# ANALYSIS OF TWO EVALUATION SYSTEMS FOR *BIOLOGÍA CELULAR* PRACTICALS INVOLVING STUDENT TEAM WORK


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1. **ABSTRACT:** Two evaluation systems were analyzed for students of *Biología Celular*: a questionnaire based on each practical vs. a scientific paper based on one of the practicals. Assessment of both evaluation systems was based on qualitative analysis of students' and lecturers' perceptions of the activities and on quantitative analysis of student marks for each activity. Unexpected themes but relevant issues emerged from the qualitative analysis that would have been overlooked by the lecturers if quantitative analysis alone had been used.

2. **RESUMEN:** Se analizaron dos sistemas de evaluación para estudiantes de Biología Celular: un cuestionario basado en cada práctica frente a un artículo científico basado en una de las prácticas. La valoración de ambos sistemas de evaluación se basó en el análisis cualitativo de la percepción de las actividades por estudiantes y profesores y en el análisis cuantitativo de las notas de los estudiantes en cada actividad. La elaboración de categorías hizo aparecer aspectos centrales inesperados que no hubieran sido tenidos en cuenta por los profesores si sólo se hubiera usado el análisis cuantitativo.

3. **KEYWORDS:** evaluation, Ground Theory, innovative methodologies, lab activities, teaching-learning processes / **PALABRAS CLAVE:** actividades de laboratorio, evaluación, metodologías de enseñanza-aprendizaje, metodologías innovativas, Teoría Fundamentada.

4. **DEVELOPMENT:**

a) **Objectives**

The Valencian regional government earmarks special funding for High Performance Groups (ARA groups) in those degrees where students obtained high marks in their University Access Exams (PAU), which is the case of Biotechnology in the *Universitat Politècnica de València*. One requirement of the ARA groups is that English must be the vehicular language. Under the ARA umbrella, our team, which includes lecturers who teach *Biología Celular* and lecturers who teach *English* in Biotechnology, was awarded a teaching innovation and improvement project (PIME) from the *Universitat Politècnica de València*. Our aim was to design new activities (Belda et al., 2012) and the corresponding evaluating systems to develop horizontal competences (http://www.upv.es/contenidos/ICEP/info/DimensionesCompetenciales.pdf) in our students (i.e. team work, self-learning, using English as vehicular language, learning skills they will use in their jobs as biotechnologists). One such activity was related to the *Biología Celular* practicals. Our aim in this study was to assess the evaluation of the practicals based on a

*questionnaire* compared to the evaluation based on writing a *scientific paper* of one of the practicals.

**b) Description of methodology**

The study was performed for both students of ARA groups and non-ARA students of *Biología Celular*. The *questionnaire* consisted of a set of questions (4 or 5) related to each practical; the students handed in their answers in the subsequent practical session, as this task involved a certain amount of research in the literature on their part. For the *scientific paper*, students had to write on one of the practicals and they had to follow the publisher's instructions to authors when submitting a proposal to a scientific journal.

Students were organized in teams of five, and every team carried out both activities. English lecturers took part in working on the language and structure of the scientific papers with the students and on marking the exercises.

At the end of the practicals, both students and lecturers were asked to give their opinions on the two evaluation systems. The students knew the question one week before they had to answer; they were given 15 minutes at the end of the last practical to write their opinion, with no word/space limit being imposed. The lecturers gave their opinions only after the marks had been handed out.

Two kinds of result were obtained in this study: a) participant perception of the two systems (based on the opinions/responses regarding the two evaluation systems stated above) and b) students' performance (based on the marks obtained by the students in each system).

Qualitative Analysis techniques were used to analyze participant perception of the two evaluation systems. Descriptive statistics served to analyze the marks obtained by students in each system and to compare both.

