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Problems-based learning for teaching forensic anthropology in High School

Aprendizaje basado en problemas para enseñar antropología forense en educación secundaria

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Abstract

Growing interest in Criminology degrees over the past few years is mainly due to various television series on forensic matters. These programs have created a distorted image of forensic anthropology which has led not only to an increase in the number of degree applicants but also, in many cases, disappointment among students regarding the course contents. Consequently, knowledge of forensic anthropology in pre-university environments involves designing educational innovation projects with active methodologies that manage to train students in the essential areas of this discipline and in the tasks performed by forensic anthropologists. This work presents the results of an educational innovation proposal, based on Problems Based Learning (PBL), implemented among students to assess the effectiveness of PBL in the learning of forensic anthropology. In a workshop, students work as anthropologists for a day, applying forensic methods and techniques to identify several individuals by determining their stature, gender and age. The results show that PBL encouraged a motivating environment and significant and collaborative learning to determine the identity of the individuals, and more advantageous acceptance is perceived of the method and workshop techniques both by the participants and by teachers in the school.

Keywords: physical anthropology, criminology, teaching methods, activity learning, educational innovations, secondary education.

Resumen

El creciente interés por el Grado en Criminología en los últimos años se ha debido principalmente a la emisión de series con temas forenses. Estas han generado una imagen distorsionada de la antropología forense que se ha traducido principalmente en un aumento del número de discentes en el grado y, en numerosos casos, en una decepción por los contenidos del itinerario formativo. Por ello, el conocimiento de la antropología forense en la etapa preuniversitaria requiere diseñar proyectos de innovación educativa con metodologías activas que logren formar al alumnado en las áreas esenciales de esta disciplina. Este trabajo presenta los resultados de una propuesta de innovación, basada en el Aprendizaje Basado en Problemas (ABP), implementada en los cursos de tercero y cuarto de educación secundaria con el objetivo de evaluar la eficacia del ABP en el aprendizaje de la antropología forense. El alumnado se convierte en antropólogos por un día aplicando métodos y técnicas forenses para identificar varios individuos a través de la experimentación y determinación de la estatura, el sexo y la edad. Los resultados del estudio muestran que el ABP fomentó en el aula un ambiente motivador, colaborativo y un aprendizaje significativo para establecer la identidad de los individuos; así como se percibió una aceptación muy favorable del método y las técnicas del taller por parte de los participantes y el profesorado.

Palabras clave: antropología física, criminología, método de enseñanza, aprendizaje activo, innovación educacional, enseñanza secundaria.

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1. Introduction

Forensic anthropology is defined by the American Board of Forensic Anthropology (2018) as "the science application of physical or biological anthropology in the legal process." This science tries to identify skeleton or semi-skeleton human skeletal remains in order to clarify the causes of death through methods and techniques of archeology and biological anthropology (Turner and Selva, 2020). This is carried out in relation to the investigation of judicial cases associated with crime, causes and circumstances of death such as pathologies, injuries, etc., trying to determine age, height, body proportions, sex, human traits and racial affiliation (Anadón and Robledo, 2010). The forensic anthropologist tries to reconstruct the entire process *antemorten*, *perimorten* and *postmorten* with the help of other scientific disciplines, since it is a multidisciplinary science that combines different disciplines such as biological anthropology, criminology, anthropology, and archeology in order to exhume and identify human skeletal remains.

Since the end of the 20th century, forensic anthropology has received greater attention from public agencies for its important contribution in the exhumation and identification of disappeared people (Rodríguez, 1994). The popular interest in this science, however, is more recent and has been mainly due to the broadcasting of series on television and on the platforms or *streaming* with forensic themes (McManus, 2010). The success of these programs seems to be a consequence of the complex cases they investigate and the ability of their protagonists to solve virtually any question. This has generated a distorted image of forensic anthropology (Sosa, 2017) and a growing interest in the Degree in Criminology that, in recent years, has increased the number of students (López, 2018).

The knowledge of forensic anthropology and the role of forensic anthropologist in the pre-university environment requires designing and implementing educational innovation strategies that allow students to learn the areas of knowledge that are essential in this science, and provide sufficient criteria for the distinction between reality and fiction of the work of forensic anthropologists and the own limitations of anthropological science.

