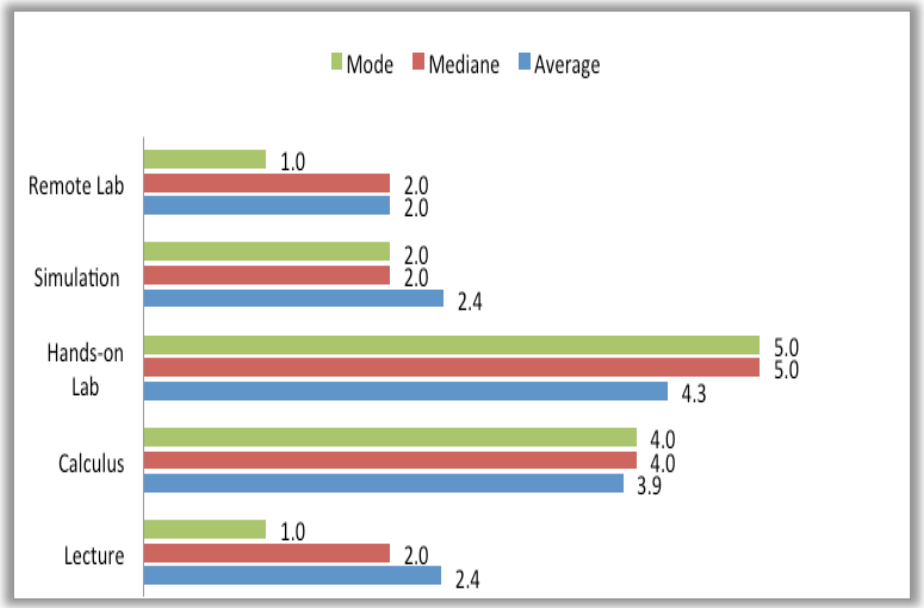
Spearman Correlation		Circuit 1			Circuit 2		Final Grade
		Calculus	Hands On	Simulation	Calculus	Hands On	
Number of Absences					-0,317*		-0,278*
Number of Accesses to	Simulator				0,314*		
	Visir ISEP						
	Visir BTH				0,268*		0,273*
	Visir (ISEP+BTH)						0,325*
	Total (Rem+Sim)				0,371**		0,306*

Results: Students Performance



Results: PLEQ Results

Hands-on Followed by **Calculus classes**



Factors Helping/Hindering their Study

- Hands-on Lab:
  - “It helps because we are able to manipulate ourselves”;
  - “students’ groups are to big and we are not able to manipulate the material ourselves”; “sometimes the material is damaged”
- Simulation/remote labs:
  - “being a way of dealing with what we will be supposed to perform afterwards”; “helps to practise from home”; “after overcoming the difficulties of operating with the remote lab, it represents a very good resource of learning”;
  - “remote lab is much more complicated to operate than simulation and by that factor the majority gives up”.

Results: Teachers' Perception

- about the didactic approach:
  - the usage of various tools is important – helps students adaptation to the complexity of practical problems in the future
  - Remote lab is of most value to compensate the large number of students per class and little lab time.
- about students' learning:
  - helps students develop basic knowledge and competences about electricity

Final Remarks

- Teacher needs to supervise students in their first time with VISIR;
- Teacher’s commitment affects students enrolment;
- Students need an additional motivation to get more involved (e.g. assessment component);
- Technical problems will affect the natural initial enthusiasm;
- Combining resources can lead to a more successful didactical implementation

Final Remarks

- Students, in general, are more involved and participative in the proposed tasks;
- Students achieve better school results.

The usage of simultaneous online resources might help students dealing with more complex information and prepare them to perform better in other competences areas.

References

[1] Deignan, T. (2009) “Enquiry-Based Learning: perspectives on practice” *Teaching in Higher Education,* vol 14, (1) pp.13-28.

[2] Alves, G., Marques, M., Viegas, C., Costa Lobo, M. C., Barral, R., Couto, R., . . . Gustavsson, I. (2011). Using VISIR in a large undergraduate course: Premiminary assessments results. *Global Engineering Education Conference (EDUCON).*

[3] Marques, A., Viegas, C., Costa-Lobo, C., Fidalgo, A., Alves, G., Rocha, J., & Gustavsson, I. (2014). How Remote Labs Impact on Course Outcomes: Various Practises Using VISIR. *IEEE-Transactions on Education*.

[4] Alves, G., Viegas, C., Lima, N., & Gustavsson, I. (2016). Simultaneous Usage of Methods for the Development of Experimental Competences. *International Journal of Human Capital and Information Technology Professionals 7(1)*, 48-63.

[5] Lima, N., Alves, G., Viegas, C., & Gustavsson, I. (2015). Combined Efforts to develop students experimental competences. *Proceedings Expa.at'15 3rd International Experimental Conference.* Ponta Delgada, Azores: ACM.

[6] Viegas, C., Lima, N., Alves, G., & Gustavsson, I. (2014). Improving students experimental competences using simultaneous methods in class and assessments. *TEEEM'14 Proceedings of the second International Conference on Technological Ecosystems for Enhancing Multiculturality* (pp. 125-132). Salamanca, Spain: ACM New York.

Thank you for your attention!

POLITÉCNICO DO PORTO

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