INTRODUCING METHODS OF HISTOLOGY IMAGE AND DATA ANALYSIS IN THE DEGREE OF BIOCHEMISTRY

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Abstract

The demand of professional competences in the field of digital skills (either transversal or specific) is growing within biomedical sciences. Indeed, acquiring such knowledge would enhance the opportunity of students to enter the labour market. Therefore, there is an urgent need of including digital competences in the academic curricula during undergraduate and postgraduate degree studies. Specifically, in the framework of life sciences (biology, biochemistry, biotechnology, medicine and related biomedical areas), software for the analysis of images obtained from histological or histopathological samples have become crucial and indispensable tools. However, the students do not usually receive any training about how to deal with these specific tasks, and there is no coordination among different subjects concerning this topic. As a result, students are unaware of the most important and suitable software for their professional profile, and are unfamiliar with these procedures. For this reason, we will include the use of the free software Image J for image analysis, and EXCEL for the subsequent data processing and graphing, in our histology classes.

Our aim is to assess the students’ self-perception concerning digital skills through self-evaluation using a pre-test/post-test design. Moreover, we propose a methodology based on a classification in different levels that would somehow certify the extent of acquisition of specific digital competences. Such levels would be equivalent to the “common European framework for language competences”. Once the student has satisfactorily succeeded specific courses will be granted with a digital badge, indicating the acquired level in each specific digital competence. For example, the course “Organology” (human microscopy anatomy), in the second semester of the 2nd year of Biochemistry, would grant an A1 level in Image J software, and database treatment of the generated data would grant a A2 level in Excel.

Keywords: Digital skills badge, Vertical and horizontal coordination, Image analysis.

1 INTRODUCTION

Digital competences are essential not only for learning but also for participating meaningfully in the new knowledge society and economy of the 21st century [1]. These capabilities are becoming increasingly necessary, since they provide the individuals with the chance of taking advantage of new possibilities associated with digital technologies, and also with tools to face modern challenges.

The recommendation of the European Parliament and of the Council of 18 December 2006 on key competences for lifelong learning [2] identified a set of eight competencies that all individuals need for personal fulfilment and development, active citizenship, social inclusion, and employment. The “digital competence” was chosen as one of them, defined as the creative, critical, and safe use of information and communication technologies (ICT) to reach goals related to work, employability, learning, leisure, inclusion, and social participation. One reason of giving serious consideration to the use of ICT is the high demand on digital skills in the professional context [3]. Within the framework of scientific fields, acquiring such digital knowledge would enhance the opportunity of students to enter the labour market by equipping them with adaptive capacity to the new needs established by technologies, and making them capable of their appropriation and adaptation to their own purposes [1].

Therefore, there is an urgent need of including digital skills and learning-to-learn (in this specific subject) competencies in the academic curricula during undergraduate and postgraduate degrees. Specifically, in the context of life sciences (biology, biochemistry, biotechnology, medicine and related biomedical areas), software for the analysis of images/data obtained from histological histopathological samples have become crucial and indispensable tools. The enormous development in computer hardware and software technologies during the last few decades has revolutionized their application in biomedical sciences. The continuous surge in biological data requires more efficient...
computational tools for their analysis and interpretation [4]. However, the students do not usually receive any training about how to deal with these specific tasks, and there is no coordination among different subjects concerning this topic. As a result, students are unaware of the most important and suitable software for their professional profile, and are unfamiliar with these procedures.

Considering all of this, we propose that the inclusion of activities to inform and train students about general and specific software will increase their digital skills necessary for (1) good learning experience in the classroom and (2) overcoming the challenges presented by the technological and scientific work market. For this reason, we intend to include the use of the free software Image J for image analysis, and EXCEL for the ulterior data processing and plotting, during our histology classes.

2 METHODOLOGY

2.1 Participants

Undergraduate students (N = 55; female (n = 29), male (n = 26) coursed the subject Organology (microscopy anatomy), included within the second year of Biochemistry Degree at the University of Malaga, were enrolled.

