Investigación e innovación en la Enseñanza Superior

Nuevos contextos, nuevas ideas
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58. Chances of Twitter for PK-based assessment and teaching in higher education

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ABSTRACT

The new generations of university students are increasingly using ICT for learning. In addition to their trends in the learning process, it is well known that their prior knowledge (PK) impacts significantly on learning acquisition. Considering the strategic advantages of technology, we aimed to display benefits of Twitter for PK-based assessment and teaching in higher education. In this paper, a trial with 61 students is shown. PK about the terms ‘Research’ and ‘Scientific Research’ was assessed using Twitter and Text Mining. Data gathering was conducted by means of a specific software, implemented with Python and Java. The definitions students’ provided in Twitter were extracted through the Application Programming Interface (API) of this social network. Both definitions were analyzed in the R software using text pre-processing techniques, and hierarchical and co-occurrence grouping analyses for getting the distributions and emerging relations between several lexical units. Results suggest that students associated research mostly to information searching and not much to the application of a rigorous and systematic method. That was interesting for teaching, as gave opportunities for clarifying general wrong PK at a time and building complex mental structures based on correct PK. The efficiency of Twitter in different PK assessments and the limitations of its use in future lines of work are discussed.

KEY WORDS: prior knowledge, twitter, text mining, Higher Education, conceptual learning.

1. INTRODUCTION

Recent review papers on changes in the higher education institutions reported that new generations of students already incorporate ICT in their learning processes (Noguera Fructuoso, 2015). Therefore, embodying the use of educational technology in university teaching is an essential condition for learning properly. In this line, the principle of prior knowledge (PK) by Ausubel (1968) has a significant impact on learning acquisition and reformulation. Significant learning is more feasible when linking new information to PK.

Assessing the university students’ PK is fundamental for an effective and ‘student-centered learning’ (SCL) teaching. This is the direction the European Higher Education Area has recommended (see especially 2009 Louvain-la-Neuve Communiqué, as well as Ministerial Conferences of Bucharest in 2012 and Yerevan in 2015).

When students arrive to university, they learn from complex PK structures, which have been created in previous stages of the education system. For this reason, assessing their PK is relevant for providing a learning that connects with contents already acquired. Otherwise, there is a risk of teaching what the students know before enrolling to a course in the university, or not clarifying what they learned wrongly at another time. All this has an impact on the quality of learning.

From constructivist viewpoint, the intervention principles that guide any teaching program should consider the students’ PK. Thus, it is supposed to contribute to significant learning and, this way, to
active participation of the students. Assuming this approach in a classroom, the use of ICT may allow changes in the teaching-learning processes if PK is taken into account.

In this paper, PK was assessed by means of Twitter and applying semantic analysis techniques. These are emerging strategies in the field of educational sciences to evaluate quickly and completely the PK the university students have about certain concepts. In this case, the concepts Research and Scientific Research were tested, after carrying out an activity in the frame of the subject ‘Introduction to the Research in Physical Activity and Sport Sciences’. This subject was part of the program of the Degree in ‘Physical Activity and Sport Sciences’ by the University of Valencia. The syllabus of this university degree (DOCV No. 6912, 11/28/2012) has a statement, by which this subject is compulsory and is equivalent to 6 credits ETCS, taught in the first semester of the second year.

After considering this evaluation trial, specific didactic proposals were elaborated for teaching and learning the concepts Research and Scientific Research.

2. METHOD
The general curricular lines pointed out in the teaching guide for this subject were: [1] basics for getting the concept Scientific Research and [2] approaching to information management procedures as support for research processes.

The classroom study that is shown in this paper is focused in the first point:

1. Scientific Research: Basics
   1.1. The Concept of Science
   1.2. Scientific Research and Knowledge
   1.3. The Scientific Method

2.1. Participants
The study was conducted during the first class session of the subject. 61 students (74% male and 26% female) aged from 19 to 47 years attended to this session. Regarding the academic profile of the students, most of them had access to university studies through the University Entrance Exams (45%) or after getting a Certificate of Higher Education (ISCED-5) (35%). More than half of the students had no additional university studies (65%).

