KAHOOT APPLICATION AS A TOOL TO TRACK STUDENT
ASSIMILATION OF BIOLOGY PRACTICAL COMPETENCES WITHIN
THE DEGREE OF MEDICINE

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Abstract

Due to the adaptation process to the European Higher Education, Spanish universities have coordinated their degrees and a deep reorganization has been done to meet European curricula requirements. However, this reorganization has forgotten the existing formative gap between secondary education and university degrees course curricula, which is particularly important in experimental subjects such as Biology. This formative gap is usually uneven among first year university students and its extent needs to be first addressed before programming the formative activities. The implementation of new technologies may help to achieve this goal by the development of attractive activities for the students. We propose to carry out several activities based on the Kahoot! application to interrogate the student knowledge on experimental aspects of the Biology course within the “Degree in Medicine”.

Cells are the most elemental physiological units of all living organism, and the assimilation of several key concepts of cell biology is the objective of the Biology course. This is an eminently fundamental subject in the “Degree in Medicine”. This subject has several specific competences related to the understanding of all aspects of cell physiology and development and laboratory experimentation. To this respect, the subject Biology includes an intense practical course to fulfill the transversal competences of understanding laboratory protocols, training in different laboratory techniques and collecting and analysing experimental results. This objective is partially hampered by the initial student knowledge; therefore, in order to test the student knowledge in experimental aspects of cell biology, several tests based on Kahoot! application have been developed. The results provide valuable information on how to modify activities and/or reinforce different parts of the practical course in order to meet the students’ needs and fill the knowledge gap, with the final objective to fulfill the competences of the Biology practical course.

Keywords: new technologies, scientific laboratory, teamwork, transversality.

1 INTRODUCTION

Within the Degree in Medicine, Biology, and more specifically Cell Biology, constitutes a fundamental subject in which all aspects related to cell structure and function, including developmental and cell fate determination processes are included. As a fundamental subject, it is tightly linked to past, present and future advances in the field of cell biology and the development of new and powerful experimental techniques. Therefore, besides the introduction of essential concepts and processes relevant to Cell Biology, an optimal and fruitful academic progress should also stress the experimental and methodological aspects. For this reason, the Cell Biology course within the Degree in Medicine at Universitat Jaume I also contains laboratory training sessions in which students learn widely used methods in Cell Biology or Biochemistry research: histological sample staining, protein isolation and analysis of their enzymatic activity, etc... This subject is offered to first year students; therefore, the adequate academic exploitation of the laboratory sessions is hampered by previous theoretical and practical knowledge gathered during secondary education. Nevertheless, the starting conceptual and technical knowledge of first year students of Medicine is uneven, including some important knowledge gaps and the aspects that need to be stressed are not clear. For this reason, it is proposed to start a pilot study to investigate the general knowledge in Cell Biology, focusing on methodological aspects. It must be also noted that the Teaching Guide for this subject establishes that, among the competences and learning outcomes to be achieved, ‘Laboratory material handling along with basic laboratory techniques’ and the development of research skills ‘physicians as researchers’, constitute essential generic aspects.
In order to evaluate the knowledge gap existing between previous concepts and the actual contents and learning objectives established for the subject, it is proposed to interrogate students performing an initial quiz to challenge the starting point. To attain this objective, the online Kahoot application will be used. Kahoot! is an online interactive game-based platform which learning games, named ‘Kahoots’ are multiple-choice quizzes that allow user generation and can be accessed via a web browser. The introduction of gamification, this is the introduction of gaming elements such as challenges, performance and rewards, as an interrogation tool to assess the learning process has been applied to different areas [1]. To this respect, Kahoot! allows reviewing students’ knowledge to assess formative performance or, in this case, also to assess initial knowledge. Initially, Kahoot! was designed for social learning, with learners gathered around a common screen such as an interactive whiteboard, projector or a computer monitor. The site can also be used through screen-sharing tools such as Skype or Google Hangouts. The gameplay is quite simple; all players connect using a game PIN provided by the professor, and using a benchtop or portable device they are asked to answer questions created beforehand. Interestingly, Kahoot! launched a mobile application for homework in 2017.

Moreover, as mentioned above, Kahoot! is a useful option to provide immediate and meaningful assessment of students’ learning [3]. Besides this, the immediacy of having smartphone apps available to play Kahoots questionnaires constitutes and advantage allowing students to establish their pace in the learning process.

To sum up, the overall objective in this work is to interrogate the students' knowledge in fundamental and technical aspects of experimentation in Cell Biology using Kahoot! and assess their knowledge before and after each laboratory session. The information gathered before laboratory sessions will help professors to properly design the teaching experience and stress those ‘weak’ aspects. Afterwards, a final re-evaluation will allow the assessment of the teaching performance, in order to provide more feedback for the rational design of teaching materials and/or the dissertation.

2 METHODOLOGY

The practical course of biology consists of five laboratory sessions concerning relevant concepts and processes of Cell Biology:

   1 Basis and handling of the optical microscope. Staining techniques.
   3 Cell division: mitosis
   4 Extraction of proteins and study of their membrane mobility in function of the isoelectric point (pI).
   5 Analysis of oxidative damage and antioxidant capacity.

Every year, around 80 new first year students enrol in the Degree in Medicine. For the laboratory sessions, they are equally-distributed into four groups (LA1 through LA4, based on the students’ qualifications and preferences). This distribution allows us to allocate two groups as control groups where the “classical teaching scheme” is followed, and the other two as the Kahoot! assay groups where the Kahoot! implemented work scheme teaching is followed.