### c) Results and conclusions

*Students' and lecturers' perceptions of the activities*

Students' and lecturers' perceptions of the activities were analyzed with methods of the Ground Theory (Scott and Howell, 2008). Ground theory was chosen because it allows for the organization and systematization of the issues arising from the open question to help in the interpretative process. Two types were considered: 'student' and 'lecturer', since they might need different interpretation. For some specific aspects, "lecturer" type was divided into 'English lecturer' and 'Biology lecturer'. Open code strategy was chosen to identify single concepts and allow categories to merge from them. Concepts were labeled as core, subcore and recurring. The coding sorted the concepts in two nuclear concepts, 10 categories for students and 7 categories for lecturers. A reflective coding matrix was constructed to serve as a model and to lead the story line.

The two nuclear concepts were perception of evaluation by *questionnaire* and perception of evaluation by *scientific paper* for both type 'student' and type 'lecturer'. Some categories coincided for both types: preference, involvement in the activities, forward-looking, marks, sources and teamwork. In the 'student' type, four more emerged from the open code: workload, consistency with the lab activities, lack of experience and general perception. In the 'lecturer' type, proposals also emerged as a category.

From the students' perspective the **forward-looking** of the activity emerged as a core category. The *scientific article* was useful to help them learn how to write scientific reports; it taught them how to use references and how to draw graphs. They felt 'it prepares them for the future' and makes them 'feel part of the scientific world'. They expressed lack of experience: this is the first time they deal with this kind of exercise; they don't feel prepared, and they find it 'difficult because we have no previous experience'. Concomitantly they considered this activity as 'difficult to formulate', 'long', 'requires more time than the *questionnaire*' and 'requires more dedication'. However, when comparing it with the *questionnaire* they acknowledged that the *scientific article* 'allowed

for more flexibility as we were given more time to hand it in' and it did not imply so much time whilst the *questionnaire* required finding time for team meetings every week. With respect to the *questionnaire,* an unexpected category emerged: **consistency with the lab activities**. Most students did not find it had 'a direct relationship with the practicals'. This concept was recurring as it appeared in 40% of the responses. The fact that they had to search the literature to be able to answer some of the items in the *questionnaire* made it 'difficult' and 'not adequate to their level'. Hence, the activity was not appropriate for the evaluation of their practicals. Nonetheless, their perceptions on the *questionnaire* were not altogether negative because they described the questions as 'interesting', 'entertaining' and 'varied' and, some indicated that they would have rated it more positively 'if the questions had been more [closely] related to the practicals'. They also felt they were more involved with the practicals as 'questions force you to be alert during the lab sessions' and 'help consolidate and deepen the knowledge'. Besides, students asked for clarification on the use of references. By contrast, the *scientific article* allowed for a 'deepening' and a 'better understanding of the practical', the students noting the benefits of 'the compilation of much interesting information' and 'all the efforts converged in an in-depth work'. They positively valued the support material they could find in the *Biología celular* web site and the lecturers' explanations on how to write the article. Nonetheless, they requested a 'clearer explanation on how to address and present the 'Introduction'', which was the section they felt most insecurity, as the content was more open. Another recurring concept was their **perception on marks** (they did not know their marks at the time they were asked to give their opinions of the evaluation systems). They considered the *questionnaire* 'includes all the practicals under evaluation' and 'you don't risk the mark [of] a single practical', whilst with the *scientific article* 'you risk the mark on just one exercise' and there are 'less opportunities for a good mark'. They asked for marks to be handed out weekly in order to be able to improve on the subsequent task. A subcore category that emerged in 33% of the answers was the **perception of teamwork**. They considered that both activities 'got them used to work in teams', some students stating that 'working in teams gave them confidence', that it 'allowed solving problems' and that it 'allowed sharing workload'.

However, they claimed there were 'too many in a group', that 'there were too many different opinions' and that 'not everyone ends up happy with the solution'. Although the **preference** for one system or the other was not in requested the survey, 61% gave a preference: 40% preferred the *scientific article* over the *questionnaire* (21%).