The active methodologies for teaching forensic anthropology and criminology in high school students have yielded very positive results in relation to evidence collection, experimentation and collaborative work (Vallejo *et al.,* 2005, 2007), gamification (Carrillo *et al.*, 2018), role-playing (Sebastiany *et al.*, 2013), case methods (Núñez, 2015, 2016; Núñez and Rodríguez 2020) and Problem Based Learning (PBL) (Kousen and Vargas, 2021), among others, as an alternative to traditional methods.

The PBL is a constructivist methodology that promotes reflective, critical, and open learning based on the complexity of knowledge, making teachers in the classroom cooperate in different tasks, through reflection and negotiation with the aim of obtaining a final product that provides a solution to a problem or challenge (Schwartz, 2013).

The use of the PBL allows students to acquire knowledge to solve a real or fictitious problem. It is an active methodology in which students collaborate to build their own knowledge through real-life problems (Moust *et al.*, 2021).

Studies based on the PBL confirm that students using this method show an improvement in learning compared to traditional teaching or master class (Aidoo *et al.,* 2016). The PBL promotes a comprehensive education, which favors the development of positive values such as affectivity, facilitates student participation, generates an environment of trust and mutual respect and enhances the ability to analyze contexts and realities contributing to the acquisition of critical thinking and the integral formation of citizens (Basilotta and García-Valcárcel, 2019). It is therefore a methodology in which students must solve the problem posed by teachers through research and reflection.

Therefore, the PBL is conceived as the most favorable active methodology for teaching and learning forensic anthropology. Choosing a learning strategy and designing a project based on real cases can allow positioning students in situations that allow them to understand the importance of the research work, either individual or collective, of forensic anthropologists. The project contemplates activities that stimulate different attitudes in the student: from observation to the manipulation of bone elements, from curiosity to interrogation and inquiry, from reasoning to experimentation and trial and error (Sebastiany *et al.,* 2013). The combination

of these attitudes encourages students to develop skills related to analysis, understanding, communication and creativity and contributing to the acquisition of skills and abilities to achieve a comprehensive education in the individual according to the 21st century (Pérez and Beltrán, 2014).

This paper presents the results of an educational innovation proposal based on the PBL, implemented in students of third and fourth Compulsory Secondary Education (ESO) in a high school in the Community of Madrid, as a didactic strategy for teaching and learning basic knowledge of forensic anthropology and the work performed by forensic anthropologists. Therefore, the main objective of this research is to evaluate the effectiveness of the PBL methodology in the teaching of forensic anthropology. The achievement of this main objective additionally enables the following specific objectives:

- Introduce the students to the knowledge of forensic anthropology.
- Teach students to identify the main bones of the human skeleton and to recognize and learn their most basic functions.
- Learn the information provided by the main bones of the human skeleton for recognizing and identifying people.

2. Methodology

This educational innovation proposal has been designed to be implemented in the subject of biology, part 4, people and health, with the students of third grade of the ESO (Royal Decree 1105/2014, of December 26); although this can be implemented in other educational levels as fourth of the ESO or first of Baccalaureate (Fernández-Laso *et al.*, 2022).

The proposal is to teach forensic anthropology in a criminal investigation. In other words, it seeks to promote the analysis and evaluation skills in the different expert actions in human identification in a criminal investigation. To do this, the design of the proposal has been based on the biological tetrahedron (age, sex, height and ancestry) and antemorten information described by Núñez and Rodríguez (2020) (table 1).

Table 1. *Bioanthropological tetrahedron for postmortem identification of individuals in forensic anthropology*

Concept	Method	Techniques
Age	Thorough visual inspection of tooth development, emergence, and replacement	Observation of morphological changes or degeneration of bones in the joint
Gender	Analysis of the morphological characteristics of the skull and pelvis. The most robust and largest segments are male, while the most graceful and smallest segments are female.	Size and robustness using formulas to identify sexual dimorphism and corpulence indexes
Ancestry	Craniofacial variations (nostril and orbits), and tooth patterns and postcranial skeletal morphology	It is classified into leukoderms, xanthoderms, and melanoderms
Height	Total length of long bones	Broca´s Osteometric table according to ancestral pattern and sex.

