D.2.1 – Guidelines for Identification of Good Practices

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Author(s)	*Evita Tasiopoulou, Barbara Schwarzenbacher*

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1. Introduction

The primary objective of the UniSchooLabS project is to produce a Toolkit and a set of Good Practices (GPs) that will provide schools the opportunity to use remote and virtual laboratories to conduct experiments that otherwise would not have been possible.

The Toolkit will be composed of twelve (12) GPs which aim to cover a variety of Science subjects.

The purpose of this report is to analyze the criteria used by UniSchooLabS partners in order to identify the most suitable laboratories, as well as the selection methodology used in order to arrive to the final selection.

2. Selection criteria

One of the questions that we are trying to answer within UniSchooLabS and consequently put into practice is: Which criteria make up good practices (GPs)?

2.1. Subject understanding

One of the results of a GP should be that students **understand, learn and master** the **subject at hand**. This can be achieved only by **respecting the diverse talents and ways of learning** of students. There are different learner types (haptic, visual, and auditory learners) which need different kinds of activities to be able to understand and internalise a topic well. Therefore, GPs may be made up of various types of exercises that cater to all of these different learner types. This is not only important for acquiring knowledge, but also for students to be able to develop their talents, which might be very different, and thus, grow as individuals and gain confidence. Teachers should keep in mind that:

"Brilliant students in the seminar room may be all thumbs in the lab or art studio. Students rich in hands-on experience may not do so well with theory" (Chickering A. W., Gamson, Z.F. (1987) p.6).

By deploying teaching methods and activities that meet all students' needs, the motivation of the students raises, which consequently has a positive effect on the study process.

2.2. Connection to the curricula

While there is great curricula variety around Europe, it is essential that the selected GPs cover subjects and concepts that can be applied to different national contexts. This is also very important for the final evaluation of the GPs and the Toolkit where results from different countries will be

analysed in order to measure the impact made on the different groups. The experience of the UniSchooLabS partners as long as the input provided by the UniSchooLabS pilot teachers on this matter is crucial.

2.3. Inquire-based learning & role of the student

Furthermore, a GP should encourage **active inquiry-based learning (IBSE)**. In inquiry-based learning progress is assessed by how well students develop experimental and analytical skills rather than how much knowledge they possess. According to the Computer Supported Inquiry Learning[1] community,

"*Inquiry learning is not about memorising facts - it is about formulating questions and finding appropriate resolutions to inquiries and issues. Inquiry can be a complex undertaking and it therefore requires dedicated instructional design and support to facilitate that students experience the excitement of solving a task or problem on their own. Carefully designed inquiry learning environments can assist students in the process of transforming information and data into useful knowledge".*

For this reason, the selected GPs should promote and facilitate inquiry and engage students in the learning process.

Another important criterion, directly connected to IBSE is the **role of the student** in the learning process. The student should be at the center of the learning activities and with the assistance of his/her teacher take ownership of the investigation process. GP activities should be designed in a way that promotes decision making, participation and critical thinking. In other words:

"*The process of investigation becomes meaningful because the ownership comes from students work and not from a worksheet created for them… Because they had already discovered it for themselves, they are able to understand the concept better than if I had showed it to them initially. This gives them a sense of ownership over their discovery"* (Bresnick, 2000).

2.4. Regular feedback

Another criterion that distinguishes a GP from a regular teaching practice is the fact that students receive **regular feedback** concerning their work. This will help students realise what they already know and what they do not know yet.

"Students need appropriate feedback on performance to benefit from courses. When getting started, students need help in assessing existing knowledge and competence. In classes, students need frequent opportunities to perform and receive suggestions for improvement. At various points during

[1] http://kaleidoscope.gw.utwente.nl/SIG-IL/

college, and at the end, students need chances to reflect on what they have learned, what they still need to know, and how to assess themselves." (Chickering A. W., Gamson, Z.F. (1987) p.4)

2.5. Students social & management skills

Besides teaching the topic of the GP in an effective and interesting way, a good practice should also help students **improve their social skills** and raise their self-awareness; this is to say that a GP should encourage interaction and cooperation among students. This kind of approach is not only improving the learning processes, but it also facilitates the improvement of students' social skills and team-building abilities.

"Learning is enhanced when it is more like a team effort than a solo race. Good learning, like good work, is collaborative and social, not competitive and isolated. Working with others often increases involvement in learning. Sharing one's own ideas and responding to others' reactions sharpens thinking and deepens understanding". (Chickering A. W., Gamson, Z.F. (1987) p.3)

Furthermore, it is important that students learn to **manage their time well** when studying or when working on a specific task which will also help them in their future professional life. A GP should ideally provide time frames for each task and clear guidelines for the succession and duration of activities.

"Students need help in learning effective time management. Allocating realistic amounts of time means effective learning for students and effective teaching for faculty". (Chickering A. W., Gamson, Z.F. (1987) p.5)

2.6. Travel-well requirements

Another important criterion for identifying a GP is that it has **travel-well requirements**. This means that the GP should not be too complicated and that it can be easily adjusted according to the needs of different learning groups. The GP should not involve too mannered and complex materials, so that it can be easily reformed. Furthermore, it should be clearly structured, have defined aims and objectives, use new teaching methodologies and set realistic time indications. In the case of UniSchooLabS, GPs will be tested in different learning contexts so as to ensure their multicultural dimension.

