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SOME METHODS USED TO POTENTIATE SELF-LEARNING AND PEER TEACHING BY TOXICOLOGY STUDENTS.

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RESUMEN

Este artículo describe y comenta varios métodos que hemos diseñado y utilizado con éxito para potenciar el aprendizaje activo con nuestros estudiantes de Farmacia y Veterinaria, en la enseñanza de la Toxicología mediante estrategias cooperativas y de autoaprendizaje. El primero de los métodos que describimos es un trabajo en grupo en el que los estudiantes realizan un periódico toxicológico semanal o quincenal. Los otros dos métodos se realizan por los estudiantes, de forma individual. En uno, los estudiantes han de preparar un informe breve pero crítico, sobre un fármaco retirado del mercado debido a su toxicidad o sus reacciones adversas; en el otro, se le pidió a cada estudiante que trajese al laboratorio cinco sustancias tóxicas junto a una ficha toxicológica para cada uno y sobre los que debía realizar un breve presentación a sus compañeros. Cada una de estas actividades se recompensaba con puntos adicionales para la nota final de la asignatura. Asimismo, se discuten las principales ventajas y desventajas de cada uno de los métodos.

PALABRAS CLAVE: Autoaprendizaje, aprendizaje activo, peer teaching**,** toxicología**,** trabajos prácticos.

ABSTRACT

In this paper we describe and comment on several methods that we have devised and implemented successfully to potentiate active learning with both our Pharmacy and Veterinary Toxicology students, by means of cooperative and self-learning strategies. One of the methods we describe is a group exercise in which the students make up a weekly/fortnightly toxicology newspaper. The other two methods are more individualistic in nature. In one the students had to prepare a short, critical report on a drug withdrawn from the market because of toxicity or adverse reactions whereas in the other, each student was asked to bring to the laboratory five toxic items together with a written report on the toxicity of each and to give a short presentation on all or some of those items to their colleagues. Each of these activities was rewarded with extra points towards the final mark in the subject. Here we also discuss the main advantages and

disadvantages of each of the strategies presented.

KEYWORDS: active learning, self-learning, peer teaching, toxicology, practical work.

INTRODUCTION

Many theories have been proposed to explain how we learn, but it was probably Carl R. Rogers who clearly proposed that experiential learning was important in acquiring applied knowledge. This is in contraposition to cognitive learning, which would refer to a more academic learning, such as vocabulary, arithmetic, etc. (Rogers, 1969). It was however, some years earlier that this author began reflecting about student-centered teaching, stating for example that "we cannot teach another person directly; we can only facilitate his learning" (Rogers, 1951). Knowles formulated in 1973 andragogy theory which maintains, that in adults learning focuses more on the process and less on the content that is being taught, and as a consequence, experiential learning has a central value to this learning model (Knowles, 1984; 1990). These two theories and others such as those of Jung and Piaget undoubtedly influenced David Kolb when he described his learning styles model (a four stage learning cycle: concrete experience, reflective observation, active experimentation and abstract conceptualization) and his experiential learning theory (Kolb, 1984). The role of experimentation in learning has received considerable attention since then, to the point that it is generally agreed that, at least in adults, the most effective type of learning is that based on experimentation or as it is sometimes described, learning by doing (Percival et al, 1993). Furthermore, it has been argued that professional education and training should enhance learning by doing and should also potentiate the ability for continued learning and problem solving throughout one's professional career (Schön, 1987).

Toxicology is a complex interdisciplinary subject, which is based on an intricate relation with other disciplines and which is constantly being updated, not only because of the general advancement of science, but also due to the discovery of new hazardous substances. Thus, Toxicology teaching can be sometimes a very hard task, partly because of its inherent difficulty and partly due to the complex interrelation that it maintains with so many other disciplines. Thus to attain an adequate learning of Toxicology it is required that the student gains knowledge of the relevant toxicological facts but also, and perhaps more importantly, that the student accomplishes a deep understanding of the biological/chemical events that xenobiotics can cause in living organisms. In recent years (at least in Science courses), a shift has been taking place to move the role of the student from being the receptor of a series of scientific facts to a student

who learns to think critically and who acquires knowledge by gaining a deep understanding of the various scientific disciplines. Consequently, teaching is taking a new direction, with many lectures moving form the more traditional passive learning with the teacher lecturing and the student being the receptor of the information, to a more dynamic learning process (active learning) in which the student is not just the mere recipient of the information provided by his/her lecturer, but instead the students play more important active roles, since they are involved, and sometimes in charge, of their own learning process (Moench, 1986).

This change require a significant change in the approach and attitude both of lecturers, and students to the discipline being taught, or learned as well as a change in the procedures, methods and techniques used to teach and learn. In many teaching centres, teaching methods developed towards active and experimental learning with more self and peer-tuition methods are being implemented and are used as a natural part of such education (Bergendorff, 2000; Rodilla, 2003; Rodilla 2005).