Note. Own elaboration from Núñez and Rodríguez (2020).

The educational innovation project has been conceived from a qualitative and quantitative approach to design a proposal based on empirical research that analyzes, through PBL, a fictitious or real case with information that can be analyzed qualitatively and quantitatively in relation to the findings of some bone remains (Fernández-Laso *et al.*, 2022). This type of methodology and its resolution degree depends on the role of the teacher, who goes from transmitter to enhance a participative attitude of the student and his reflective capacity on the achieved learning. To do this, it is necessary to design a proper pedagogical project that connects the problem with a real context that arouses the interest of the students and leads them to make justified decisions (Poot-Delgado, 2013).

2.1 Sample

The present proposal was carried out at the Francisco de Goya High School (IES) in Madrid, with a sample consisting of 11 third (six students and five students) and 10 fourth (seven students and three students) of the ESO. The students were selected by the school's management based on criteria based on final grades and in accordance with the Covid-19 prevention measures established by the Community of Madrid for the 2020-2021 academic year. In addition, the workshop was evaluated by three teachers from the center present during its development and who teach subjects related to the specialty of Biology and History (one and two teachers, respectively).

2.2 Procedure

The workshop was held on June 16, 2021 in the Natural Sciences and Biology Laboratory of the IES.

The center provided all the necessary resources for its conduction: fact sheet with the news, knowledge sheets, police, anthropological and expert (figure 1), replicas of bone remains, osteometric table to measure long bones and the rubrics of self-assessment of teachers and evaluation for teachers (tables 2 and 3).

The workshop was conducted first with third and then with fourth grade students, lasting approximately two hours. The workshop began with a PowerPoint presentation that explained basic ideas on forensic anthropology; the workshop was subsequently conducted in different phases.

2.3 Problem Presentation

Students were presented with a recent news story in Cerdido (A Coruña, Spain) and published by Europa Press:

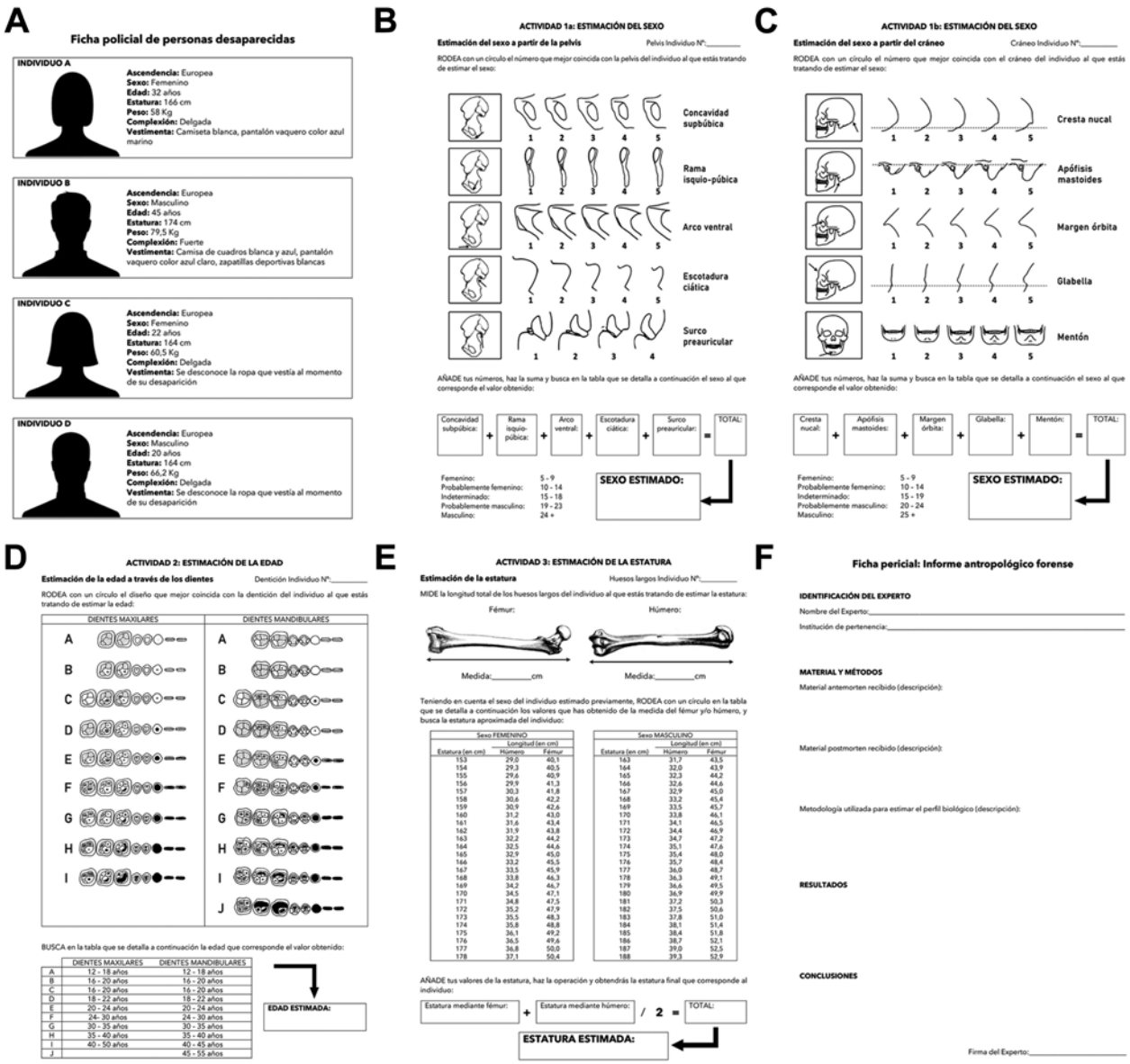
- Bone remains of a human body were found late Wednesday afternoon, August 26, in A Casanova, belonging to the parish of A Barqueira, in the municipality of Cerdido (A Coruña).
- During the morning of this Thursday, it is expected that agents of the Scientific Police and Judicial Police of the Civil Guard in addition to forensics will travel to the place, which is sealed, to proceed with the removal of the remains and try to determine their identity.
- After the discovery, speculation about the body's identity began in the area. Some sources consulted shuffle that it may be Yago de la Puente, the young man from A Coruña whose track was lost on July 14, 2019 when he returned from the International Celtic World Festival of Ortigueira.
- He was last seen at Piggy Station. After his disappearance, several search forces were deployed on several occasions, involving the Civil Guard and Civil Protection, as well as family and friends, although they were unable to find his whereabouts. It is less than two kilometers away from the train station of Cerdido to the place where the skeletal remains have appeared. (27 August 2020)

And they were asked to collaborate as forensic anthropologists so that they could recognize the identity of the skeletal remains.

2.4 Phase 2: gathering background knowledge

At this stage, each student was provided with an anonymous "knowledge sheet" intended to determine the degree of knowledge they had about bones and their usefulness in the identification process. This file consists of six images accompanied by two questions each. The 12 questions are multiple choice. The first six items per image provided information on the identification of skeletal remains represented in each of the images and the remaining six items collected information on the potential information that each of the skeletal elements can provide in the personal identification process. In these images, the student should circle the name of the bone he considers shaded and the anthropological usefulness. For evatuating pre-workshop knowledge, the answers to the items mentioned above were re-coded in a dichotomous way (correct/incorrect answer).

Figure 1. *Tabs provided to students for conducting the workshop*



Note: A: Police record; B and C: Sex estimation record; D: Age estimation record. E: Information sheet for estimating height; F: Information sheet. Elaboration from Fernández-Laso et al. (2022).

2.5 Phase 3: Construction of the "Anthropological Puzzle"

In phase 3, students were randomly divided into four working groups of two or three people, and the different bones were explained to know their value at the anthropological level. To do this, each group was given a bone sample belonging to the same person; this consists of a skeleton cranial (a skull and a jaw) and postcranial (a humerus, an ulna and a radius, a pelvis, a femur and a tibia). If the center of the bone elements is not available, they can be replaced by images.