Travel-well requirements are of major importance as proved by the fact that projects like eQNet, (http://eqnet.eun.org/), focus on the issue of identifying the criteria allowing GPs to travel-well across national borders and be used in a cultural and linguistic context different from the one in which they were created.

In the framework of achieving the production of effective GPs, the pilot team of UniSchooLabS includes schools of rural areas which have limited access to ICT facilities and scientific equipment. Thus, the UniSchooLabS GPs can also be tested for their efficiency in demanding cases of application so as to ensure that they might be implemented under realistic environment from schools all over.

2.7. Science image & stereotypes

As we are looking into GPs in the Science context, it has to be said that several **stereotypes** concerning the individual subjects exist. Mathematics, Chemistry or Physics are often considered as difficult, abstract and boring subjects. This phenomenon is more intense when it comes to female students as very few of them choose to study science and follow scientific careers. According to a study that was carried out by European Schoolnet regarding the role of women in ICT, this disinterest of women in ICT or Science studies results from the lack of support from role models, persistent stereotyped views that the sector is better suited to men, and in some cases, how easy or difficult they find the subject (Gras-Velázquez, et al. (2009) p.2).

However, the stereotypes that exist concerning Science subjects do not only concern girls, but also boys. Teachers should take special attention in confronting these stereotypes and eliminating such beliefs. GPs may contribute to the elimination of these prejudices towards science by providing a clear connection between "real" life and the subject taught.

According to the ROSE study[2] which took into account more than 20 countries, most of them have seen declining numbers of students choosing to pursue the study of physical sciences, engineering and mathematics at university. At the same time, Science topics score low in the list of popular school subjects. The selected GPs should target subjects in an attractive way making sure that the produced activities not only showcase the connection between Science and "real' life applications, but are also putting Science into perspective and allowing students to understand its applications, potential and impact to their day to day life.

2.8. Remote and Virtual Laboratories

The GPs chosen by the UniSchooLabS project should also be in accordance with the main objectives of the project which include the use of remote and virtual laboratories. More specifically, the selected GPs should involve the use of one or more virtual or remote laboratories, certifying that the included guidelines are sufficient for the proper implementation at any context, even from schools with limited access to ICT infrastructures.

[2] http://www.pollen-europa.net/pollen_dev/Images_Editor/Nuffield%20report.pdf

The combination of RL and VL to a traditional laboratory environment provides better learning outcomes that when used individually. Taking as an example a study focused on the teaching of Electricity:

"The use of the simulation was able to improve students' learning outcome compared to laboratory work. Content analysis showed that the simulation helped the students to acquire scientifically accepted model of current flow. The simulation helps students to understand the theoretical principles of electricity. After understanding the basics of electricity on a theoretical level makes it easier for a student to transfer acquired knowledge into the laboratory exercises with real circuits. Thus the combination of laboratory and simulation work can bridge the gap between theory and reality." (**Explaining the basics of electricity – can online electricity simulation enhance learning?**, conclusion, Tomi Jaakkola and Sami Nurmi, Education Technology Unit, University of Turku, Finland).

3. Selection methodology

3.1. Voting procedure

UniSchooLabS partners have discussed a draft list of criteria during the **kick-off meeting in Bologna** (21-22 December 2010). Based on that first list, European Schoolnet completed, improved and finalised those criteria in order to produce a draft that partners used for selecting their GPs. These first draft criteria can be found here: http://tinyurl.com/5uyhjpn. Comments coming out of this procedure were used in order to produce the final selection criteria listed in Section "2. Selection Criteria".

During that same management meeting, it was agreed that each partner should contribute a pre-agreed number of GPs. The exact numbers can be found below:

Pre-selection

European Schoolnet (EUN): 6 GPs

Scienter: 4 GPs

Menon: 6 GPs

Ellinogermaniki Agogi (EA) : 4 GPs

CNR-ITD: 4 GPS

Total: 24 GPs

The initial idea was that each partner would contribute half of the above GPs to the final selection. The exact numbers can be seen below:

Final selection

EUN: 3 GPs

Scienter: 2 GPs

Menon: 3 GPs

EA: 2 GPs

CNR-ITD: 2 GPs

Total: 12 GPs

However, during the **audio meeting of 16th of February 2011**, it was agreed by all partners that the selection of the GPs should solely be based on the quality of the proposed GPs and thus the above distribution would not have to be strictly respected. This means that it is possible that, based on their quality, one partner may contribute two (2) or three (3) GPs to the final selection while others might contribute none or just one (1).

At the time the pre-selection took place a total of 28 GPs had been received. One of them has been submitted by three different (3) partners so a composition of all related information had to be made. Four (4) more GPs have been submitted by Scienter after the selection was completed so they have not been taken into account. It was agreed by all partners though that in case of lack of acceptable GPs or disagreement among partners on the final selection, the above mentioned GPs would have been taken into account.

