

Biology in University Access for the Over-25s in Spain¹

Biología en el acceso a la Universidad para mayores de 25 años en España

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Abstract

University access for the over-25s is an examination held annually at all Spanish universities. After an initial interest in analysing and evaluating this exam, few studies now research its current status. This is the case for the specific Biology test. This article outlines the specific Biology test of the 2015–2019 examination sessions for the over-25s to access university in the autonomous communities of Spain. For that purpose we conducted a comparative study with a descriptive approach, following the strategy proposed by Ruiz-Lázaro and González-Barbera (2017), to analyse the frequency of the content blocks and the cognitive level required. Some differences were observed between autonomous communities, with priority given to subjects concerning microscopic aspects of Biology and with cognitive demands based on memorisation. Solutions and future lines of research are proposed, which may help to improve the features of this test.

Keywords: university; entrance examination; biology; comparative analysis; maturity.

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Resumen

El acceso a la universidad para mayores de 25 años es una prueba que se realiza anualmente en todas las universidades españolas. Tras un interés inicial en el análisis y evaluación de la misma, actualmente son pocos los trabajos centrados en conocer el estado de esta prueba. Así sucede en el caso de la prueba específica de Biología. Este trabajo se centra en caracterizar la prueba específica de Biología de las convocatorias de 2015 a 2019 que dan acceso a la universidad a mayores de 25 años en las diferentes comunidades autónomas de España. Para ello, se llevó a cabo un estudio de carácter comparado desde un enfoque descriptivo, siguiendo la estrategia propuesta por Ruiz-Lázaro y González-Barbera (2017), en el que se analiza la frecuencia de aparición de los diferentes bloques de contenidos y el nivel cognitivo demandado. Se observan ciertas diferencias entre comunidades autónomas, priorizándose temáticas centradas en aspectos microscópicos de la biología y con demandas cognitivas basadas en la memorización. Se proponen soluciones y futuras líneas de trabajo que pueden ayudar a mejorar las características de esta prueba.

Palabras clave: universidad; examen de ingreso; biología; análisis comparativo, madurez.

Introduction

There are several ways to gain entry to Spanish universities. On the one hand, the general procedures that include students with a *bachillerato* qualification (Spanish baccalaureate) or equivalent or a university qualification, and, on the other, the specific procedures for people older than 25, older than 45 or with proof of professional or work experience (Royal Decree 412/2014).

Ongoing updates to the regulations on general routes of access have resulted in them often resurfacing as a research topic from several perspectives (Lorenzo et al., 2013; Ruiz-Lázaro and González-Barbera, 2017; Fernández-Mellizo and Constante-Amores, 2020). Conversely, research on alternative routes of access are less frequent as most studies describe university access for adults as a whole, focusing primarily on access criteria through proof of professional experience or the interview held in examinations for the over-45s (Lorenzo et al., 2013; Gairín and Muñoz, 2015; García-Rodríguez et al., 2014).

Consequently, few studies retrospectively analyse the status of university access for the over-25s, and those that do mostly analyse the sociodemographic characteristics of the people taking this examination and quantitative data on students in an autonomous community or specific university that have registered for, sat and passed the exam (Requejo and Caballo, 2001; Rodríguez and Díaz, 2008; Casa de la Mujer, 2012; Sáez Bondía, 2021).

Research analysing the features of the university access examination for the over-25s (referred to from now on by its Spanish acronym, PAM25) based on the various tests it comprises are infrequent and rarely updated (Escudero, 1983; Paulauskaitè, 2004). In contrast, several studies analyse the characteristics of the tests forming the general routes of access in various areas of knowledge (Franco-Mariscal et al., 2015; Ruiz-Lázaro and González-Barbera, 2017; Ruiz-Hidalgo et al., 2019; Ruiz-Lázaro et al., 2021).

Given there are so few updated studies on the PAM25, and, more precisely, on the specific Biology test, this article describes the latter. The features of this test in the Spanish autonomous communities are analysed from a descriptive and comparative perspective.

University access for the over-25s

University access for the over-25s involves sitting the PAM25. This examination can be taken by people over 25 or turning 25 in the year it is held and do not have a qualification giving them direct access to university studies (Royal Decree 412/2014). There is only one examination session every year, usually between February and May, depending on the autonomous community.

The PAM25 consists of two phases, one general and one specific. The general phase includes a series of assessable tests whose aim is to evaluate maturity, reasoning capacity and written expression. The specific phase gives students the option to choose from a series of subjects or tests on the branch of knowledge they want to study at university. Specifically, five options are offered associated with the branches of knowledge of their chosen university degree: A) Arts and Humanities; B) Science; C) Health Sciences; D) Social Sciences and Law; and E) Engineering and Architecture. The aim of this phase is to evaluate the students' abilities, aptitudes and skills to successfully complete their university studies in the branch of knowledge they have opted to study (Royal Decree 412/2014).

