BREAKING BARRIERS IN LABORATORY EDUCATION FOR NON-TRADITIONAL STUDENTS

F. Verelst & G. Langie, Hogeschool voor Wetenschap & Kunst, Belgium


Summary

One of the Lisbon objectives in higher education is to make education more flexible. Twenty to sixty percent of the contact moments in scientific and engineering higher education are dedicated to mandatory laboratory sessions. Non-traditional students however cannot attend all the scheduled sessions. Currently, this problem is addressed in an ad hoc manner. We are in need of a structural and qualitative solution. The aim of this project is to develop a possible solution for non-traditional students, we call it laboratory immersion, and to test it in four separate cases. However, before we can start working on a solution, we need to know precisely the barriers these non-traditional students encounter in the context of laboratories. We interviewed face-to-face seven non-traditional students. Their answers are the basis of an e-questionnaire which will be addressed to all non-traditional students of the participating institutions. The major problem our non-traditional students encounter is that the time slots they can spend on learning, do not match the scheduled contact moments. Flexibility of these students as well as the instructors is primordial. The outlined learning trajectory is not always very clear when they hop from one course-group to another. And moreover they miss the group dynamics.

Introduction

In 2005 the New Lisbon partnership for growth and jobs was launched. It seeks to reform the continent’s still fragmented systems into a more powerful and more integrated, knowledge based economy. Subsequent communications from European policymakers have only strengthened the belief that higher education institutions will be crucial to Europe’s future well being. In this way it is important to increase lifelong learning opportunities, to widen higher education access to non-traditional and adult learners [1], [2], [3]. The project we report on in
this paper aims to create a flexible study pathway for these non-traditional students in the field of science and technology.

Students who have the capacities to acquire a degree in scientific and technological higher education, should get the opportunity to do so. Non-traditional students, as there are for example people who combine their studies with working or serious engagement in sports, do not easily acquire a degree walking the traditional path. Such non-traditional students may be better off with an alternative study path, a flexible one. Distance education can be a solution. Teaching distance students is challenging, particularly when access to practical learning components is needed.

Laboratory work is an important component of the formation of engineers and scientists [4].Twenty to sixty percent of the contact moments in scientific and engineering higher education are dedicated to laboratory work. These are strictly organised, intensively coached learning activities at the campus of the University or College. The attendance to these on-site training activities is mandatory to the program. Non-traditional students cannot attend all the scheduled sessions, so ad-hoc solutions are introduced which unfortunately do not always have the same aims as the original practical work or do not fit the required quality standard. We are in need of a structural solution which can be offered to the students when the regular experimental courses in the laboratory can not be taken.

In the past two decades great efforts have been made in designing flexible study paths. There are some examples, for instance in computer science, where all competences can be acquired through a distance course using only a virtual lab [5], [6]. The strong point of a local laboratory is to permit the student to acquire real practical skills. In the virtual systems there is a lack of interaction with the real equipment and a lack of sufficient feedback. To solve the feedback problem some make use of a virtual assistant to complement their own feedback [7], [8]. For some topics it is easy to solve the lack of hands on experience by offering laboratory experiments which can be done at home, using materials readily available from local grocery and hardware stores [9]. Other course developers created a networking laboratory that allows students to connect to and configure devices remotely [10], [11].

Many problems can be addressed by e-learning, but there are still many disadvantages [12], [13]. Course facilitators try to avoid these by making all kind of blends consisting of e-learning and face-to-face learning. E-learning can be used as to facilitate existing face-to-face teaching and to encourage more effective student preparation [8]. Sometimes students do experiments in the lab and continue practicing at home using e-learning [14].

The research presented in this paper focuses on a possible flexible solution for non-traditional students: laboratory immersion. This is a short, very intensive on-campus laboratory practical preceded by and finished with distance learning activities. In fact, the three phases in the experimental work are consciously divided: the virtual prelab phase at home focussing on preparation, the on-site laboratory session for the hands-on activities and the remote postlab for reflection and reporting. As Barros, Read and Verdejo noted ‘The addition of virtual laboratory scenarios which include simulations, collaborative tasks and periods to encourage student reflection, greatly improved the learning of the experimental material and enabled students to work more effectively when they actually undertook the real labo work ’[15]. This idea is conform with previous projects [16], [17], [18] en [19].

The design of these three phases depends on the aims of the practical work and the needs of the non-traditional students for whom we perform this project. We should be aware of the barriers these students encounter. We focus in this paper on these barriers. Answering this question includes that we know which students are non-traditional and their relative amount in the total student population. In the following section we discuss the categorization of the
non-traditional students and their share in the student population. The barriers these students run into, are discussed afterwards and finally some conclusions are presented.