Below, one can find a table presenting the number of GPs that each partner was supposed to contribute as well as the actual number of GPs that were finally received.

Organisation	**Expected No. of GPs**	**Received No. of GPs (within deadline)**
EUN	6	10
Scienter	4	3 (after the deadline)
MENON	6	6
EA	4	5
CNR.ITD	4	9
Total	**24**	**30**

The selection procedure followed by all partners was the following:

1) European Schoolnet has circulated to all partners a document explaining the selection procedure and including all information collected on the various GPs.

2) Partners had to carefully study Section 4,"Information on collected good practices (GPs)" in order to obtain good understanding of the various GPs, their content as long as their advantages and disadvantages.

3) Partners had to then rate the GPs for every category (general characteristics, pedagogical framework etc) and then use those rates in order to reach a final conclusion. The table with the individual votes had to be filled in and sent to European Schoolnet in order to include in the corresponding deliverable. The rating table used by partners can be seen on Table 1.

4) Once the table was filled in, partners were invited to rate the GPs by using the provided form: http://tinyurl.com/6g6r832

5) Partners had the possibility to rate each GP by choosing one of the following options:

   a) Basic

   b) Average

   c) Excellent

6) After rating all GPs, partners clicked on the Submit button in order to save their ratings and ensure that they would have been taken into account.

7) EUN converted "Excellent", "Average" and "Basic" to numerical values and added up all points for each GP.

8) EUN provided partners with the final results of the voting and based on them proposed which GPs could qualify directly for the UniSchooLabS Toolkit and which ones needed to be discussed further among partners during the audio of the 4th of March 2011.

9) The Deadline for partners to submit their votes was on **Tuesday 1st of March at 12:00pm**.

3.2. Rating the GPs and recording the final votes

With the help of Section 4 and using the suggested table below, partners evaluated all available GPs in relation to the different categories (e.g. 1 – bad/not known, 2 – ok, 3 – good). In this way partners obtained a clear idea of each GPs advantages and disadvantages which facilitated the final voting.

After completing Table 1. below, partners went to the electronic form (http://tinyurl.com/6g6r832) and recorded their final votes.

No	Org	GP Title	General characteristic	Pedagogical framework	Organisational setting	Human & Technical infrastructure, Usability issues, Additional information
1	**EA**	Practicing Physics Principles & Ideas with ATLAS				
2	**EA**	Conservation of Momentum				
3	**EA**	Introduction to elementary particles				
4	**EA**	The Planets & their characteristics				
5	**EA**	Observations of the Galaxy				
6	**EUN**	Modular Rigs				
7	**EUN**	TeleRobot				
8	**EUN**	Remote Laboratories				
9	**EUN**	NetLab				
10	**EUN**	Nano-World				
11	**EUN**	Remote farm				
12	**EUN**	Experiment on Natural Nanomaterials				
13	**EUN**	Planet impact				
14	**EUN**	Develop a drug!				
15	**EUN, Menon, ITD.CNR**	Interactive Science Simulations				
16	**ITD.CN**	The Discovery				

No	Org	GP Title	General characteristic	Pedagogical framework	Organisational setting	Human & Technical infrastructure, Usability issues, Additional information
	R	Space project				
17	**ITD.CNR**	Radioactivity iLab				
18	**ITD.CNR**	MicroObservatory				
19	**ITD.CNR**	World Pendulum				
20	**ITD.CNR**	The Virtual Chemistry Laboratory				
21	**ITD.CNR**	The Worldwide Telescope				
22	**ITD.CNR**	Observing with NASA				
23	**ITD.CNR**	Virtual Microscope				
24	**MENON**	Shell and tube heat exchanger				
25	**MENON**	WebLab deusto				
26	**MENON**	UVA VL				
27	**MENON**	Catching Evolution in Action				
28	**MENON**	Online Labs				

Table 1.

3.3. Selection of the twelve (12) best GPs

For facilitating the calculation of scores, textual characterisations have been converted to numerical values

Excellent = 3

Average = 2

Basic = 1

- Origin of the Laboratory: An effort to use mostly European Laboratories was made so in the final selection there were three (3) from the US, one (1) from Australia and eight (8) from Europe.
- Remote - Virtual labs: A good balance of RL and VL was also kept. The final list is composed of eight (8) remote labs and four (4) virtual labs
- Subject: The need to cover various science fields was also taken into account. Quality remained on top of the selection criteria so partners preferred to omit certain subjects (i.e. Biology) instead of compromising the quality of the chosen Laboratories.
- Complementary Laboratories: The option to include both VL and RL in the same GP was also taken into consideration. In this way a more complete and well established educational experience can be provided and students will have the opportunity to acquire different views and experiences on the same subject. Based on all the above, we arrived at the results you can see in the table below:

Based on all the above, the following results were obtained:

	Ev. No.		GP name	Type	Men on	EA	EU N	Scien ter	ITD. CNR	Tot al	Avg	Total
1	**4**	**EA**	The Planets & their characteristics	RL	3	3	3	3	3	15	**3**	**15**
2	**5**	**EA**	Observations of the Galaxy	RL	3	3	3	3	3	15	**3**	**15**
3	**2**	**EA**	Conservation of Momentum	VL	2	3	3	3	3	14	**2.8**	**14**
4	**8**	**EUN**	Remote Laboratories	RL	3	3	3	3	2	14	**2.8**	**14**
5	**16**	**ITD. CNR**	The Discovery Space project	RL	3	3	3	2	3	14	**2.8**	**14**

	Ev. No.		GP name	Type	Men on	EA	EU N	Scien ter	ITD. CNR	Tot al	Avg	Total
6	**20**	**ITD. CNR**	The Virtual Chemistry Laboratory	VL	3	3	3	2	3	14	**2.8**	**14**
7	**3**	**EA**	Introduction to elementary particles	VL	2	3	2	3	3	13	**2.6**	**13**
8	**9**	**EUN**	NetLab	RL	2	3	3	2	3	13	**2.6**	**13**
9	**11**	**EUN**	Remote farm	RL	2	2	3	3	3	13	**2.6**	**13**
10	**13**	**EUN**	Planet impact	VL	3	3	2	2	3	13	**2.6**	**13**
11	**19**	**ITD. CNR**	World Pendulum	RL	2	3	2	3	3	13	**2.6**	**13**
12	**22**	**ITD. CNR**	Observing with NASA	RL	2	3	3	2	3	13	**2.6**	**13**

All GPs with score lower than 13 were automatically rejected as their overall quality and content was not rated high enough in order to fulfill the purpose on the UniSchooLabS project.

Two (2) GPs, “The Virtual Chemistry Laboratory” and “Observing with NASA” have been developed in the US but because of their high quality and educational value were included in the Toolkit. All the other submitted GPs were of European origin so a reasonable balance between Europe and US was kept.

All GPs were selected unanimously. More information on “Introduction to elementary particles” and “Observations of the Galaxy” had to be provided by Ellinogermaniki Agogi (EA) since despite their excellent content, additional information was required.

4. Information on collected good practices (GPs)

4.1. General Information on GPs

In the following table we show the general information collected on each GP including: title, author, URL, type, subjects and language.

No	Org	GP Title	URL	Author	Type (VL= Virtual Lab RL= Remote Lab)	Subjects	Languages
1	EA	Practicing Physics Principles & Ideas with ATLAS	http://www.learningwithatlas-portal.eu/en/node/93575	University of Birmingham	VL	Physics	English
2	EA	Conservation of Momentum	http://www.learningwithatlas-portal.eu/en/node/93575	Ellinogermaniki Agogi	VL	Physics	English, Greek
3	EA	Introduction to elementary particles	http://www.learningwithatlas-portal.eu/en/node/93606	Ellinogermaniki Agogi	VL	Physics	English, Greek
4	EA	The Planets & their characteristics	http://www.cosmosportal.eu/cosmos/en/node/16895	Part of Cosmos Portal	RL	Astronomy	English, German
5	EA	Observations of the Galaxy	http://www.cosmosportal.eu/cosmos/en/node/55933	Ellinogermaniki Agogi	RL	Astronomy	Greek
6	EUN	Modular	http://www.ilough-	Loughborough	RL	Physics	English

No	Org	GP Title	URL	Author	Type (VL= Virtual Lab RL= Remote Lab)	Subjects	Languages
		Rigs	lab.com/index.php?option=com_content&view=article&id=79&Itemid=76	University, UK			
7	EUN	TeleRobot	http://telerobot.mech.uwa.edu.au/index.html	School of Mechanical and Materials Engineering The University of Western Australia	RL	Robotics	English
8	EUN	RLoratories	http://remotelabsup.fe.up.pt/experiments.htm	Instituto de Recursos e Iniciativas Comuns da Universidade do Porto	RL	Physics	English
9	EUN	NetLab	http://netlab.unisa.edu.au/index.xhtml	School of Engineering, University of South Australia	RL	Physics	English
10	EUN	Nano-World	http://labor.nano-world.org/	Partner project of the universities Basel, Bern, Fribourg , Manno and the Gymnasium Liestal.	RL	Nanotechnology	German and parts in English
11	EUN	Remote farm	http://remote.physik.tu-berlin.de/farm/index.php?id=1&L=1	Berlin Institute of Technology	RL	Physics	English, German, Russian
12	EUN	Experiment on Natural Nanomat	http://nanoyou.eu/en/component/content/article/87-hands-on-activities/499-experiment-on-natural-	Intedisciplinary Nanoscience Center, Aarhus University,	VL	Nanotechnology	English

No	Org	GP Title	URL	Author	Type (VL= Virtual Lab RL= Remote Lab)	Subjects	Languages
		erials	nanomaterials-nanotechnology-education-resources.html?directory=4&Itemid=4	Denmark			
13	EUN	Planet impact	http://amazing-space.stsci.edu/resources/explorations/impact/	Formal Education Group of the Space Telescope Science Institute's Office of Public Outreach - STScI, USA	VL	Physics, Astronomy	English
14	EUN	Develop a drug!	http://www.xplorehealth.eu/	Xplorehealth	VL	Biology	English, Spanish, French, Polish
15	EUN, Menon, ITD. CNR	Interactive Science Simulations [3]	http://phet.colorado.edu/	University of Colorado.	VL	Physics, Chemistry, Maths, Biology	English + translations to different languages
16	ITD. CNR	The Discovery Space project	http://www.discoveryspace.net/index.asp?Cat_id=584	OTE S.A., QPLAN SA, Ellinogermaniki Agogi, Foundation for Research and Technology, Telescope Technologies , Science Projects - The Observatory Science Center,	RL	Astronomy	English

[3] GP has been submitted by three (3) partners: EUN, ITD.CNR and MENON. In the table we have included a general entry composed by information submitted by all 3 partners.