Universidad Cardenal Herrera CEU

PERIÓDICO TOXICOLÓGICO

TOXICO

SEMANA DEL 1 AL 8 DE DICIEMBRE DE 2000

UN BUQUE VIERTE EN EL PUERTO DE VALENCIA UNA MEZCLA DE ÁCIDO SULFÚRICO Y BICARBONATO

La tripulación del buque químico Tobueno, que permanece atracado en Valencia desde el pasado lunes, ha denunciado la presencia de fisuras en los tanques con alto riesgo de fuga. El Tobueno descargo ácido sulfúrico en Castellón el pasado fin de semana, pero durante su transporte un temporal dañó los contenedores, por lo que el ácido sulfúrico se derramó por la estructura interna de los tanques de la nave. Durante la limpieza del buque, los armadores derramaron al mar el ácido sulfúrico acumulado que ha sido neutralizado con bicarbonato. Uno de los tripulantes tuvo que ser hospitalizado por desvanecerse al inhalar vapores químicos, ya que en la zona se condensan vapores de alto riesgo para la salud. Se ha destinado una unidad de especialistas para vigilar que no se produzcan nuevos vertidos y evitar así una posible contaminación.

El ácido sulfúrico es un producto corrosivo que tiene un efecto deshidratante muy poderoso. La intoxicación puede producirse por contacto con piel y mucosas (quemaduras con erosiones y ulceraciones), por ingestión (quemaduras en las mucosas lingual y bucal, vómitos, diarrea, shock y muerte) y por inhalación, como en este caso. Cuando se produce inhalación de gases aparece disnea muy intensa, edema pulmonar y cianosis de las mucosas. Aquí hay que realizar tratamiento sintomático para el shock y para el dolor mediante corticosteroides y antibióticos.

EL PAÍS, 6, 7 y 8 de diciembre de 2000

FALLECE UN MAGREBÍ AL INHALAR GASES TÓXICOS DE LA EMBARCACIÓN EN LA QUE VIAJABA

El fallecido murió tras inhalar los gases desprendidos del combustible de la rodiac con la que trataba de alcanzar la península a través de Tarifa(Cádiz) junto a otros 31 indocumentados, nueve de los cuales resultaron heridos con quemaduras de primer, segundo y tercer grado. Según los voluntarios de Cruz Roja, lo más probable es que el fallecido perdiera el conocimiento tras llevar bastante tiempo respirando los gases tóxicos del motor y que, al desmayarse, tragara agua mezclada con gasolina del fondo de la zodiac.Aun así, esta muerte resulta inexplicable en un hombre de 25 años en una lancha descubierta sometida a los vientos del mar.

Gases carbónicos y hidrocarburos, una mezcla mortal

El monóxido de carbono (CO) es un gas venenoso, incoloro, inodoro e insípido producido por la combustión incompleta de combustibles carbónicos como la gasolina. Las propiedades de toxicidad del CO se atribuyen a su alta afinidad por hemo proteínas Fe^{2+} transportadoras de oxigeno como la hemoglobina y la mioglobina que es de 210 a 240 veces mayor que por el oxigeno.

Las altas exposiciones pueden provocar envenenamiento agudo. el CO puede ocasionar la muerte a las personas cuando son expuestas a concentraciones superiores a 750 PPM por algunos minutos.El coma o colapso comienza a producirse a niveles de carboxihemoglobina de >40% (697). Sin embargo, la mayoría de las exposiciones al CO en entornos urbanos son varias veces inferiores a las asociadas con la intoxicación y el envenenamiento pero algunas exposiciones pueden afectar de manera adversa al corazon, cerebro y sistema nervioso central.

Por otro lado la intoxicación por ingestión de hidrocarburos como la gasolina o el gasoil no es muy frecuente en los humanos, no así en las especies domésticas (bovidos, ovidos, équidos y perros) en las que las intoxicacionespor hidrocarburos son relativamente frecuentes y se producen por ingestion de petróleo, gasolina, o insecticidas preparados con hidrocarburos o bien por inhalación. Los síntomas por ingestión son anorexia, depresión, debilidad, adelgazamiento, olor a petróleo en heces, vómitos y a veces convulsiones, colapso y muerte. En caso de inhalación se produce incoordinación motora, temblores, tos, espasmos bronquiales y después de 48 a 72 horas se puede complicar por gérmenes que producen una bronconeumonia mortal. Las lesiones son degeneración de hígado y riñones, olor a petróleo de los reservorios gástricos, enteritis, congestión y edema pulmonar, a veces bronconeumonia, hemorragias y enfisema pulmonar claro. El tratamiento es sintomático ya que no hay antídoto.