2.2. Data collection
As shown in Figure 1, the activity for assessing the PK on curricular contents was executed in three phases:

1. Data collection of conceptual PK.
2. Analysis and assessment of that PK.
3. Teaching design for learning the concepts.

In the phase 1 related to data gathering, an activity was designed and carried out for getting a definition set where all the meanings that the students offered to define the concepts Research and Scientific Research were captured. That definition set was based on their PK. In this first activity, both the students and the professor were saw as players in the learning context and as mediating elements of such a process, the ICT and the social network Twitter.

For the evaluation session, the professor proposed to the class an introductory task consisting on an activity for the assessment of the PK on the concept Scientific Research. He asked each student for an isolated description of the concept Research and another one of the concept Scientific Research. Both
texts had to be published in Twitter and they were in Spanish. The use of hashtags was let in order to emphasize the most relevant ideas in the writings and using emoticons and GIFS as expression characters was also allowed. At this point in the experience, two independent sets –two different defining corpus– were segregated: one regarding Research and another with respect to Scientific Research.

2.3. Analysis
In the phase 2 related to PK analysis, the professor extracted and monitored all the descriptions published in Twitter by the students. Data extraction was led by means of a specific software implemented with Python and Java in roaming with the Application Programming Interfaces (API) of Twitter. All analyses were conducted using the software R. The list of elements for the analysis and evaluation of PK was as follows:
1. Tweet ID
2. Username
3. Introduction to the profile
4. Publication date and time
5. Number of users followed
6. Number of followers
7. System (Android, IPhone, website…)
8. Content of the tweet
9. Keywords (Hashtag)

Semantic analysis techniques were applied by means of Text Mining for assessing this activity. Basic techniques for text pre-processing (tokenization and normalization) and noise elimination (stop words and stemming, among others) were used in both defining corpus for debugging data. These two
sets were then submitted to a hierarchical clustering analysis, computing the Ward index for getting the associations. This method allowed to know the distribution of the different lexical units within each defining corpus (Drout & Smith, 2012). According to each corpus, two dendrograms were obtained: *Research* and *Scientific Research*.

In the context of Text Mining, dendrograms let to obtain a representation about the existing lexical groups and the similarities in the lexical patterns located within those descriptions the students written. The grouping relations between data and the groups are represented on the ordinate axis and dissimilarity in the distribution of the lexical units within each defining corpus is on the abscissa axis.

A co-occurrence analysis was conducted considering the defining corpus *Scientific Research* to study the relations established between the units that interacted in the descriptions. In this test, concepts with total frequencies ≥ 3 were analyzed through the Jaccard coefficient, without determining a minimum correlation coefficient between the terms. In the graphic representation for showing this analysis (Figure 4), the nodes size was proportional to the total frequency of each term. The highest relations were highlighted in a gray scale.

3. RESULTS

3.1. PK on the concept ‘Research’

Data structure is represented in Figure 2 with 5 color-differentiated clusters. In the red cluster, the association between the concepts ‘draw’ and ‘conclude’ was very close to the origin of the scale, suggesting high similarity in the distribution of these two lexical units within the defining corpus. The blue cluster joined the verbs ‘research’ and ‘ignore’ with similarity, nesting both to the term ‘study’; and also associated ‘search’ with ‘data’. This cluster provided information about how students knew the initial research process. In the yellow cluster there were six concepts. The terms ‘search’ and ‘information’ had a greater proximity in their distributions and were connected to the peer composed by ‘subject’ and ‘research’. This set of four terms was finally merged with the pair formed by ‘discover’ and ‘objective’, stressing the need for a clear topic for the research process.

The pink cluster was the most homogeneous, given its position in the dendrogram, and had the least internal distanced within the corpus. The association between a ‘method’ and offering an ‘answer’ to the research question stood out. These two terms were nested by ‘acquiring’ research findings and, in turn, by the verb ‘want’, which would imply the research aim. The green cluster was constituted by the melting of two smaller sub-groups: one composed by ‘research’ and ‘knowledge’ and located considerably close to the origin of the dendrogram in a homogeneous association; and the other one formed by the terms ‘human’ and ‘learn’.
3.2. PK on the concept ‘Scientific Research’

A tree diagram (Figure 3) was set up in the wake of final partition of four clusters. Generally, these four clusters had greater dissimilarity in the distribution of their terms if compared to the results after analyzing the concept ‘research’ (see head 3.1.).