No	Org	GP Title	URL	Author	Type (VL= Virtual Lab RL= Remote Lab)	Subjects	Languages
				The European Physical Society, MENON Network, EEIG Telefonica I+D			
17	ITD. CNR	Radioactivity iLab	http://www.ilabcentral.org/radioactivity/	Lab: University of Queensland, Australia Learning material: North-western University, IL	RL	Physics	English
18	ITD. CNR	MicroObservatory	http://mo-www.harvard.edu/OWN/training.html	Funded by the NASA Science Mission Directorate, and managed by the Science Education Department at the Harvard-Smithsonian Center for Astrophysics. The Space Telescope Science Institute serves as Educational Partner to the project.	RL	Astronomy	English
19	ITD. CNR	World Pendulum	http://rcl.physik.uni-kl.de/worldpendulum/eng/material.htm	S Gröber, M Vetter, B Eckert and H-J Jodl	RL	Physics	German English, Italian and French
20	ITD. CNR	The Virtual Chemistr	http://www.chemcollective.org/instructors.php	Many of the original activities on this site were	VL	Chemistry	English

No	Org	GP Title	URL	Author	Type (VL= Virtual Lab RL= Remote Lab)	Subjects	Languages
		y Laboratory		developed by Carnegie Mellon. Many VL activities were also designed by other universities, including a number from Robert Belford.			
21	**ITD. CNR**	The Worldwide Telescope	http://www.worldwidetelescope.org	National Aeronautics and NASA	VL	Astronomy	English
22	**ITD. CNR**	Observing with NASA	http://mo-www.harvard.edu/OWN/	The project is funded by the NASA Science Mission Directorate, and managed by the Science Education Department at the Harvard-Smithsonian Center for Astrophysics. The Space Telescope Science Institute serves as Educational Partner to the project.	RL	Astronomy	English
23	**ITD. CNR**	Virtual Microscope	http://virtual.itg.uiuc.edu	Funded by NASA	VL	Biology	English

No	Org	GP Title	URL	Author	Type (VL= Virtual Lab RL= Remote Lab)	Subjects	Languages
24	MENON	Shell and tube heat exchanger	http://cosmos.ucc.ie/~jb7/ISE/Procedure.html	Department of Process & Chemical Engineering- University College Cork	VL	Chemistry	English
25	MENON	WebLab deusto	http://code.google.com/p/weblabdeusto/	University of Deusto	RL		English
26	MENON	UVA VL	http://www.virlab.virginia.edu/VL/home.htm	University of Virginia			
27	MENON	Catching Evolution in Action	http://www.mhhe.com/biosci/genbio/tlw3/virtual_labs/lab1/labs/lab1/home.html	University of California	VL	Biology	English
28	MENON	Online LAbs	http://highered.mcgraw-hill.com/sites/0072437316/student_view0/online_labs.html	Peter H. Raven, Missouri Botanical Gardens & Washington University George B. Johnson, Washington University Jonathan Losos, Washington University Susan Singer, Carleton College		Biology	English

4.2 Pedagogical Framework of GPs

In the following table we show the pedagogical related information collected on each GP investigating, in the form of questions how IBSE (inquiry based learning) principles are expressed and fulfilled.

No	Org	GP Title	Does it help students understand and learn a specific subject better?	Does it encourage inquiry-based learning? Are the students actively engaged in the learning process?	Does it provide students with regular feedback? Does it help them identify their strengths and weaknesses?	Are there existing experimental plans for this GP? Has it been used or will be used in the near future?	Has there been any follow up (validated experience)? Has it been used by other schools/classes?
1	EA	Practicing Physics Principles & Ideas with ATLAS	Yes	Yes	Yes	Yes	No
2	EA	Conservation of Momentum	Yes	Yes	Yes	Yes	No
3	EA	Introduction to elementary particles	Yes	Yes	Yes	Yes	No
4	EA	The Planets and their Characteristics	Yes	Yes	Yes	No	Yes
5	EA	Observations of the Galaxy	Yes	Yes	Yes	Yes	Yes
6	EUN	Modular Rigs	Yes	Yes	Yes	Yes	No
7	EUN	TeleRobot	Yes	Yes	Not sure	Yes	Yes
8	EUN	Remote Laboratories	Yes	Yes	TBC	Yes	TBC