2.2 instruments

For data acquisition, we designed a one-group pretest-posttest (see Appendix 1 and 2) using the free platform “Kahoot!” (Kahoot.it). The group of questions (Q1-Q4 for pretest, and Q1-Q3 for posttest) and their possible answers were accompanied by the following Likert scale, ranging from 1 (Null/Very low); 2 (Low); 3 (Medium) to 4 (High/Very High). Finally, for the ulterior data processing and plotting, EXCEL (Microsoft Office) was used.

2.3 Procedure

The questionnaires and the activity were completed within the classroom in a single session during the academic teaching period. Students were asked to fill in questionnaires aimed to collect information about their experiences, skills, and attitudes regarding the use of ICTs, before and after the workshop.

First of all, before performing the pre-test, students were informed about the aim of this study and the importance of acquiring digital competence so as to be more competitive in the labor market. Next, with the aim of determining their perception about their level concerning digital capabilities, they were asked to fill one of the interactive digital questionnaires (Kahoo.it; Pre-test, see detailed questionnaire below, Appendix 1).

Subsequently, during the workshop, students were introduced to some of the more frequently used software in the area of histology and cell biology. We emphasized on one of the most well-known free software for digital image analysis: Image J (developed by National Institutes of Health). The activity consisted of a practical case in which students have to assess the thickness of “tunica media” (mainly layers of muscle cells) in different blood vessels to classify them as arteries or veins by using Image J tools. Blood vessels images were taken either from a virtual microscope (University of Malaga) or previously captured with optical microscopy from rat samples. Measurements were noted in EXCEL and data analyzing and plots were addressed by using basic tools (mean, standard deviation, different types of graphics). Finally, the post-test was carried out and the results were analyzed.

3 RESULTS

3.1 Student body self-perception regarding digital skills ranged from medium to very low levels

After the activities, analysis of the data obtained from the questionnaires was performed. In this way, the first question (Q1) (Table 1) of the pre-test yielded a mean value of 2.42 out of 4, corresponding to a self-perception between low and medium levels of software management. Among the respondents, 44% reported considering a medium skill level; 38.18 % highlighted a low
Table 1. Self-perception pre-test. Average level and percentage of students within each level of digital skills.

<table>
<thead>
<tr>
<th></th>
<th>Average</th>
<th>%</th>
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<tbody>
<tr>
<td></td>
<td>Null/Very low</td>
<td>Low</td>
</tr>
<tr>
<td>Q1</td>
<td>2.42</td>
<td>12.73</td>
</tr>
<tr>
<td>Q2</td>
<td>3.04</td>
<td>0</td>
</tr>
<tr>
<td>Q3</td>
<td>1.50</td>
<td>52.73</td>
</tr>
<tr>
<td>Q4</td>
<td>3.44</td>
<td>1.82</td>
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Concerning Q2 (Table 1), the students reflected a mean value of 3.04 out of 4 that corresponded to a medium level in the management of basic office software. Actually, 63.64% of the student body considered their level as Medium, while the 20% and 16.36% left, showed high and low levels, respectively. None of the students considered their level in this section as null/very low.

Figure 1. Results of the test after the presentation of specific software and the realization of the activity. The percentage of students corresponding to the answers given in each of the questions asked is shown: Q1 (A), Q2 (B), Q3 (C) and Q4 (D). Students recognized that their digital skills were improved after the activity (A). They showed great interest in including these learning in the subjects (B) and considered it very useful for their perspective careers (C).

However, analysing Q3 (Table 1), we observed that 52.73% of the students confessed having null/very low knowledge in specific software related to their professional career, followed by 41.82% who considered it low. Only 5% felt that their level was above average. The average interest rate in learning new digital skills (Q4, Table 1) turned out to be 3.44 out of 4 (medium-high level); while 52.73% had a high/very high level of interest, followed by 40% that showed medium interest rates.
The analysis of both questions leads us to the conclusion that implementing activities such as the one we propose in this project are necessary and interesting.