In the blue cluster, the association between the terms ‘refer’ and ‘search’ formed the most homogeneous group, nesting first in the ‘answer’ to research questions and then in ‘Scientific Research’.
itself. The yellow cluster was divided into two groups: one greater group with the terms ‘process’ and ‘knowledge’ nested by ‘obtaining’ results; and another integrating ‘research’ and ‘inquiry’. The group with greater similarity in the pink cluster had the terms ‘search’ and ‘topic’, which converged on the term ‘specific’ and created a new and more heterogeneous group. ‘Searching a specific topic’ was joined to the cluster regarding ‘search for data’, which was composed by the concepts ‘use’ and ‘information’. In the green cluster, ‘method’ and ‘study’ were connected in a first stage and had obtained high similarity in the distribution of these two lexical units. Establishing a research ‘aim’ was merged to this group with considerable distance, suggesting a proactive feature when conducting scientific research.

**Figure 3.** Hierarchical clustering analysis results on ‘Scientific Research’ definitions
After co-occurrence analysis on words in domain –tweet– it could be identified up to 7 word clusters (Figure 4). The largest group assumed a total of 8 words and had a density of 12.5%. Those terms used in the tweets published for defining Scientific Research with frequency ≥ 20 were: ‘research’, ‘scientific’ and ‘information’. Aside from that, the words ‘research’, ‘searching’, ‘information’ and ‘process’ were especially relevant, as they had more conceptual associations than others. A moderate correlation was also found between ‘study’ and ‘method’ (.42); ‘process’ and ‘knowledge’ (.33); and ‘search’ and ‘method’ (.29). However, ‘method’ and ‘aim’ were not directly related to each other, although they belonged to the same cluster.

Figure 4. Co-occurrence analysis results on ‘Scientific Research’ definitions

4. DISCUSSION AND CONCLUSION

The use of Twitter in the classroom let to renew the didactic and evaluation aspects for university teaching. Conceptual PK of university students was assessed with precision and nimbleness taking advantage of Text Mining regarding the concepts Research and Scientific Research. In addition, during the data collection process each student had been able to dynamically activate their personal knowledge, had become aware of his/her ideas and had written and exchanged with peers the information recognized (López-Recacha, 2009). Therefore, there are reasons that lead to think that this evaluation process involves not only cognitive and metacognitive elements, but also social, affective and motivational related to learning.
From the teaching perspective, it was detected that PK of the students on Scientific Research is incomplete and heterogeneous, taking as reference one of the most accepted definitions in the area of research methods (Kerlinger, 1987). Thus, a need to deepen the characteristics of scientific research was identified and, that case, scientific knowledge.

4.1. Getting aware of the wrong PK

Once the data had been analyzed, we knew the general PK of the class group about the concepts that will be worked in the near future in the subject. Now, the first teaching task would be to determine if students are at risk of an incorrect acquisition of the concepts Research and Scientific Research due to wrong PK.

For this, preventing wrong PK is and ensuring a correct acquisition of simple and new mental structures is essential. That should contribute to reformulate previous mental structures and to correctly build new complex schemes. In the study shown in this paper, students associated ‘searching specific information’ with ‘research findings’—whether scientific or not—, without certainly going through a procedure or a homogeneous method that provides guarantees in obtaining valid and effective results or conclusions. Moreover, the most usual terms in the sample of texts were ‘research’, ‘scientific’ and ‘information’, and no direct relationship was found between the ‘method’ and the research ‘aim’.

In such a situation, students seem to need to clarify that research involves the use of a systematic method for searching information in the initial phase of a study, but also for searching data that can provide answers to certain questions or research aims in order to draw latter conclusions. Research does not only consist in reading and getting informed about a certain topic, no matter how specific it may be; and the same for scientific research and for non-scientific research.