No	Org	GP Title	Does it help students understand and learn a specific subject better?	Does it encourage inquiry-based learning? Are the students actively engaged in the learning process?	Does it provide students with regular feedback? Does it help them identify their strengths and weaknesses?	Are there existing experimental plans for this GP? Has it been used or will be used in the near future?	Has there been any follow up (validated experience)? Has it been used by other schools/classes?
9	**EUN**	NetLab	Yes	Yes	Yes	Yes	TBC
10	**EUN**	Nano-World	Yes	Don't know	There is an evaluation hotline, so it could	don't know	don't know
11	**EUN**	Remote farm	Yes	Yes	TBC	Yes	Maybe only by Universities
12	**EUN**	Experiment on Natural Nanomaterials	Yes	Yes	Yes	Yes	Yes
13	**EUN**	Planet impact	Yes	Yes	No	No	Awards
14	**EUN**	Develop a drug!	Yes	Yes	Yes	Yes	Yes
15	**EUN**	Interactive Science Simulations	Yes	Yes	No	Yes	No
16	**ITD.CNR**	The Discovery Space project	Yes	Yes	Yes	Yes	TBC
17	**ITD.CNR**	Radioactivity iLab	Yes	Yes	Yes	Yes	Yes
18	**ITD.CNR**	MicroObservatory	Yes	Yes	No	Yes	Yes
19	**ITD.CNR**	World Pendulum	Yes	Yes	No	Yes	Yes

No	Org	GP Title	Does it help students understand and learn a specific subject better?	Does it encourage inquiry-based learning? Are the students actively engaged in the learning process?	Does it provide students with regular feedback? Does it help them identify their strengths and weaknesses?	Are there existing experimental plans for this GP? Has it been used or will be used in the near future?	Has there been any follow up (validated experience)? Has it been used by other schools/classes?
20	**ITD.CNR**	The Virtual Chemistry Laboratory	Yes	Yes	TBC	Yes	Yes
21	**ITD.CNR**	The Worldwide Telescope	Yes	Yes	Yes	Yes	Yes
22	**ITD.CNR**	Observing with NASA	Yes	Yes	Picture of the selected astronomical object isn't sent to the provided e-mail on the same day (but one or two days later) and only if the weather conditions allowed the telescope to be operative. The user is	Yes	Yes

No	Org	GP Title	Does it help students understand and learn a specific subject better?	Does it encourage inquiry-based learning? Are the students actively engaged in the learning process?	Does it provide students with regular feedback? Does it help them identify their strengths and weaknesses?	Are there existing experimental plans for this GP? Has it been used or will be used in the near future?	Has there been any follow up (validated experience)? Has it been used by other schools/classes?
					allowed to give feedback about his/her own use of the telescope.		
23	**ITD.CNR**	Virtual Microscope	Yes	Yes	No	Yes	No
24	**MENON**	Shell and tube heat exchanger			Yes	Yes	No
25	**MENON**	WebLab deusto	Yes	No	No	Yes	Yes
26	**MENON**	UVA VL	Yes	Yes	TBC	TBC	TBC
27	**MENON**	Catching Evolution in Action	Yes	Yes	No	Don't know	Don't know
28	**MENON**	Online LAbs	Yes	Yes	Not exactly	Don't know	Don't know

4.2. Organisational Settings of GPs

In the following table we show the organizational settings information collected on each GP including, in the form of questions, whether they facilitate the collaboration between schools and laboratories as well as the possibilities of data-mining:

No	Org	GP Title	Does it facilitate the collaboration between schools and laboratories? Is there a possibility to receive input from the hosting university or support? Any possibility to collect feedback from the users?	Are there any possibilities for data-mining? Will it be possible to collect and compare data between schools?	Is there the potential to have several Universities working together on providing one lab?
1	**EA**	Practicing Physics Principles & Ideas with ATLAS	Yes	Yes	Yes
2	**EA**	Conservation of Momentum	Yes	Yes	No
3	**EA**	Introduction to elementary particles	Yes	Yes	Maybe
4	**EA**	The Planets and their Characteristics	Yes	Yes	Yes
5	**EA**	Observations of the Galaxy	Yes	Yes	Yes
6	**EUN**	Modular Rigs	Yes	Yes	No
7	**EUN**	TeleRobot	Yes	Yes	Yes
8	**EUN**	Remote Laboratories	Yes	Yes	Yes
9	**EUN**	NetLab	Yes	Yes	TBC
10	**EUN**	Nano-World	Don't know	Don't know	Don't know

No	Org	GP Title	Does it facilitate the collaboration between schools and laboratories? Is there a possibility to receive input from the hosting university or support? Any possibility to collect feedback from the users?	Are there any possibilities for data-mining? Will it be possible to collect and compare data between schools?	Is there the potential to have several Universities working together on providing one lab?
11	**EUN**	Remote farm	Yes	Yes	don't know
12	**EUN**	Experiment on Natural Nanomaterials	Yes	Yes	Yes
13	**EUN**	Planet impact	No	No	No
14	**EUN**	Develop a drug!	Yes	Yes	Yes
15	**EUN, ITD.CNR, MENON**	Interactive Science Simulations	No	No	Yes
16	**ITD.CNR**	The Discovery Space project	TBC	Yes	Yes
17	**ITD.CNR**	Radioactivity iLab	Yes	Yes	Yes
18	**ITD.CNR**	MicroObservatory	No	Yes	Yes
19	**ITD.CNR**	World Pendulum	Yes	Yes	Yes
20	**ITD.CNR**	The Virtual Chemistry Laboratory	Yes	TBC	Yes
21	**ITD.CNR**	The Worldwide Telescope	Yes	Yes	Yes
22	**ITD.CNR**	Observing with NASA	No	Image-editing software is provided.. A complete list of all the pictures taken in the former two weeks by all users is available and	Yes