The contents, correction criteria and structure of each of the exercises forming the examination are regulated at an autonomous community level together with the universities in each community. Although examinations are subject to general regulations, specifications for subjects, especially those forming part of the specific phase (from now on referred to as specific tests) may be modified slightly, since they are not necessarily linked to the *bachillerato* syllabus, as the general access examinations are (Order ECD/1941/2016).

Adults passing the PAM25 have a number of places reserved for them per degree, which has to be above two per cent of the total places offered. However, unlike in the general access routes, candidates that have passed the examination in the same community where they want to take up their university studies have priority. This means the effect of any differences in the examination between autonomous communities is not as significant as it can be in ordinary access routes, in which standardisation and objectivity have a national impact (Ruiz-Lázaro et al., 2017).

Biology in university access

In general, research analysing the topics included in ordinary entrance examinations for different subjects take the *bachillerato* syllabus as a reference. Not only does this give candidates an idea of the examination specifications, it also makes the curricular domains and the abovementioned exams consistent with each other (Alda, 2015).

As commented above, adults taking the PAM25 must only meet the age criterion, since they can take the examination without having the compulsory secondary education qualification (Royal Decree 412/2014). This calls into question whether the Biology test in this context covers the knowledge domains needed to study and pass their future university course after they have passed the test.

As with the other tests, the content included in the PAM25 Biology test is stipulated in a specific autonomous community regulation and supplemented in many communities with public documentation that includes a test programme. In general, these programmes or regulations include Biology content from the first and second years of the *bachillerato* syllabus, although some communities also include content from the Applied Anatomy subject (Royal Decree 1105/2014).

Over 30 years ago, Escudero (1983) reflected on the general features of the PAM25 and the differences between questions set at the various universities. One of the aspects he criticised then was that the specific tests 'put too much emphasis on information, on remembering data . . . often turning them into something strongly resembling the questions of a quiz show' (p.13). In other words, he found fault with the excessive memorisation requirement of the questions asked in the specific phase at that time.

The cognitive demand of questions set in tests is still being analysed today (Crowe et al., 2008; Yus et al., 2013; Martín-Páez et al., 2019). It is generally associated with Bloom's taxonomy (Anderson and Bloom, 2001), divided into high and low cognitive demands, which establishes a hierarchical order from less to more cognitive complexity. There are usually three groups that become increasingly more complex: (1) memorisation or recall demands; (2) comprehension demands; and (3) knowledge application or transfer demands (Crowe et al., 2008; Yus et al. 2013).

Objectives

The general objective of this article is to outline the specific Biology test for the 2015–2019 examination sessions for the over-25s to access university in the Spanish autonomous communities. Specifically:

- To describe the branch of knowledge each of the analysed tests is associated with.
- To describe the general structure of the test referring to choice and the number and type of questions it includes.
- To analyse the frequency with which the topics appear in the test.
- To analyse the cognitive level required in the test questions.

Method

Sample selection procedure

Initially, 48 Spanish state universities offering the PAM25 were selected based on the list that can be consulted on the official website of the *Conferencia de Rectores de las Universidades Españolas* (CRUE, Conference of Rectors of Spanish Universities); the Spanish National

University of Distance Education (UNED) was ruled out as it has its own specific regulations (Order ECD/1663/2016).

In general, universities in the same autonomous community are grouped into university districts offering a unified PAM25 examination; in other words, a single session with the same examination for every candidate in that autonomous community. Nevertheless, there are two autonomous communities where there is not just one community examination: the Community of Madrid and the Canary Islands. In Madrid, five of its six state universities independently offer the Biology test and the sixth does not, while both universities in the Canary Islands provide the Biology test. Furthermore, the University of Las Palmas de Gran Canaria provides different sessions at its two centres.

The following resources were consulted to learn the general characteristics of the test and its structure: 1) the specific PAM25 regulations of each autonomous community; 2) the documents on the official websites on the programme contents and test structure; and 3) the examinations set in past years. This information was organised by autonomous community.

The analysis of the topics and cognitive demand was based on the Biology tests set by each community from 2015, the year when the current regulations were established, to 2019. The 2020 examinations were not considered in the analysis due to the unusual social and health conditions in which they took place, which resulted in some communities slightly altering the programme.

The examinations of the five years studied were selected for almost all the autonomous communities. Nevertheless, the number of examinations available from 2015 varies due to particular aspects of each community, namely: 1) the exceptional circumstances in the autonomous communities of Madrid and the Canary Islands; 2) no students registered for the test in some of the sessions; 3) reserve examinations and the type of choice in the questions in the same session (choice of one of two examination options, question choice in the same examination or no choice). The relative importance of each question—categorised on the basis of the associated Biology topic and cognitive demand—in every examination was also considered for the analysis, as shown in the following section.

Table I shows a summary of the sample selected by autonomous community and its particular circumstances. The results section, which concerns the general features of the Biology test, details aspects related to the choice within the test and the number of questions each test contains. These help to understand the specified sample.

Despite the difference in the sample size in some autonomous communities, we decided to select all the available cases to gain a more approximate idea of the test features. Consequently, a total of 160 tests and 1185 questions were analysed and grouped by community.