In addition, each group received a "police record" with the physical characteristics of the 4 missing people (figure 1A); an "anthropological record" with the main differences and tables used in forensic anthropology to identify a person (figure 1B-E); and a

final "expert record" to make an expert report determining the anthropological identification of the bones they had (figure 1F). Thus, each group had to identify to which individual in the "police record" the assigned skeletal remains belonged. At this stage the teacher should act as a guide.

2.6 Phase 4: Solving the "anthropological puzzle"

In phase 4, the different groups explained in an argumentative way, to which individual they believed the bone remains analyzed belonged. In the case of coincidences in the same identification between two or more groups, a debate should be initiated between the different coincident groups and the teacher should help them to verify the anthropological characteristics of each bone through questions that guide the students to clarify the bone identifications. Finally, the identification of all individuals was completed, the news was resumed, and a scientific debate was held in the assembly as "anthropologists" on the relevance of the work of forensic anthropologists.

2.7 Phase 5: Post-workshop data collection

In phase 5, each student re-filled the "knowledge sheet" to obtain the assessment and reflection of the students on the workshop held. The post-workshop evaluation was re-coded in a dichotomous way (correct/incorrect).

2.8 Phase 6: Students' perception of the workshop

In phase 6, participants completed a self-assessment rubric designed to encourage reflection on their own learning (table 2) so that they could assess their knowledge of the subject matter and, consequently, explore the possibilities of improving the workshop (Reddy and Andrade, 2010).

Table 2. *Self-assessment heading*

Evaluation criteria	1 Bad	2 Average	3 Good	4 Very good
I know the roles of a forensic anthropologist.				
I recognize the main bones of the human skeleton.				
I am able to use every bone to determine every single anthropological parameter.				
The tables provided can be used correctly.				
I am able to think and argue coherently.				
I recognize the importance of positive identification.				
I can identify the actual cases in which the forensic anthropologist's action is necessary.				

Note. Fernández-Laso et al. (2022).

2.9 Phase 7: Teachers' perception of the workshop

Finally, an assessment rubric was given to the teachers attending the workshop (Table 3).

The purpose of the rubrics in these last two phases was to: 1) facilitate the definition of the main aspects to evaluate and the relevance given to each of them; 2) allow students to reflect on what they have learned. For this purpose, it is essential to identify the objectives of the activity and establish evaluation criteria; explain to the student what objectives are pursued in the workshop, how it will be carried out and what criteria will be evaluated; and finally, analyze with the student the qualification obtained by these students and the one given by the teacher (Fraile *et al.*, 2017).

Table 3. *Heading of teacher evaluation*

Evaluation criteria	1 Average	2 Good	3 Very good	4 Excellent
The activity improves the contents explained in class.				
The activity is related to real cases.				
The activity is dynamic and novel.				
The duration of the activity is adequate.				
The materials provided are suitable for the activity.				

Note. Fernández-Laso et al. (2022).

2.10 Statistical Analysis

Descriptive analysis techniques and nonparametric statistical techniques were used in the statistical analysis of the data obtained. Descriptive analysis was performed to determine the characteristics of the study sample (mean, standard deviation and percentage). The comparison of students' knowledge between pre and post-workshop was performed using the McNemar test (also known as paired chi-square or paired data).

The McNemar test is applied to 2×2 contingency tables with dichotomous traits, with paired pairs of data, to determine whether the marginal row and column frequencies are equal, i.e., whether there is "marginal homogeneity". Note that McNemar test calculations focus on discordant pairs and ignore concordant pairs. More specifically, the test is a relationship between the squared difference in discordant frequencies relative to total discordant frequencies. In this case, the test has been used to verify the existence of differences in dichotomous data (correct/incorrect answer) before and after the participation of the students in the learning workshop, i.e., to evaluate the effectiveness of the developed workshop.

To assess students' perception of competency-based learning, the *U*-Mann-Whitney analysis was performed for ordinal qualitative variables. This test allowed us to assess whether there are differences in the proportions of each category observed in two different groups.

All statistical analyzes were performed using IBM SPSS Statistics (version 25.0 for Windows), using a significance level of $p < 0.05$.