No	Org	GP Title	Does it facilitate the collaboration between schools and laboratories? Is there a possibility to receive input from the hosting university or support? Any possibility to collect feedback from the users?	Are there any possibilities for data-mining? Will it be possible to collect and compare data between schools?	Is there the potential to have several Universities working together on providing one lab?
				every image comes with several information such as: geographical info coordinates etc. Info is static. A huge and deep comparison is in fact hard to perform.	
23	**ITD.CNR**	Virtual Microscope	Maybe	Maybe	Maybe
24	**MENON**	Shell and tube heat exchanger	No	No	-
25	**MENON**	WebLab deusto	Yes	-	Yes
26	**MENON**	UVA VL	Maybe	Maybe	Maybe
27	**MENON**	Catching Evolution in Action	Yes	Maybe	Maybe
28	**MENON**	Online Labs	Maybe	Maybe	Maybe

4.3. Human and Technical Infrastructure, Usability Issues and Additional Information

In the following table we show all information collected related to the technical infrastructure, usability issues and any other information important for the selection of the final GPs. The following abbreviations have been used throughout the table:

A = Is the software and its GUI (Graphical User Interface) easily accessible and of good quality?

B = Is the level of technology provided good? Is the quality of the instruments good? Is it compatible with a variety of systems?

C = Is the technology used easily accessible to a wide audience? Is it independent of internet bandwidth or type of user's equipment?

D = Does the GP have travel-well requirements? Can it be translated or used within other cultures or different ages?

E = Has this GP been used for any major EU initiative?

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
1	EA	Practicing Physics Principles & Ideas with ATLAS	Yes	Yes	Yes	Yes	Yes	Life Long Learning Program	-
2	EA	Conservation of Momentum	Yes	Yes	Yes	Yes	Yes	Learning with ATLAS @ CERN	-
3	EA	Introduction to elementa	Yes	Yes	Yes	Yes	Yes	Idem	-

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
		ry particles							
4	**EA**	The Planets and their Characteristics	Yes	Yes	Yes	Yes	Yes	cosmosportal.eu	-
5	**EA**	Observations of the Galaxy	Yes	Yes	Yes	Yes	Yes	cosmoportal.eu	-
6	**EUN**	Modular Rigs	Yes	Yes	-	Yes	No	-	-
7	**EUN**	TeleRobot	Average	Yes	Yes	No	No	-	Registrations seem to have stopped for the moment due to technical maintenance. Lab will be available again in 4 weeks. (end of March)
8	**EUN**	Remote Laboratories	TBC	Yes, IE only	Yes	Yes	No	-	Good variety of experiments and the participation of a wide number of labs: Laboratory of Instrumentation for Measurement (LIM) – FEUP, Laboratory of Earthquake and Structural Engineering (LESE) – FEUP; Laboratory of Industrial Informatics – FEUP, Thermochemistry Laboratory CIQ – FCUP,

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
									Science Museum - FCUP
9	**EUN**	NetLab	Yes	Yes	Yes	-	No	-	-
10	**EUN**	Nano-World	Yes	Yes	Yes	Yes	No	-	Specific experiments are based on Atomic Force Microscope (AFM). this is a common experiment widely used nowadays, with very few or none experimental set-up in secondary school. Having an introductory experience on AFM it would help when students go to University
11	**EUN**	Remote farm	Yes	Yes	Yes	Yes	No	-	The website provides live streams of Remote-Experiments so you can also watch them. Choice between modern and classic physics.
12	**EUN**	Experiment on Natural Nanomaterials	Yes	Yes	Yes	Yes	Yes	Nanoyou	-
13	**EUN**	Planet impact	Yes	Yes	Yes	No	No	-	Pro: quality Con: more of a simulation
14	**EUN**	Develop a drug!	Yes	Yes	Yes	Yes	Yes	Xplorehealth	Easy to follow, nicely made, low requirements

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
15	**EUN**	Interactive Science Simulations	Yes	Yes	Yes	Yes	No	-	- Excellent interactive simulations - Allows collaboration
16	**ITD. CNR**	The Discovery Space project	Yes	Yes	Yes	No	No	-	Innovative approach that brings closer schools, research centres, science thematic parks and the public..
17	**ITD. CNR**	Radioactivity iLab	Yes	Yes	Yes	No	-	-	The Radioactivity iLab is a well driven inquiry-based activity. Good documentation is also provided.
18	**ITD. CNR**	MicroObservatory	Yes	Yes	Yes	No	-	-	The amount of learning materials provided and the project's publication suggest taking this project in consideration as a "good practice".
19	**ITD. CNR**	World Pendulum	-	-	Yes	Yes	-	-	Remotely Controlled Laboratories are real experiments which can be executed through the internet. A user at a location A is allowed to conduct an experiment at a distant location B via his or her computer. Controlling the experiment is enabled by accessing an interface and a web