TABLE I. Sample selected by autonomous community

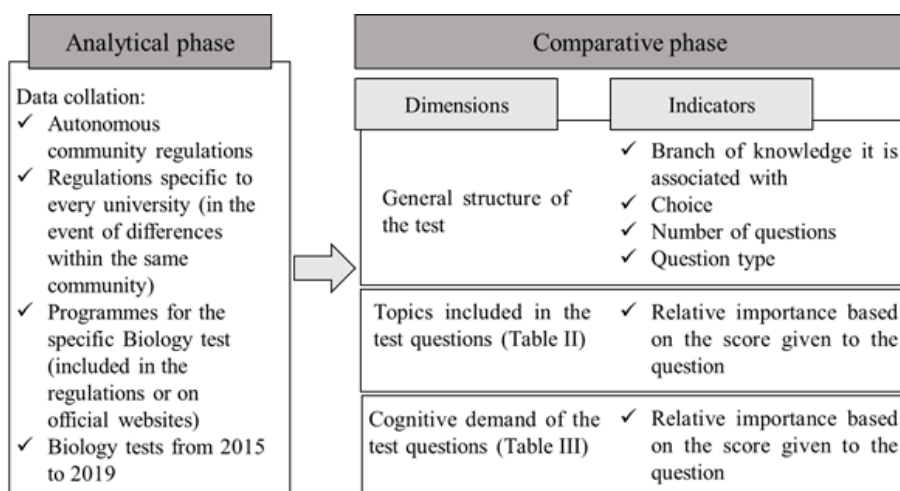
Community	Examination sessions analysed	Tests	Questions
Andalusia	2015, 2016, 2017, 2018, 2019	5	30
Aragon	2015, 2016, 2017, 2018, 2019	10	50
Asturias	2015, 2016, 2017, 2018, 2019	10	50
Balearic Islands	2015, 2016, 2017, 2018, 2019	5	20
Basque Country	2015, 2016, 2017, 2018, 2019	5	25
Canary Islands	2017, 2018, 2019 of Las Palmas de Gran Canaria University at each of its two centres, and 2015, 2016, 2018 and 2019 of the University of La Laguna	10	256
Cantabria	2015, 2016, 2017, 2018, 2019	5	20
Castilla-La Mancha	2015, 2016, 2017, 2018, 2019	10	140
Castilla-Leon	2015, 2016, 2017, 2018, 2019	10	50
Catalonia	2015, 2016, 2017, 2018, 2019 Including the reserve examinations.	10	40
Community of Valencia	2015, 2016, 2017, 2018, 2019	5	40
Extremadura	2015, 2016, 2017, 2018, 2019 Additional examination due to clashes in test schedules	6	24
Galicia	2015, 2016, 2017, 2018, 2019	5	100
Madrid	Alcalá University: 2015, 2016, 2018, 2019 Polytechnic University of Madrid: 2015, 2016, 2017, 2018 Rey Juan Carlos University: 2016, 2017, 2018, 2019 Autonomous University of Madrid: 2015, 2016, 2017, 2018, 2019 Complutense University of Madrid: 2015, 2016, 2017, 2018, 2019	44	220
Murcia	2015, 2016, 2017, 2018, 2019	10	50
Navarre	2015, 2016, 2017, 2018, 2019	5	20
Rioja (La)	2015, 2016, 2017, 2018, 2019	5	50
Totals		160	1185

Source: Own.

Data analysis

The study was conducted in two phases. The first was analytical and the second comparative. Both were descriptive in focus, following the strategy proposed by Ruiz-Lázaro and González-Barbera (2017), as shown in Graph I.

GRAPH I. Study phases



Source: Own.

Initially, a general analysis of the Biology exercise was conducted outlining, for every autonomous community, the branches of knowledge this subject can give access to, based on the content of current regulations: A: Arts and Humanities; B: Science; C: Health Sciences; D: Social Sciences and Law; and E: Engineering and Architecture.

The exercise structure was analysed next considering the following aspects: (a) whether choice formulae were present and, if they were, the type of choice (two test options to choose from or several questions to choose from); (b) the number of questions the test contained; and (c) the type of questions asked: multiple-choice, true or false, labelling (related

to identifying biological structures), short-answer or essay, according to Crowe et al. (2008).

Next, the questions set in the sample of selected tests were analysed for the Biology topics they referred to and their cognitive demand.

The topics in the exams were categorised by taking the main content blocks in the *bachillerato* syllabus as a reference and comparing them with PAM25 Biology programmes in every community to build the category system shown in Table II. This category system was validated by experts' agreement.