**Categorization of non-traditional students and their share**

The participants are all the registered students in the academic year 2008-2009 who can not participate in one or several scheduled courses and follow an alternative study path at the colleges and universities participating in the project. We distinguish the following types of non-traditional students: working students, students who combine top sport with study, students who combine courses from different programs and distance students. All the distance students are probably working students, but not all working students take distance courses.

The results of this counting are written in Table 1. The numbers are not accurate since the student administrations do not register these students in a special statute. The counting is done manually.

**Table 1: The amount non-traditional students per institution and type**

<table>
<thead>
<tr>
<th>Type non-regular student</th>
<th>Working student</th>
<th>Students who combine top sport with study</th>
<th>Students who combine several programs</th>
<th>Distance Student</th>
<th>Percentage of non-traditional students in the total student population</th>
</tr>
</thead>
<tbody>
<tr>
<td>Institution</td>
<td>N</td>
<td>%</td>
<td>N</td>
<td>%</td>
<td>N</td>
</tr>
<tr>
<td>industrial engineer (KaHo Sint-Lieven)</td>
<td>/ /</td>
<td>9 0,6</td>
<td>527 32,7</td>
<td>25 1,5</td>
<td>34,8</td>
</tr>
<tr>
<td>Industrial engineer (KHBO)</td>
<td>/ /</td>
<td>2 0,5</td>
<td>44 11,5</td>
<td>/ /</td>
<td>12,0</td>
</tr>
<tr>
<td>Industrial engineer (KHKempen)</td>
<td>27 5,0</td>
<td>0 0</td>
<td>85 15,9</td>
<td>/ /</td>
<td>20,9</td>
</tr>
<tr>
<td>Industrial engineer (KHLim)</td>
<td>/ /</td>
<td>1 0,3</td>
<td>143 38,1</td>
<td>/ /</td>
<td>38,4</td>
</tr>
<tr>
<td>Industrial engineer (W&amp;K)</td>
<td>11 1,8</td>
<td>3 0,5</td>
<td>128 20,8</td>
<td>/ /</td>
<td>23,1</td>
</tr>
<tr>
<td>Bio-engineer (K.U.Leuven)</td>
<td>5 0,5</td>
<td>3 0,3</td>
<td>133 13,2</td>
<td>/ /</td>
<td>14,0</td>
</tr>
<tr>
<td>Engineering (K.U.Leuven)</td>
<td>36 1,3</td>
<td>7 0,3</td>
<td>- -</td>
<td>/ /</td>
<td>-</td>
</tr>
<tr>
<td>Sciences (K.U.Leuven)</td>
<td>18 1,2</td>
<td>6 0,4</td>
<td>- -</td>
<td>/ /</td>
<td>-</td>
</tr>
<tr>
<td>Technology (KaHo Sint-Lieven)</td>
<td>/ /</td>
<td>0 0</td>
<td>63 41,4</td>
<td>12 7,9</td>
<td>49,3</td>
</tr>
<tr>
<td>Technology (W&amp;K)</td>
<td>1 0,2</td>
<td>0 0</td>
<td>80 15,3</td>
<td>/ /</td>
<td>15,5</td>
</tr>
<tr>
<td>Total</td>
<td>98 1,0</td>
<td>31 0,3</td>
<td>1203 12,7</td>
<td>37 0,4</td>
<td>14,5</td>
</tr>
</tbody>
</table>

- = data missing
/ = this type of non-traditional student officially does not exist at this institution
The largest group of non-traditional students are students who combine several programs. The hour grating is not adapted to their specific needs, so these students have to be creative in order to be able to take courses. Working students have similar problems. Only KH Kempen organizes specific study programs for these students. This explains their larger representation. The statute of top sport exists at every institution. This statute offers these sportsmen a number of advantages. However few students take advantage of this individualized trajectory. Since Belgium is a small country with 15 universities, distance education is not a success story until now. The recent life long learning policy stimulates universities and colleges to invest in distance education. KaHo Sint-Lieven is the only one of the participating institutions who organizes complete study programs for distance students.

The amount of non-traditional students compared to the total amount of students for each department and faculty varies from 12% to 49%. The total percentage of non-traditional students for the partner institutions is 15%.

Barriers
In order to make an inventory of the barriers these non-traditional students encounter in the context of laboratory work, we interviewed 7 non-traditional students. They were male students between 20 and 26 years old, who were registered at campus De Nayer (W&K). Four students were working students, one student combined several programs, one student was a top sportsman who combined moreover several programs and the seventh student was a working student who also combined several programs.