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
									server. Webcams allow the user to observe the on-going experiment. The RCL project intends to: - setup experiments, which encourage play, to excite curiosity, and to stimulate motivation (e.g. robot in a maze, "hot wire"). This kind of RCL is devoted to pupils and undergraduate students as well as to interested lay people. In particular, this kind of RCL is a well suited prototype model to build-up own RCL in school projects. - realize important experiments of physics teaching, which can be immediately used in teaching and learning (school or university), e.g. diffraction of electrons, diffraction and interference of light, photoelectrical effect.
20	**ITD. CNR**	The Virtual Chemistry Laboratory	Yes	Yes	-	Yes	-	-	The Chemistry Collective is a collection of VLs, scenario-based learning activities, and concepts tests which can be incorporated into a variety of teaching approaches as pre-labs, alternatives to textbook homework, and in-class

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
									activities for individuals or teams. It is organized by a group of faculty and staff at Carnegie Mellon University for college and high school teachers who are interested in using, assessing, and/or creating engaging on-line activities for chemistry education. The various typology of learning materials provided and the very good documentation about the laboratories imply this project would be a very good case study.
21	**ITD. CNR**	The Worldwide Telescope	Yes	Yes	Yes	No	-	-	The WorldWide Telescope is a powerful and functional astronomical tool.
22	**ITD. CNR**	Observing with NASA	Yes	Partially. The telescope control is accessible to every system platform and software is	Yes	An observation can be replicated as soon the previous image has been acquired. There's no provision to translate the web-site	No	-	The amount of learning materials provide and the project's publication suggest to take this project in consideration as a "good practice"

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
				available for every major OS (Windows, Linux and Mac OS X), but users are allowed to handle a very few settings to best control the telescope.		contents from the original English language. The MicroObservatory system can be used by any user, whatever culture or age range they belongs to, as long as: they can handle the English-only version of the tool; translation of learning materials is provided.			
23	**ITD. CNR**	Virtual Microscope	-	-	Yes	-	-	-	-
24	**MENON**	Shell and tube heat exchanger	Yes	Yes	Yes	Yes	No	-	It is well explained and easy to use since is a web based experiment. Maybe too much technical
25	**MENON**	WebLab deusto	Yes	-	-	Yes	No	-	It is a project developed by a spenish university that maybe we can

No	Org	GP Title	A - GUI	B – Technology, Compatibility	C - Accessibility	D – Travel-well requirements	E – EU Initiative	If yes, to which one?	Is there any other aspect that potentially qualifies this case as a good practice?
									contact for further collaboration in our project
26	**MENON**	UVA VL	Yes	Yes	Yes	Yes	No	-	-
27	**MENON**	Catching Evolution in Action	Yes	Yes	Yes	Yes	No	-	-
28	**MENON**	Online Labs	Don't know	Don't know	Don't know	Don't know	Don't know	Don't know	Link to Biolab is currently unavailable so it is hard to extract the needed information

4.4. Adaptations

On 20th May 2011, Ellinogermaniki Agogi requested the replacement of the two (2) astronomical GPs:

- The Planets & their Characteristics
- Observations of the Galaxy

By:

- Analyzing Lunar Craters
- Saturn Seasons

Both GPs were appropriate for primary schools and Saturn Seasons in particular was also suitable for secondary schools. Both GPs make use of DSpace lab, so no changes needed to be made regarding on the selected Laboratories.

The request was accepted so the final list with the selected twelve (12) GPs is:

Ranking	Ev. No.	Partner	GP name	Type	Total no of awarded points
1	**4**	**EA**	Analysing Lunar Craters	RL	**-**
2	**5**	**EA**	Saturn Seasons	RL	**-**
3	**2**	**EA**	Conservation of Momentum	VL	**14**
4	**8**	**EUN**	RLoratories	RL	**14**
5	**16**	**ITD.CNR**	The Discovery Space project	RL	**14**
6	**20**	**ITD.CNR**	The Virtual Chemistry Laboratory	VL	**14**
7	**3**	**EA**	Introduction to elementary particles	VL	**13**
8	**9**	**EUN**	NetLab	RL	**13**
9	**11**	**EUN**	Remote farm	RL	**13**
10	**13**	**EUN**	Planet impact	VL	**13**
11	**19**	**ITD.CNR**	World Pendulum	RL	**13**
12	**22**	**ITD.CNR**	Observing with NASA	RL	**13**

5. Conclusions

The identification of GPs and their related Laboratories represent the core of the UniSchooLabS project. Throughout the process every effort was made in order to ensure that the selected criteria cover all project aspects, are in line with the enquiry-based approach and also ensure GPs quality and variety. The identified GPs and their related Laboratories provide a variety of tools, information and material that has the potential to form a dynamic basis for the UniSchooLabS Toolkit, strengthen its potential to become a useful tool in the hands of teachers and students around Europe.

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