3. Results

The results are presented according to the learning of the teachers, the perception of the students and the evaluation of the teachers.

3.1 Effects of the workshop on students

The results of the pre- and post-workshop knowledge tests revealed increased competence of secondary school students after completing the learning workshop (Table 4). In third grade students, significant differences were obtained in the tasks related to the information that could provide the teeth, ribs, and skull in the personal identification processes ($p < 0.05$), while in fourth grade students this difference was limited only to the information that could provide the skull ($p < 0.05$).

In general, the students had good knowledge of human anatomy and did not find excessive difficulty to correctly identify and name the different skeletal elements (teeth, pelvis, ribs, femur, humerus, skull) ($p > 0.05$); however, although they understood the usefulness of some of the skeletal elements for the process of personal identification (pelvis for the estimation of sex, femur and humerus for the estimation of height) ($p > 0.05$), the participants acquired greater knowledge after the development of the workshop and improved their skills to understand the usefulness of the other skeletal elements during the forensic identification process workshop (teeth and ribs for age estimation, skull for sex estimation) ($p < 0.05$).

Table 4. *Statistical analysis of pre- and post-activity students' knowledge about the nomenclature of the different skeletal elements and its usefulness in providing information in the process of personal identification*

Group	n/N (%)											
	Task 1		Task 2		Task 3		Task 4		Task 5		Task 6	
	Name bone	Inf.	Name bone	Inf.	Name bone	Inf.	Name bone	Inf.	Name bone	Inf.	Name bone	Inf.
Group 1 (3RD ESO)												
Pre-activity	9/11 (81,8)	4/11 (36,4)	9/11 (81,8)	10/11 (90,9)	11/11 (100)	1/11 (9,1)	8/11 (72,7)	9/11 (81,8)	5/11 (45,5)	7/11 (63,6)	10/11 (90,9)	4/11 (36,4)
Post-activity	11/11 (100)	11/11 (100)	11/11 (100)	11/11 (100)	11/11 (100)	7/11 (63,6)	11/11 (100)	10/11 (90,9)	8/11 (72,7)	9/11 (81,8)	11/11 (100)	11/11 (100)
McNemar test	0,500	5,143	0,500	0,000	N/A	4,167	1,333	0,000	1,333	0,250	0,000	5,143
p-value	0,500	0,016*	0,500	1,000	N/A	0,031*	0,250	1,000	0,250	0,625	1,000	0,016*
Group 2 (4° ESO)												
Pre-activity	10/10 (100)	7/10 (70,0)	10/10 (100)	8/10 (80,0)	10/10 (100)	0/10 (0)	9/10 (90,0)	10/10 (100)	5/10 (50,0)	6/10 (60,0)	9/10 (90,0)	0/10 (0)
Post-activity	10/10 (100)	10/10 (100)	10/10 (100)	10/10 (100)	10/10 (100)	2/10 (20,0)	10/10 (100)	9/10 (90,0)	8/10 (80,0)	4/10 (40,0)	10/10 (100)	9/10 (90,0)
McNemar test	N/A	1,333	N/A	0,500	N/A	0,500	0,000	0,000	0,800	0,250	0,000	7,111
p-value	N/A	0,250	N/A	0,500	N/A	0,500	1,000	1,000	0,375	0,625	1,000	0,004*
Groups												
combined	19/21 (90,5)	11/21 (52,4)	19/21 (90,5)	18/21 (85,7)	21/21 (100)	1/21 (4,8)	17/21 (81,0)	19/21 (90,5)	10/21 (47,6)	13/21 (61,9)	19/21 (90,5)	4/21 (19,0)
Pre-activity	21/21 (100)	21/21 (100)	21/21 (100)	21/21 (100)	21/21 (100)	9/21 (42,9)	21/21 (100)	19/21 (90,5)	16/21 (76,2)	13/21 (61,9)	21/21 (100)	20/21 (95,2)
Post-activity	0,500	8,100	0,500	1,333	N/A	6,125	2,250	0,250	3,125	0,125	0,500	14,063
McNemar test	0,500	0,002*	0,500	0,250	N/A	0,008*	0,125	1,000	0,070	1,000	0,500	0,000*
p-value												

Note: Info, information; N, number of students participating; n, number of students correctly answering questions; %, percentage of students correctly answering questions; N/A, statistical test not applicable. *Significance level for $p < 0.05$.