TABLE II. Category system to analyse topics

Category	Topics included
Biochemistry	Bioelements and biomolecules (carbohydrates, lipids, nucleic acids, proteins and enzymes) from the point of view of composition, structure and general functions.
Molecular genetics	Replication mechanisms (DNA replication) and protein synthesis (transcription, translation and genetic code). Mutations.
Cell structure and physiology	Cell structure, structural differences between cells (animal/plant; eukaryotic/prokaryotic). Nutrition (metabolism, mechanism of enzyme action), relationship (membrane transport, cell communication) and reproduction (cell cycle, mitosis and meiosis).
Inheritance bases	Principles of Mendelian genetics and basic related concepts.
Immunology	Basic concepts, cells involved in the immune response, mechanisms, vaccines, serums and transplants.
Histology	Characteristics of the main animal and plant tissues.
Systematics and taxonomy	Classification and naming of living organisms, overall differences between kingdoms.
Microbiology	Microbiology and its applications. Viruses, bacteria, and food and pharmaceutical industries. Biotechnology associated with microbiology.
Anatomy and physiology	Vertebrate organs and systems: structure, functions and relationship between them.
Ecology	Ecosystem structure and dynamics: population, community, biotic relationships, succession, cycles of matter and energy.
Evolution	Biological evolution: theories and implications.

Source: Own

The last objective was to categorise the questions in every autonomous community based on their cognitive demand, following the categorisation

proposed by Crowe et al. (2008), to obtain three categories, corresponding to knowing, comprehending and applying, as shown in Table III.

TABLE III. Categories for the type of cognitive demand and examples

Category	Main skills evaluated	Examples of questions taken from examinations ²
Knowing	Identifying, remembering, recognising, listing, defining. Multiple-choice questions involve remembering information.	Andalusia. 2016.6 <i>Define passive natural immunity, active natural immunity, passive artificial immunity and active artificial immunity.</i>
Comprehending	Describing or explaining in one's own words. Multiple-choice questions involve understanding concepts and/or contain alternative ideas that students usually express.	Castilla-La Mancha. 2016.OB.6 <i>Which of the following is a true difference between animal and plant cells? A) Animal cells burst when they absorb too much water by osmosis and plant cells do not; B) Plant cells store cellulose and animal cells store starch; C) Animal cells have ribosomes and plant cells do not; D) Animal cells have mitochondria and plant cells do not.</i>
Applying	Predicting using different concepts, using information in new contexts, drawing conclusions from the data provided. Multiple-choice questions force predictions to be made when certain changes are proposed in a system.	Catalonia. 2017OA1c. <i>In the article published in the Journal of Proteome Research, the authors state that 'haemoglobin adapts to high mountain conditions'. If two people who have spent a month's holiday in a high mountain area conceive a child soon after, will this child inherit their parents' changes in haemoglobin? Discuss your response in Neo-Darwinist terms.</i>

Source: Own and PAM25 biology tests of the autonomous communities specified

After categorising the questions set by each autonomous community for the analysed aspects (Tables II and III) the relative importance of this category in every community was estimated, considering the score given to every question in relation to the total test score.

⁽²⁾ The following are specified: autonomous community, examination year, option (if any) and no. of questions, subsection (if the whole question is not considered).

Results

General features: branch of knowledge and general structure

In most of the autonomous communities, Biology is considered an assessable test out of the exercises that can be chosen in the specific phase to access Science (B) and Health Sciences (C). Nevertheless, there are autonomous communities where it is also linked to Social Sciences and Law (D) (Castilla-La Mancha) or Engineering and Architecture (E) (Murcia) (Table IV, marked in grey). Extremadura is a particular case as it holds a unified Health Sciences test that essentially includes questions associated with Chemistry and Biology.

TABLE IV. Branch of knowledge the Biology test is associated with by autonomous community

Community	Branch of knowledge it is associated with		
	Science (B)	Health Sciences (C)	Others
Andalusia		Compulsory	
Aragon			
Asturias			
Balearic Islands	Compulsory		
Basque Country			
Canary Islands ²	Only at ULL, where it is compulsory	Only at UPGC, where it is compulsory	
Cantabria			
Castilla-La Mancha			Branch D
Castilla-Leon			
Catalonia			
Community of Valencia		Compulsory	
Extremadura	Does not offer Biology with this name		
Galicia		Compulsory	
Madrid			
Murcia			Branch E
Navarre			
Rioja (La)			

Source: Own

⁽³⁾ Meaning of the abbreviations. ULL: University of La Laguna; UPGL: University of Las Palmas de Gran Canaria.

Concerning the criteria for choosing the branch of knowledge, it is important to note that in the specific PAM25 phase, people sitting this examination have to take between one and three subjects or exercises, depending on the autonomous community. There is an option to take two exercises of the three offered for each branch of knowledge in almost all the autonomous communities, and they may coincide in some of them. For example, in Aragon a person who decides to be assessed on branch B (Science) and C (Health Sciences) has the option of choosing two subjects out of Chemistry, Biology and Mathematics. Nevertheless, there are communities that make some subjects compulsory depending on the branch of knowledge opted for. This occurs in Andalusia, the Canary Islands, the Community of Valencia, Galicia and the Balearic Islands (shown in Table IV).