Another misconception of the students was understanding the search for specific information on a given topic as a procedure for obtaining knowledge. In this line, it should be clarified that knowledge is generated from information contrast, the categorization and re-categorization of data, the application of the research method and other similar points. In any case, knowledge is not equivalent to raw information or data available on a specific subject of study. This must be understood before explaining new contents inside the frame of the concepts to be worked on in the classroom.

A professor can employ common teaching techniques to ensure that all wrong PK have been clarified. For that matter, a useful method is to ask about these wrong PK from a Socratic perspective (Gargallo López, 2017), or even to raise cases to be solved during the class (García-Féliz, Morera, Sarrià, & Cebrià, 2017), so that the professor be able to check whether they have adjusted the mistaken ideas they had.

4.2. Concept comparison for clarifying knowledge

For this section, it is supposed the situation where the professor has just clarified that scientific research requires a systematic method and does not consist only of reading specific data. This clarification may lead the professor to explain the scientific method as a differentiating feature of scientific research in contrast to non-scientific research. The comparison of the concepts Research and Scientific Research may highlight differences and similarities that contribute significantly to understand differentiating aspects, which define one concept and not the other.

When the students of this group understand what differentiates scientific research from non-scientific research, surely will better understand what each concept consists of separately. This moment of the teaching plan constitutes an intermediate step between the prevention of the wrong PK and the
explanation of new ideas about both concepts. If the students have already clarified the basic mistakes and learned the differences about both concepts, they would be prepared to assume new information that will make their mental structures more complex.

4.3. Chain incorporation of new ideas

Explaining both concepts should engage the PK that students already have, whose errors have been clarified and compared. In other words, the new ideas should be chained on the basis of previous ideas that make up the concept that students already have about what *Scientific Research* is (i.e. Phase 3).

Data analysis made it easy to see that there is confusion about the method. It seems that this class group does not have much awareness of the need to carry out the research process through a systematic method. Perhaps this could be due to the fact that they have not had practical research experiences and thus cannot become aware of the importance of the scientific method during the process.

Either way, the research method should be explained on the basis of the PK of the class group. That is, the professor should begin from explaining the search for specific information and expose why the search and reading per se is not enough for researching. Afterwards, it would be explained what the method consists of and why it is necessary to carry out scientific studies. Positive and negative examples can be used to clarify the new ideas that are being incorporated into the students’ previous mental schemes.

4.4. Replication and didactic use

Using Twitter in the university classroom has allowed a nibble and accurate way for evaluation. This method let to assess the PK on the concepts *Research* and *Scientific Research* of a whole class group. It has also been useful in planning the teaching proposal. However, this assessment model is not suitable for any educational situation.

The evaluation conducted along this study was helpful to assess the PK of a group. Usually, this is a complex and difficult task, and one of the most useful functions of ICT is to systematize, clarify and make easier the assessment. As evident, it is not the same to assess the PK of a class group and the PK of a particular student. When it is about one single person, the assessment could be much simpler, as applying the same procedure that we did in this trial is not necessary. In such a case, it would be enough to ask the student orally to give an idea of his/her PK and, surely, teaching would be also simpler.

PK assessment is necessarily an initial evaluation, but the evaluation of knowledge in general could be initial, formative, summative or other kind. When assessing students’ knowledge, it is enough to ask an open-ended question and give feedback to each student. Moreover, when assessing the recognition of one concept, multiple-choice quiz would be enough. In fact, in these two situations it might not make sense to set a teaching program in view of the acquisition of concepts; for example, if it were a test at the end of a block or subject taught during a limited time.

After all, the use of Twitter and semantic analysis let to know in an accurately and effectively the conceptual PK of the group of students. For certain situations, such as the initial evaluation of PK, these tools offer attractive features, both in the evaluation and in the subsequent planning of the subject. Based on the evidence, we suggest the following three stages to use Twitter for assessing and teaching in higher education:

1. Previous stage: teaching design to assess the general PK, allowing to link it with the contents of the subject.
2. Development stage: explanation of the aim, timing and specific criteria for carrying out the activity.
3. Completion stage: assessment of the PK, giving feedback to the students and planning the progress of the subject from evidences.

5. REFERENCES

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