From the lecturers' perspective, it is important to mention they gave their opinion after marking. With respect to **student involvement in the activities,** the lecturers pointed out that the *questionnaire* allowed for the 'analysis and maturing of contents' and that if they exclusively wrote the *scientific article* 'they might only concentrate their efforts in that practical'. This being said, they also emphasized that the students 'don't fully understand the article structure/essence', though they 'work the results and interpretation well'. Lecturers value the fact that students develop 'competences and skills that they wouldn't by simply carrying out the practicals' and that it is 'advisable as a first approach to data handling'. The English lecturers pointed out that the article was 'linguistically and cognitively the most interesting option' and that it allowed students to 'become familiarized with the structure of scientific/academic articles which is obviously beneficial to them, not only for their university work (projects, TFG, etc.), but thereafter', that it gave them 'more freedom to choose what aspects to write about' and that it forced them to do 'more research into other aspects of the task proposed' and that, in brief, it was 'a more challenging activity for the students'. With respect to the *questionnaire* the lecturers remarked that it required the students to look for 'more specific information and a finer analysis of the task at hand'. With respect to the **sources** cited, the biology lecturers pointed out that students would search for the answers to the *questionnaire* almost exclusively in the internet and that 'the level of complexity ought to be adjusted' and that 'proposals of questions that require the use of recommended literature ought to be put forward'. Lecturers also stated their opinion on teamwork suggesting that 'there shouldn't be more than three students in each team'. Besides, they recognized that 'teamwork forces students to negotiate the answers, the presentation structure'. As subcore characteristics, 'lecturers' workload in evaluating tasks' also emerged. In this respect the *questionnaire* was considered more

demanding and that if it were to be used in the future, it would be necessary to reduce the number of items included.

*Students' performance*

Student performance was analyzed with descriptive statistics (mean and standard deviation) and with frequency analysis.

The *scientific article* average mark was 7.02±1.5 and the *questionnaire* average mark was 7.06±1.3. This would indicate that there is little bias when using one or the other system.

The mark obtained by the *questionnaire* was subtracted from the *scientific article* mark for each team and averaged. The result was 1.05, which means that the mark could be 1.05 points greater depending on the system.

The frequency histogram (Figure 1) shows that the majority of students had a better mark with the *scientific article* than with the *questionnaire* and that those students with better marks in the *scientific article* differed less between the two systems.

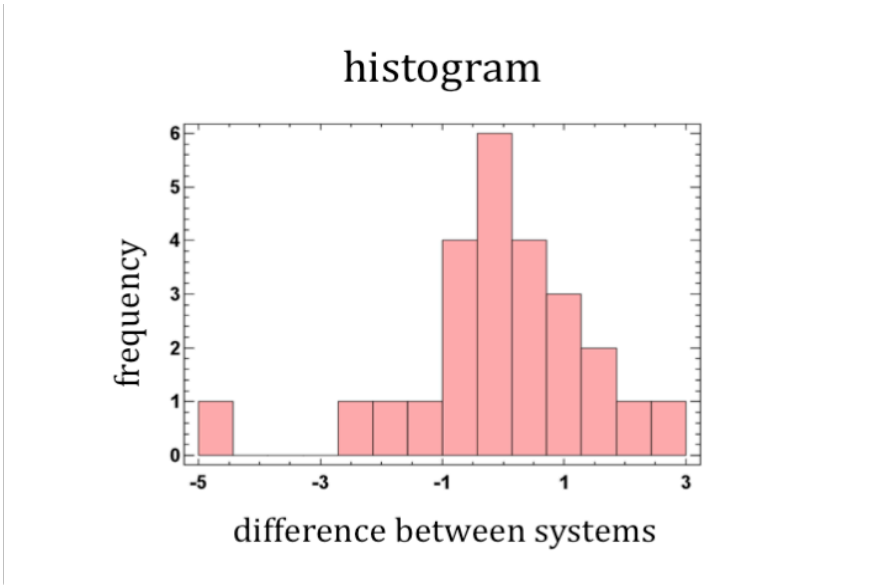


Figure 1. Histogram of frequencies of the difference of mark between the two evaluation systems. Positive values indicate the *scientific article* obtained higher marks and negative values indicate the *questionnaire* obtained higher marks.

Conclusions

By comparing the two evaluation systems for the lab practicals, we were able to distinguish the strengths and weaknesses of both, not only from the lecturers' perspective but also from the students', allowing us to assess aspects of the activities that could have not been perceived when analyzing student performance exclusively.

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## 5. REFERENCES

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