The specific autonomous community or university regulations propose a series of assessable content for the test with a specific programme, which refers to the *bachillerato* educational level in all the communities or universities, except Extremadura. In this community, the knowledge required for the test is compulsory secondary education (Official Gazette of Extremadura, 2015).

Concerning choice within the test, different types are observed: choice between two exams, choice of questions within the same exam, and no choice (Table V). There is also diversity in the choice of questions: free choice among those available (Andalusia, Navarre or the Community of Valencia), two options in one of the questions, while the others are compulsory (Catalonia or the Basque Country) or choice of questions of a certain type, as occurs in the Canary Islands, where there is a choice between essay questions and short-answer questions.

TABLE V. Choice and number of questions in the test by community

Community	Choice	Number of questions	Main aspects
Andalusia	Questions	6	They must choose three out of the six questions asked.
Aragon	Tests	5	They must choose one out of two exam options.
Asturias	Tests	5	They must choose one out of two exam options.
Balearic Islands	No choice	4	
Basque Country	Questions	5	They can only choose between two options in the first question.
Canary Islands	Questions	ULL: 21 and UPGC: 35	They can select from certain question types. Only essay or definition questions.
Cantabria	No choice	4	
Castilla-La Mancha	Tests	28	They must choose one out of two exam options.
Castilla-Leon	Tests	5	They must choose one out of two exam options.
Catalonia	Questions	4	They can only choose between two options in the first question.
Community of Valencia	Questions	8	They must choose five out of the eight questions asked.
Extremadura	Tests	2	They must choose one out of two exam options. Every exam in Health Sciences contains three questions, two on Biology and one on Chemistry.
Galicia	No choice	20	
Madrid	Tests	5	They must choose one out of two exam options.
Murcia	Tests	5	They must choose one out of two exam options.
Navarre	Questions	4	They must choose two out of the four questions asked.
Rioja (La)	No choice	10	

Source: Own

Concerning the test question types (Table VI), there are three autonomous communities where only essay questions are set (Cantabria, Navarre and Asturias). Only two communities set multiple-choice questions (Canary Islands and Castilla-La Mancha) and only Galicia sets

true or false questions together with essay, short-answer or labelling questions. The other communities generally set short-answer, essay or labelling questions.

TABLE VI. Question types in the test by community

Community	Question type				
	Multiple-choice	True/false	Labelling	Short-answer	Essay
Andalusia					
Aragon					
Asturias					
Balearic Islands					
Basque Country					
Canary Islands					
Cantabria					
Castilla-La Mancha					
Castilla-Leon					
Catalonia					
Community of Valencia					
Extremadura					
Galicia					
Madrid					
Murcia					
Navarre					
Rioja (La)					

Source: Own

Biology topics set in the tests

Topics related to biomolecules and to cell structure and physiology are common in all the autonomous communities (biochemistry and cells, Graph II). While the topic of biochemical structures varies across the communities, the topic of cells is observed to occur highly frequently in all of them. The latter is a category including numerous aspects, such as cell structures, metabolism, communication or reproduction processes, in which the importance of the questions is distributed more or less uniformly. Questions on the following are observed:

- 1) cell structures, how to identify cell organelles and specify their main functions, comparing the differences between an animal and a plant cell;
- 2) cell reproduction, for example identifying in an image whether it is mitosis or meiosis and naming its phases or comparing the differences between mitosis or meiosis; and
- 3) cell metabolism with questions that ask candidates to define catabolism and anabolism, to identify where the main processes of photosynthesis occur in the cell, to describe the catabolic process of glucose in aerobic conditions as a whole.

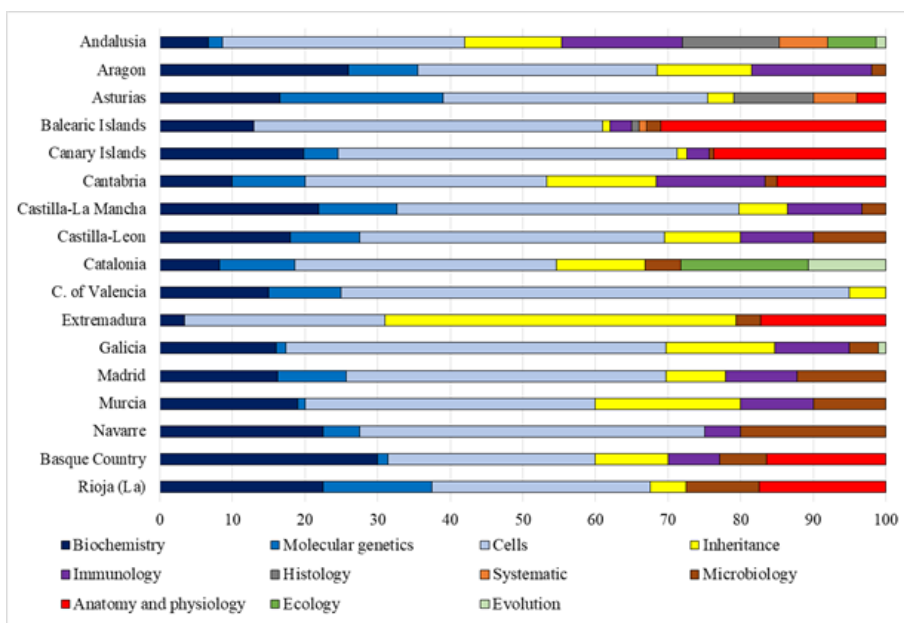
Conversely, there are hardly any questions on processes related to membrane transport or cell communication.