El Mundo, Martes 5 Diciembre de 2000

Otras Noticias

- **-Aumenta el nivel de nitratos en el agua potable de Alzira y Algemesí**
- **-El 85% de las viviendas no son saludables y la mayoría están repletas de materiales nocivos**
- **-Se detecta un foco radiactivo en la central nuclear rusa de Novovoronezh**
- **-Un buque vierte en el puerto de valencia una mezcla deácido sulfúrico y bicarbonato**
- **-Metales Pesados**
- **-Gran nube tóxica en Carcaixent consecuencia de una fuga de ácido clorhídrico en una empresa de lejía**

Detectan otra mancha tóxica del "levoli"

Una patrullera francesa detectó ayer frente a las costas de Normandía una mancha tóxica de 3,6 kilómetros de largo por 300 metros de ancho procedente del barco levoli Sun, hundido el pasado martes en el Canal de la Mancha

Una capa de contaminantes de 3,6 kilometros de largo por 300 metros de ancho fue descubierta ayer en el Canal de la Mancha, al noroeste de Francia, segun afirmaron fuentes de la prefectura maritima de la Mancha y el Mar del Norte. Esta capa, fue señalada por un barco que patrullaba para evaluar las consecuencias del naufragio del barco-cisterna italiano levoli Sun,que se hundió el martes pasado.

El levoli Sun fue fletado por los grupos Shell y Exxon-Mobil Transportaba 4.000 toneladas de *estireno*, un **producto corrosivo y cancerígeno** no soluble en el agua, y 2.000 toneladas de productos no tóxicos. La capa observada podria ser *gasóleo*, agregó la prefectura marítima.

Efectos del estireno

El Estireno es sustancia química de alta toxicidad, inflamable e insoluble en agua, sobre la cual ya se ha tratado en otras ediciones de este mismo rotativo.Se trata de un compuesto potencialmente cancerígeno y teratógeno. El estireno tiene una ventaja y es que primeramente se queda en la superficie marina no causando la muerte inmediata de la fauna marina, pero si un envenenamiento lento.

Las Provincias, 8 de diciembre de 2000

Figure 1. An example of a front page of a newspaper prepared by students of Toxicology in the academic year 2000-01.

In this paper we describe and discuss several methods that we have devised and implemented successfully to potentiate self-learning and peer-teaching with our Toxicology students, enrolled both in Pharmacy and Veterinary degree courses.

METHODOLOGY

The three activities we describe and comment in this

paper have been used over various years and can be considered as active learning strategies which have been well received by our students. The first activity we describe (the production of a newspaper on toxicology) is carried out in groups of three to five students, whereas the other two activities (a report on withdrawn drugs and a laboratory practical) are more individualistic but have a very important component of peer teaching.

Newspaper.

For this collaborative group work approach to learning toxicology, the class was randomly split into groups of three to five students. Each of the groups had to compile news related to toxicology during a week (occasionally a fortnight) which was assigned to them. At the end of this period, the group had to submit a two/four page (A4) newspaper with the news they had elaborated (Figures 1 and 2), together with the sources of their information (photocopies, printouts date and program of broadcasting, etc.). Detailed instructions were given to the students at the beginning of the year as to what was required from them to carry out this assignment effectively and successfully, which was not just simple copying and pasting the news they had found but they had to look for, and complement the news with additional information on mechanisms of actions, symptoms, treatment, etc. Broad guidelines were given to the students as to what to include in their newspaper, as well as several issues related to the format and presentation of the newspaper. However, no information was given to the students as to what sources of information to use, where to find them and how

Dosis sola facit

VENENUM

Del lunes 1 al viernes 5 de diciembre de 2003 — VALENCIA — C. Serra, V. Boullosa, C. Martínez y M. Gutiérrez

Madrid participa en un estudio europeo sobre la polución del aire

MADRID.- Durante el miércoles 3 de diciembre más de ciento cincuenta voluntarios llevaron en su solapa un medidor de agentes contaminantes que se respiran en las calles y edificios de Madrid.

Esta actividad forma parte de una investigación europea cuya finalidad es acabar con la contaminación en el aire en el ámbito de todas las ciudades.

El proyecto People (Population Exposure to air Pollutants in Europe) medirá la cantidad de bencenos y otros agentes contaminantes en diez grandes ciudades europeas. Ya se ha realizado en cuatro de ellas (Lisboa, Bruselas, Liubliana y Bucarest), y los resultados han sido inquietantes.

Las partículas que se midieron fueron de menos de 10 micras: aquellas que entran en los pulmones. La muestra se llevó a cabo durante doce horas, tanto dentro como en el exterior.Se midieron oficinas, colegios, bares, tiendas y taxis. Sólo 25 de los voluntarios fueron fumadores para conocer la incidencia del tabaco.

Según el coordinador para la UE de People, Emile Saeger, "los niveles de benceno están por encima de lo que las directivas exigen para 2010". Sin embargo, Saeger puntualizó que para ese año, las medidas que se tomen hasta entonces podrían normalizar los niveles.