4.2 Perception of students

The results revealed the high perception of third and fourth grade students on their learning (Table 5). Thus, while the third grade students showed a greater perception of learning in the competence related to the functions of the forensic anthropologist ($p < 0.05$), the fourth grade students showed a greater perception of learning in two competences: the one related to the importance of carrying out an identification process on skeletal remains and the one related to knowing how to identify the real cases in which the action of the forensic anthropologist is necessary ($p < 0.05$).

Table 5. *Perception of students' competency-based learning*

Groups	Competencies														
	C1			C2		C3		C4		C5		C6		C7	
Group	*N*	*M*	*DE*	*M*	*DE*	*M*	*DE*	*M*	*DE*	*M*	*DE*	*M*	*DE*	*M*	*DE*
Group 1 (3rd ESO)	11	2,45	0,522	2,82	0,405	1,82	0,751	3,00	0,632	3,09	0,944	3,73	0,467	2,18	0,603
Group 2 (4th ESO)	10	3,00	0,471	3,30	0,675	2,30	0,823	2,90	0,568	2,80	0,632	2,90	0,568	3,00	0,667
Groups combined	21	2,71	0,561	3,05	0,590	2,05	0,805	2,95	0,590	2,95	0,805	3,33	0,658	2,57	0,746
U Mann-Whitney test		28,00		32,50		38,00		50,50		44,50		17,50		22,00	
p-value		0,026*		0,057		0,191		0,704		0,432		0,003*		0,011*	

Note: N, number of students participating; M, mean; SD, standard deviation; Scale 1 (minimum), 4 (maximum); *Level of significance for $p < 0.05$; C1, I know the functions of the forensic anthropologist; C2, I identify the main bones of the human skeleton; C3, I know how to use each bone to determine each of the anthropological parameters; C4, I know how to use the tables correctly; C5: I know how to argue coherently; C6, I know the importance of making a positive identification; C7, I know how to identify the actual cases in which the forensic anthropologist is necessary.

4.3 Teacher evaluation of the workshop

The results revealed the good perception of the teachers about the learning of the students, scoring with the maximum value all the evaluated categories.

4. Discussion and conclusions

Active methodologies, such as the PBL, facilitate the learning and development of certain competencies through real or fictitious situations linked to the professional and social world, which allows preparing students for the current information society. The implementation of active methodologies requires the teacher to rethink, reorient and plan teaching, placing the student in the center as the protagonist of the construction of his own learning. This type of didactic strategies requires, at the same time, a correct choice of evaluation criteria (Medina-Díaz and Verdejo-Carrión, 2020).

The implementation of the workshop "Anthropological Puzzle: Who is Who?" has allowed us to observe that the PBL as a teaching strategy has had very positive effects on students for the learning of basic knowledge about forensic anthropology. During the workshop, the students perceived a positive attitude to all the activity. Indeed, the use of images and some bone elements in the resolution of the case allowed the students to immerse themselves in the knowledge of human anatomy used in anthropological surveys for determining sex, age and height. This type of active methodologies allows achieving an adequate and useful learning in criminology (Beltrán *et al.*, 2017; Núñez and Rodríguez, 2020).

The workshop allowed to detect that the students had good knowledge about human anatomy in general, showing less difficulties the fourth-grade students than the third-grade students when identifying bone elements and their usefulness in the forensic identification process. Probably, this is a consequence, in both courses, of the absence or scarce practical activities that teachers carry out due to the lack of time to address the curricular contents (Carrillo *et al.*, 2018). However, it can also be due to the stress involved in conducting these workshops with specialists outside the center. Therefore, when designing these didactic strategies, it is essential not to burden the student with excessive information but to try in an objective way to introduce the minimum theoretical and methodological contents necessary for an essential understanding in forensic anthropology (Fernández, 2015).