Molecular genetics, inheritance, microbiology and immunology are topics set in most of the autonomous communities. Questions associated with molecular genetics are extremely important in Asturias (22%), while no questions are set on this topic in Extremadura or La Rioja. In general, they include questions asking for a description of transcription, translation or replication processes, or a sequence of DNA nucleotides is given and candidates have to use it to predict either the mRNA chain that would form (considering extremes), or the sequence of amino acids in the protein that would be synthesised from this fragment. In contrast, questions on inheritance are especially important in Extremadura (48.27%) and are only associated with Mendelian genetics problems based on the inheritance of a single character. Immunology is extremely important in Aragon (16.5%), where various types of questions are set on vaccinations, cells involved in the immune response or the possible immunological implications of transplants. Lastly, microbiology and its applications are generally not as important in all the communities, with most importance placed on them in Navarre (20%) and Madrid (12.2%), where there is generally a question related to the applications of microbiology in industry. In the other autonomous communities where microbiology questions are set, they generally refer to the structure of viruses, of bacteria or to the cycles of a bacteriophage.

Questions on anatomy and physiology are included in seven autonomous communities and appear quite frequently (15–24%). In all cases, except the Balearic Islands, all the questions refer to human rather than animal anatomy and physiology. Differences between the exams set at the Canary Islands universities are observed in this topic. While the

University of La Laguna (ULL) offers another specific test called Applied Anatomy, the University of Las Palmas de Gran Canaria (UPGC) does not. This means questions on anatomy and physiology are only present in the latter, with a high percentage (35.5% out of the total number of questions at UPGC).

GRAPH II. Frequency with which Biology topics appear by autonomous community



Source: Own

Questions on both plant and animal histology and on the classification of living organisms are set in three communities: Andalusia (13.3% and 6.6%, respectively) Principality of Asturias (11% and 6%) and the Balearic Islands (1% and 1%). In general, the listing and functions of the main tissues (both animal and plant) are required for the former, and the main characteristics of kingdoms for the latter.

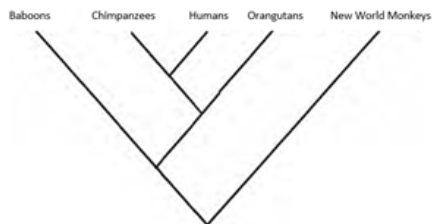
The minority topics are ecology and evolution. Although some communities indirectly ask questions related to evolution when referring

to mutations, they have not been considered in this category as they allude to the consequences of mutations and are based on questions requiring their classification. In Catalonia, a high percentage of the questions are associated with ecology (17.5%) and they are very varied (food webs, succession, global concepts such as ecological niche, population, ecosystem, and so on). Furthermore, some of the questions are based on a daily context, an aspect barely covered in other autonomous communities. Andalusia also sets questions related to ecology (6.7%), focused mainly on defining concepts. The evolution category is found in questions in Catalonia (10.7%), and to a lesser extent in Andalusia (1.3%) and Galicia (1%). Some of the questions Catalonia sets concern aspects related to evolution: phylogeny, Neo-Darwinist theory, fixist theories (see an example in Graph III).

GRAPH III. Example of a question on Evolution (CAT201610B)

Charles Darwin shook the foundations of the society of his time with his important and influential works, including *On The Origin of Species*, published in 1859, and *The Descent of Man*, published in 1871. In these works, Darwin links the origin of man with that of other species.

- a) In colloquial language, it is often said that ‘the human species descends from apes’, which could lead us to think that we come from current apes, such as the chimpanzee or the orangutan. Observe the following genealogical tree and explain in a reasoned and justified way whether it is true that the human species descends from chimpanzees or orangutans. [1 point]