In future these interviews will be the basis of an e-questionnaire which will be presented to all non-traditional students of the participating institutions.

We prepared a semi-structured interview guide. All the interviews were recorded but none of them were transcribed.

The results of these interviews are systematically classified and additionally completed with the opinions and experiences of some willing students, colleagues, administrative staff and the study advice service.

Barrier 1: every non-traditional student misses at least one obligatory laboratory session.
This means that most mandatory practicals can be undertaken. However often some creativity and flexibility of the student and/or the professor is needed. For example:

- One attends the laboratory session together with another student group.
- One completes the session individually after appointment.
- One simply skips the session because the teacher says it is not that important.
- One skips the session because he knows there will be no consequences.
- One puts his name as a free rider on a group report.
- One accomplishes a replacing task.
- One accomplishes all the laboratory sessions during his holiday.

Barrier 2: when non-traditional students carry out laboratory sessions on their own or together with changing student groups, they miss social contacts.
During the laboratory they obtain a lot of information from their companions since this is the ideal moment for them to get some informal information on the theoretical courses they missed.
Barrier 3: the students indicate that replacing tasks focus on other skills.
The interviewees indicate that a laboratory session is important to them in order to get to know the equipment and to develop some practical skills. They fear they will miss some essential hands-on training when too many replacing tasks are introduced.

The students indicated some possible advantages and disadvantages of laboratory immersion and gave us some recommendations:

Advantages
- The prelab will help the student to be better prepared before starting the experiment.
- The pre- and postlab will allow the student to study at moments it’s comfortable for him.
- Working students won't have to take several days off in order to be present in the laboratory sessions.
- The students who combine several programs will be able to take more theoretical courses. For the moment laboratories get priority, and theoretical courses are skipped.
- Non-traditional students won’t feel guilty anymore when the regular students have to finish group reports or group exercises on their own without the help of the non-traditional students.

Disadvantages
- The students will miss social contacts.
- The students will miss the group-feeling with the associated social pressure.
- The students will need a lot of discipline and responsibility for the pre- and postlab.
- The students will have to come to the university or the college when other people are free.

Recommendations
- The group feeling is important.
- It’s more comfortable to have your own teacher as a guide.
- The guidelines for the pre- and postlab should be clear and representative.
- The e-applications should work properly.
- One should organize a help desk for all phases.
- The laboratory immersions should be flexible tools adaptable to the different types of students.

Conclusions
The percentage of non-traditional students during the academic year 2008-2009 is 15% in the participating institutions, one seventh of the students. This is moreover an underestimation of the reality.
In the future this number will certainly increase not only because we will develop solutions but also because the government stimulates flexible learning. We are in the middle of rolling over to another student population. Our current education system is not adapted to these new flexible ways of studying. Once we have introduced some new methods and techniques appropriate for these new students, the number of non-traditional students will increase significantly.

Not every student belonging to this large group will take advantage of laboratory immersion. However it’s worthwhile to develop this flexible solution since we can increase the accessibility of scientific and engineering courses for all types of students.
Almost always students, who combine several programs, are able to attend the mandatory laboratory sessions thanks to the necessary flexibility of themselves and of the supervisors. Mostly they attend the lab with another students group inducing a lack of group dynamics. It’s more difficult for these students to see the outlined learning trajet.

Working students are the non-traditional students who are most in need of an alternative. They have a very low success rate when there are no adapted study programs. They put a lot of effort in trying to be present in the labs. They are in need of evening courses.

In faculties and departments where laboratory work is an essential part of the working methods, we are in need of a qualitative solution. The interviews give us an impression of some elements we should take care for when designing the laboratory immersions. The major problem the non-traditional students encounter with laboratory work is that their time schedule does not match the scheduled contact moments. Alternative replacing tasks are not always representative. During the creation of our laboratory immersion we’ll take into account that the group dynamic is very important. Barros, Read and Verdejo come to the same conclusion [15]. It should be our aim to give students a coherent learning environment which enables them to acquire the preset competences on the basis of blended learning, without too much administrative and organizational obstacles. The students need tools for collaborative learning and the teaching staff is in need of tools which make regular feedback possible. Benmohamed, Lelevé and Prévot [20] and Barros, Read and Verdejo [15] emphasize these elements as well.

In future, the concept 'laboratory immersion' will be tested in four pilots organised at five different locations. The results of these pilots will offer us the opportunity to investigate to what extent we have succeeded in removing the barriers.

Reference list


Remote experiments physics


Acknowledgements
This project is realised thanks to the financial support of ‘het onderwijsontwikkelingsfonds van de Associatie K.U.Leuven’.

Keywords: flexible learning, flexible study paths, laboratory practical, multicampus….