However, despite this, the results of the workshop show that its realization provided students with greater knowledge about human anatomy, both in the identification of anatomical elements and, more

specifically, in their usefulness during the forensic identification process. In both courses, the skills of analysis, identification, comprehension and usefulness of bones improved after the workshop. This may be related to the use of the PBL for teaching forensic anthropology (Sosa, 2017), since it favors that students have a positive willingness to learn significantly and even more so when the idea is to motivate students (Carranza and Caldera, 2018; Pérez and Beltrán, 2014) through the solution of a real and mysterious case.

Indeed, the implementation of a workshop related to a real problem, as well as the knowledge and application of current anthropological techniques contributes to develop two of the fundamental aspects to achieve meaningful learning, such as knowing the functionality of what is learned (Coll, 2014; Carranza, 2017) and getting students to participate in the activity (Carranza, 2017; Garcés *et al.*, 2016). In this way, it is possible to get these students involved in the learning process and achieve a meaningful learning.

The results show that this type of constructivist methodologies in which the student is placed in real situations of the forensic anthropologist or criminologist provides a greater knowledge and integration of forensic anthropology and reality (Carrillo *et al.*, 2018; Núñez and Rodríguez, 2020; Sebastiany *et al.*, 2013; Vallejo *et al.*, 2007). Likewise, this workshop based on PBL promotes the development of the capacities of observation, inquiry, representation and prediction, contributing to arouse interest, curiosity, creativity and the development of hypotheses and explanatory models (Carrillo *et al.*, 2018). In addition, the workshop promotes the development of critical thinking in students by generating a reflective process when looking for solutions to the case (Morales, 2018), favoring dialogue, debate and group discussion (Colorado and Gutiérrez, 2016); as well as promoting cooperation and teamwork and, therefore, interpersonal relationships (Vallejo *et al.*, 2007).

In relation to the perception of the students about the workshop, the results indicate that aspects related to functionality stand out in both courses, i.e., the ability to understand the importance of what they have learned and to know how they can use it. Therefore, one of the essential aspects referred to by Coll (2014) and Carranza (2017) to achieve meaningful learning is highlighted again. The student is able to recognize the importance of the collective, individual and research problem, which leads him to get involved in the problems of scientific research (Sebastiany *et al.*, 2013) and, therefore, to recognize the limitations of science and, at the same time, appreciate the idealization of criminology in the series (López, 2018). It also allows the State to detect and accept the possible existence of group conflicts, in which situations lead it to recognize the point of view of others and to value the importance of negotiating through dialogue, reflection and debate. These active didactic strategies for teaching identification of individuals in forensic anthropology promote meaningful and collaborative learning (Núñez and Rodríguez, 2020); and allow students to recognize individual differences that have their origin in body characteristics (height, age and physical and psychic differences), motivating tolerance towards difference (Vallejo *et al.*, 2007) and ethnic and cultural diversity.

Regarding the participating teachers, these results, although not representative for the scarce sample, highlight the need for evaluating the own activities to be carried out by teachers who have a broad knowledge of their subjects and who are involved in the constant search for new active teaching and learning strategies (Marcelo *et al.*, 2016).

Finally, although the number of participants in the workshop was reduced due to Covid-19, the results are consistent with those obtained in similar works (Carrillo *et al.*, 2018; Núñez and Rodríguez, 2020; Vallejo *et al.*, 2007). Therefore, the development of the proposal is considered a success for teaching and learning forensic anthropology in the students of the ESO. However, it is expected to be implemented in high schools with a wider sample to verify the feasibility of the project.

In conclusion, the development of this activity demonstrates that: 1) the PBL is a very suitable active methodology for teaching basic knowledge of forensic anthropology in secondary school students; 2) this active methodology allows students to check how knowledge of human anatomy is key to identify the identity of individuals and solve different issues in criminology; 3) provides basic knowledge in forensic anthropology to know the reality from the fiction of the forensic anthropologist's work; 4) reinforces the knowledge of human anatomy learned in the classroom by arousing their interest in an acti-

vity that favors meaningful learning and the development of certain competencies; 5) the workshop is values positively, both by students and teachers, due to its similarity with the cases developed in television series and *streaming* platforms and the reality performed by forensic teams today. In short, it provides them with practical knowledge about forensic anthropology and allows them a better choice of degree in their future university studies.

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