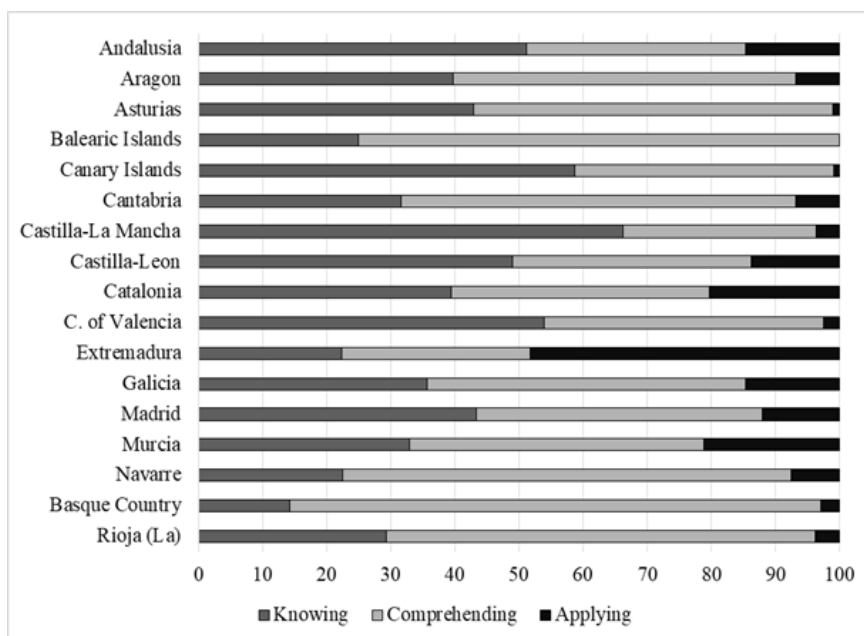
- b) Darwin's main contribution to the theory of evolution is the concept of *natural selection*. Explain its significance. [1.5 points]

Source: Translated from http://universitats.gencat.cat/es/que_puc_fer/25_anys/models_examen/

Cognitive demand type in the questions

The examples shown in relation to the topics included in questions in the PAM25 Biology test hint at the type of cognitive demand they entail. As seen in Graph IV, questions related to the application of knowledge are minority in general. Nevertheless, there is an exception: Extremadura. In this case, out of the three questions asked for the two test options in all the exams set for Health Sciences, two generally correspond to biology content, and one question is always asked on Mendelian genetics problems in all of them (48.3%). This type of problem requires candidates to understand concepts such as autosomal inheritance, sex-linked inheritance, genotype or phenotype and use them to predict the phenotype or genotype of descendants. This means they have been categorised as knowledge application questions ('applying', Graph IV).

GRAPH IV. Frequency with which cognitive demand type appears by autonomous community



Source: Own

In the other autonomous communities, most of the questions categorised within the 'applying' category often correspond to Mendelian genetics problems. Nevertheless, questions are also observed on the structure of biomolecules, molecular genetics, cell membrane transport or immunology, which involves a certain transfer of knowledge, although they are generally in the minority.

The communities with more varied topics in application questions are Andalusia and Catalonia. Furthermore, in the case of Catalonia, as commented above, a contextualised question is always set, and more often than not one of its sections is the application type (Graph III).

Questions related to the 'knowing' category are in the majority in five autonomous communities (Andalusia, Canary Islands, Castilla-La Mancha, Castilla-Leon and Community of Valencia); in the others, except for the abovementioned Extremadura, 'comprehending' questions are in the majority.

Questions associated with the 'comprehending' category include topics requiring processes to be described or explained, examples to be provided or comparisons to be made. One of the questions frequently set in many autonomous communities is related to comparing DNA and RNA. Although most of the questions on anatomy and physiology are in this category, its topics still vary greatly.

Requiring definitions on different topics is present in most of the autonomous communities. Furthermore, in some of them, for example Catalonia, Castilla-La Mancha, the Canary Islands and the Balearic Islands, one of the exam sections always corresponds to the definition of three or four concepts. Other questions in the 'knowing' cognitive demand concern identifying structures. They are frequent in most of the communities, and they are explicitly included as a question type in all the exam sessions in Galicia and Castilla-La Mancha, associated with the 'labelling' question type.

The topics for this type of question, related to the 'knowing' category and requiring the identification of images, are varied. They are generally associated with topics on cells, biochemistry, molecular genetics and cellular reproduction and, in some cases, immunology. The definitions form a wide range covering all the topics.

Conclusions

The Biology exercise in university access for the over-25s in Spain has barely been explored in the educational literature. When Escudero (1983) assessed the examination taken at that time, he highlighted both differences at universities and the excessive specification of some of its contents. Since then, regulations for this examination have changed and this study has attempted to outline the current situation of the Biology exercise in the Spanish context.

The comparison between the analysis dimensions related to the examination structure, Biology topics and cognitive demand has helped to better understand its current features and the similarities and differences between the autonomous communities.

Globally, similarities are observed between the communities in the Biology test structure, such as the branches of knowledge it is linked to or the features of the examination structure. Nevertheless, there are some noteworthy differences: 1) Extremadura continues to set an exam structure similar to that set at other universities before 2003, in which the specific phase included only one exercise with several questions on a variety of subjects associated with the branch of knowledge the candidate had opted for; 2) differences are observed between the universities in the Canary Islands related to the presence of different subjects to choose from in the specific phase; 3) concerning the type of questions, in general essay, short-answer and labelling questions are set and some communities, such as the Canary Islands or Castilla-La Mancha, that set multiple-choice questions, perhaps with the intention of covering more content.

In the context of the university entrance examination and the *bachillerato*, Alda (2015) stated that covering all the topics in the *bachillerato* syllabus was complicated given the low number of questions set. Every autonomous community, together with the universities, is responsible for deciding the assessable content of the PAM25, which is why differences in the topics covered in their questions can be observed.