### 3.2 High acceptance of the implementation of specific digital skills in their academic curricula

In order to investigate the impact generated by the performance of the workshop described above, students performed another interactive digital questionnaire post-test (Kahoot.it; see detailed questionnaire below, Appendix 2). Analysing Q1 (Figure 1A), we observed that for the 72% of the student-body, the number of known software increased considerably. In addition, they agreed on learning more about them and other image analysis software. Only 7% showed no interest and 8% did not consider necessary to go beyond what they have learned during the activity. Moreover, at Q2 (Figure 1B), the vast majority (91%) considered this type of activities highly appropriate for acquiring digital skills. Only 2% considered it unnecessary and inadequate. The remaining students (7%) stayed indifferent. Finally, the 76% of students admitted (at Q3, Figure 1C) that learning based on specific software would be helpful and quite relevant when it comes to their professional future, followed by 20% who considered it relatively useful, despite not pronouncing on its future usefulness.

Therefore, it became obvious that students welcome these initiatives, considering highly helpful incorporating this kind of activities for the development of the subject and their future careers.

### 4 CONCLUSIONS

The urgent need of implementing specific digital competence in the academic curricula during undergraduate and postgraduate degree studies is becoming more and more evident. The major objective of this study was to assess the students’ awareness about (1) their level in this specific subject and (2) the importance of digital skills for their professional career. To this aim we have enrolled some students that undergone self-evaluation using a pre-test/post-test design.

Firstly, the results obtained with the pre-test evidence that students are aware of their scarce level in the topic of digital competence, not only concerning basic software (such as EXCEL) but also at common specific software (like Image J) in the field of biomedical science. Our data confirm our previous hypothesis and agree with other studies reflected in the bibliography reporting that future scientific workers are not familiarized with daily-used software.

In addition, we can affirm that students do warmly welcome these academic initiatives since they strongly believe specific digital knowledge and what is more, learning-to-learn regarding digital skills will be highly valuable. Consequently, we can confirm that digital competencies are considered extremely relevant by the students, and crucial to demonstrate effective functioning within a labour context. Therefore, there is a real need for wisely designed digital training programs or workshops.

### 5 FUTURE DIRECTIONS

For the next years, we aim to establish a methodology based on a classification in different levels that would somehow certify the extent of acquisition of specific digital competences. Such levels would be equivalent to the “common European framework for language competences”. Basically, the qualification would be based on three levels: A: imitation, B: independence and C: creation, that in turn would be subdivided into: A1: introduction, A2: beginner, B1: intermediate, B2: advanced, C1: expert and C2: professional. Once the student has satisfactorily succeeded specific courses, will be granted with a digital badge, indicating the acquired level in each specific digital competence. For example, the course “Organology” (human microscopy anatomy), in the second semester of the 2nd year of Biochemistry, would grant an A1 level in Image J software, and database treatment of the generated data would grant a A2 level in Excel.

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REFERENCES


APPENDIX 1.

1.1. PRE-TEST

Q1: Rate your level of skill/knowledge about the software you use

☐ Null/Very low
☐ Low
☐ Medium
☐ High/Very High

Q2: Rate your level of knowledge about basic office software (Office: Word, Excel, PPT)

☐ Null/Very low
☐ Low
☐ Medium
☐ High/Very High

Q3: Rate your knowledge about software strictly related to your future profession

☐ Null/Very low
☐ Low
☐ Medium
☐ High/Very High
1.2. POST-TEST

Q1: The number of software/applications related to histology that you knew has been increased

☐ No

☐ Yes, although I'm not interested in going deeper

☐ Yes, I would like to continue deepening

☐ No answer

Q2: Implementing this type of activities within the framework of this subject would be appropriate

☐ Yes

☐ No

☐ Indifferent

Q3: Learning about this type of software would be useful for my professional future

☐ Little useful

☐ Relatively useful

☐ Very useful and relevant for my professional future

☐ No answer

Q4: Rate your interest in improving your digital skills in the field of histology

☐ Null/Very low

☐ Low

☐ Medium

☐ High/Very High