2.1 Classical teaching scheme

In general, practical sessions are divided in several parts (figure 1A). First, the teacher gives a short theoretical introduction and an explanation of the practical protocol that students are going to perform. It normally takes around 20 to 30 minutes, and the detailed laboratory protocol has been provided to students the week before the practical session. Afterwards, students are randomly divided into smaller groups (2 or three students, depending on the laboratory material available) to carry out the practical session following the instructions of the protocol. During this practical session, the teacher obtains some feedback regarding students’ knowledge and performance by directly asking them. At the end of the laboratory session, each subgroup of students has to fill a short questionnaire relative to the current practical session which is, subsequently, evaluated. Based on this questionnaire, the professor assesses the students’ understanding of the theoretical bases and the protocol of the practical session.
Evaluation of the practical session is based not only on the final questionnaire but also on some notes the teacher has been taking during the practical session about student behaviour and performance in the laboratory.

### 2.2 Kahoot implemented work scheme teaching

The implemented work scheme of the practical sessions with the Kahoot app modifies the general workflow, introducing more interaction between students and teacher and a more detailed feedback information from the students to the teacher. First, students perform a Kahoot questionnaire about the practical session they must pass, asking both theoretical and practical questions. In that way, the teacher checks that students have the basic knowledge to carry out the practical session and which concepts must reinforce. As in the classical scheme, students have the laboratory protocol the week before the practical session takes place. After the teacher has clarified the relevant concepts, students are ready to carry out the practical session. As in the classical work scheme, the teacher obtains some feedback during the practical session by asking them and finally they perform a new Kahoot short questionnaire.

Here, evaluation of the practical session is like the classical work scheme but including the initial and final Kahoot questionnaire as part of the evaluation. The result of the initial Kahoot quiz is subsequently implemented in the theoretical introduction and contributes to identify which aspects the professor needs to emphasize during the development of the laboratory session. However, the short Kahoot quiz at the end of the laboratory session allows the teacher to evaluate the performance of the teaching experience, also having a feedback effect on the initial proposal and working scheme (Figure 1B).

**Figure 1. Classical (A) and Kahoot implemented (B) work scheme. Feedback points between the teacher and students in both work schemes are indicated.**

### 3 RESULTS

The Biology practical work scheme has been implemented using the Kahoot app as a pilot study to survey students’ knowledge on Cell Biology both at the experimental and at the theoretical levels. To attain this objective, the quiz has been divided into three different blocks: A) Experimental protocols: instrumentation and procedures, B) Laboratory Safety: operation and protection measures, C) Theoretical aspects underlying experimental laboratory sessions.
As a result of the preliminary analysis of the knowledge student gaps and taking into account the Teaching Guide for the Biology subject, the following issues related to each block were selected to design the Kahoot quiz’s:

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<th>Block</th>
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| A) Experimental Protocols | • Biochemical methods  
                           | • Microscopy                                                        |
| B) Laboratory Safety  | • Safety measures when working with biological material (e.g. animal tissues, blood, etc...)  
                           | • The importance of using protective clothes                        |
| C) Theoretical Aspects| • Relationship between the proposed experimental model and the expected outcomes  
                           | • Adequacy of the chosen experimental model                          |

Students from both group assay were subjected to the first Kahoot survey and several reinforcement activities were carried out: these were implemented as longer and more detailed explanations before the laboratory sessions including a proper justification of the experimental model and a clear and concise exposition of the expected outcomes of the laboratory session, explanatory videos with examples of the experimental protocols to be carried out and indications on the safety measures required for each session. The implementation of these reinforcement activities made sessions more dense and less dynamic and, as a result, students complaints became evident as well as a negative impact on the students’ ability to stay focused could be observed.

On the second Kahoot survey, a significant improvement in the aspects related to blocks A and B could be observed on Kahoot implemented (B) group respect to classical (A) group (Figure 1). However, no differences in regarding block C could be detected. Moreover, as a result of students’ exchange of impressions on the subject, several complaints on the development of the laboratory sessions raised, especially regarding their duration; on average, students from the classical group finished earlier than students from Kahoot implemented group. Surprisingly, no complaints on the absence of the reinforcement sessions were collected.

4 CONCLUSIONS

A theoretical and practical knowledge gap between the actual and the required minimal knowledge in first year Medicine students at Universitat Jaume I has been detected, especially relevant for the practical sessions of the Biology course. To fill this gap and reinforce the key Cell Biology concepts, a modification of the practical session work scheme is proposed by introducing a Kahoot quiz. This tool has been shown to be valuable for assessment of learning performance in medical education [2]. Thanks to this Kahoot quiz, the students are questioned in a funny and challenging way thus introducing an extra motivation. In order to evaluate the work scheme modification, two groups of the practical session are considered as control while the others two are the group assay. Finally, all students answer a final Kahoot questionnaire to evaluate their understanding of the cell biology concepts treated on each practical session.

The results of the pilot study indicate that the proposed scheme could be useful to allow students’ make the maximum use of the laboratory sessions. Nevertheless, duration and density of the laboratory sessions seems to be a major concern, especially when students from different groups exchange their experiences. Therefore, to make these newly-implemented laboratory sessions more dynamic allowing the students stay more focused for longer time, more concise explanations will be provided including videos and gamification strategies to identify specific deficiencies ‘on-the-go’.

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