Noticeable differences can be seen in the research purpose related to the test topics in the communities. Microscopic aspects related to the structure of biomolecules or cell characteristics are found in all the communities. However, there are biological topics such as histology, classification of living organisms, anatomy and physiology, ecology and

evolution that are set in very few communities. The PAM25 is a free external examination in which no other associated subjects are set to cover biological topics for the Science and Health Sciences branches of knowledge. Only the University of La Laguna sets Applied Anatomy as a specific separate and compulsory test for Health Sciences.

This makes it hard to select the biological topics that could prove essential in the future education of people taking this test. Surely a candidate wishing to study a nursing degree should be assessed on topics related to human anatomy and physiology, while to study a Biology degree, knowing basic aspects related to ecology or evolution would be relevant.

Knowing ‘the details’ (molecular genetics, cells) is necessary to understand ‘the big picture’ (ecosystems, how the human body works) (Gil-Quílez and Martínez-Peña, 2013). However, lack of knowledge of the macroscopic biological organisation levels makes it hard to transfer microscopic knowledge to macroscopic knowledge, and that is a problem the over-25s may face when they access certain university degrees.

This problem is not only observed in the analysed context as something similar happens at a syllabus level in the *bachillerato*. ‘In the second year, biology is actually biochemistry and cell molecular biology with some appendices on immunology and applied microbiology’ (González-García and Rivas, 2016, p. 256) and this is what is usually included as assessable subjects in the Biology tests associated with the ordinary access (Alda, 2015). However, other subjects (for example Applied Anatomy) in both the first and second year of the *bachillerato* cover these topics, although only partially (González-García and Rivas, 2016).

These results open the door to issues related to the characteristics of the people accessing university studies via the PAM25. Which degrees do they mostly choose in Science and Health Sciences? What is their previous academic baggage? Previous studies highlight that only 50% of the students sitting this exam had at least the secondary education qualification (Requejo and Caballo, 2001), with many of the people opting to follow studies linked to Health Sciences choosing degrees such as nursing, occupational therapy or medicine (Casa de la Mujer, 2012). However, they would have to take new updated studies.

Concerning the objective associated with the analysis of the cognitive demand behind the questions set in the examination, the low number of questions involving transfer of knowledge is striking. Furthermore, most

of these questions are related to Mendelian genetics problems in many autonomous communities. In the context of Chemistry questions, Smith *et al.* (2010) categorised questions involving the ‘application’ of previously systematised procedures as algorithmic questions rather than application questions. Many classified as ‘application’ in the categorisation in this study may in actual fact be ‘algorithmic’ questions. In addition, Crowe *et al.* (2008) clarify that if the questions have been ‘practised’ beforehand, they would become memorisation questions. Consequently, the genetics problems set, and even the questions on molecular genetics, could fall into this category.

Given this situation, how do the adults sitting this exam prepare for it? And, in the case of the Biology exercise, how does this education take place: autonomously, at adult centres or at academies? The assessment determines what and how students learn (Sanmartí, 2007). Consequently, perhaps there should be a new approach to the question types in the PAM25 so that students are forced to interpret data, discuss and predict results scientifically. This aspect does not necessarily involve more complexity in the examination (Franco-Mariscal *et al.*, 2015), but a way of preparing that is more in tune with the development of scientific skills and critical thinking (Sanmartí, 2007) on biological aspects that help people successfully complete their future university studies.

The autonomous communities with the most variety of topics in their questions with high cognitive demand in the exercise are Andalusia and Catalonia. The latter always sets a contextualised question that often involves outlining arguments and making predictions based on them. One aspect we also consider important is establishing contextual situations in the questions (based on either the present scientific-social situation or the history of science). This allows adults sitting this test to link biological knowledge with the socio-scientific or historical context of Biology. Consequently, not only can it serve as an assessment tool of the test candidates’ maturity, but also as a way of introducing aspects related to the nature of science through Biology, thus affording these adults a less stereotypical view of science.

This study has attempted to provide an overview of the characteristics of the Biology test in the context of the PAM25 and its situation in the autonomous communities. We are aware of the limitations arising from the difference in the number of examinations selected for each community as well as the difficulty related to the comparability of the data

in view of specific autonomous community regulations. However, criteria relating to the implementation date of current regulations have dictated the choice of the sample. As a result, this study could be extended by taking examinations prior to 2015 as a reference, an aspect that would make it possible to assess changes in the test in recent decades and their relationship to changes in its regulations.

Adults in our current society must not only have a good grasp of knowledge enabling them to deal with everyday problems. They must also learn to adapt dynamically to changes in society, which makes continuing education important for several reasons, which are related to work, life, culture and education (Rodríguez and Díaz, 2008). University access for the over-25s open the door for adults onto lifelong learning, and that is why it must be constantly assessed and reviewed in the same way that ordinary university access is studied (Lorenzo et al., 2013).

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