No obstante, Saeger señaló que este avance no será posible en las casas y en las oficinas, donde las cifras de polución están al doble de lo permisible y serán difíciles de reducir.

El benceno, que se ha utilizado como un solvente para el caucho, tintas y otros materiales, es un hidrocarburo aromático que puede provenir de los motores de combustión por acción incompleta de la misma y por ello se denominan polutantes no quemados, siendo más frecuente su origen en los motores de gasolina.

La aparición de la industria del petróleo dio como resultado una abundancia del benceno como componente de los combustibles.

Según declaró el Secretario general de Sanidad, Rafael Pérez Santamarina, "se trata de un agente asociado a la leucemia y el primero regulado en España".

Rusia anuncia que no ratificará Kioto

El Kremlin volvió a negar su ratificación del Protocolo de Kioto exusándose en la defensa de sus intereses económicos.

MOSCÚ.- Las declaraciones de Andrei Ilarionov, consejero económico de Rusia, volvieron a mostrar el martes 3 las reticencias del gobierno ruso al tratado de reducción de gases causantes del efecto invernadero.

Rusia "no puede" ratificar el tratado, afirmó Ilarionov. "El protocolo de Kioto, en su forma actual, establece límites significativos al crecimiento de Rusia", esgrimió el consejero del presidente, que calificó el tratado de "discriminatorio para Rusia".

En Moscú pesan más los argumentos económicos de quienes afirman que el despegue económico industrial que se avecina en Rusia descontrolará las emisiones de CO2 por encima de los baremos de Kioto.

La contaminación de la atmósfera por gases se realiza por los que normalmente entran en su constitución o los extraños a ella. Los primeros pueden originar trastornos cuando su concentración varía de las cifras normales.

El monóxido de carbono que se produce en las combustiones incompletas es más tóxico que el anhídrido carbónico, y aunque su dosis mortal varía con varios factores, como humedad, temperatura, la concentración media total del CO se ha estimado que es es del 0,1 ppm, aunque en las ciudades las concentraciones suelen ser superiores.

Se considera como límite de seguridad para una exposición de 8 horas en adultos sanos cifras de 100 ppm. El peligro del CO es su combinación con la hemoglobina sanguínea reduciendo la capacidad de ésta para transportar oxígeno, originando asfixia.

Distribuyen diez mil trípticos para informar a los jóvenes sobre la marihuana

ALICANTE.-La Unidad de Prevención de Drogodependencias de Cullera ha editado 10.000 trípticos para ser repartidos entre los jóvenes de entre 14 y 18 años de la población. Se busca desmitificar la marihuana y hablar de ella sin generar enfrentamientos.

El principio activo de la marihuana (*Cannabis sativa*)es el tetrahidrocanabinol. Su consumo se ha asociado con trastornos cardiovasculares, pulmonares, reproductivos y posiblemente inmunológicos.

Aún cuando la marihuana se mastica o se ingiere, la absorción es mayor 3 a 1, cuando se fuma. A los pocos minutos hay taquicardia y discreta elevación de la presión arterial. El efecto pulmonar inmediato es broncodilatación; con el uso crónico las partículas inhaladas causan broncoconstricción y eventualmente obstrucción.

Hay disminución de la movilidad espermática, del número de espermatozoides y de los niveles circulantes de testosterona. El tetrahidrocanabinol es teratogénico produciendo retrasos del crecimiento en el feto.

Existen estudios que defienden el uso terapéutico de la marihuana ya que se ha demostrado que alivia la ansiedad, disminuye la presion intraocular en el glaucoma y estimula la memoria en enfermos de alzheimer.

Los farmacéuticos de Barcelona crean una guía sobre el cannabis

El Colegio de Farmacéuticos de Barcelona ha presentado un prospecto sobre el uso terapéutico del cannabis, el primero que se publica en España.

Su fin es disminuir los riesgos asociados al consumo del mismo en los pacientes que deciden tomarlo para paliar los efectos secundarios de algunas patologías.

Figure 2. Front page of a toxicology newspaper elaborated by a group of four students in the academic year 2003-04.

to access them. The newspaper was photocopied and distributed to the rest of the class and either enlarged and exposed in a notice board in the Faculty or as we have done in later years, since 2004-05, a portable document format (PDF) version of the same was posted on the internet: http://www.uch.ceu.es/principal/noticias_toxicologia/index.asp?menusuperior.

The final piece of work, i.e. the newspaper, was evaluated by the lecturer taking into account several aspects, such as the interest of the news and their relevance to the course, the amount, quality and precision of the additional information added, as well as the format, the presentation, the clarity and the style. Additionally, students were given a form and asked to evaluate each member of the group on their contribution both on news gathering and in generating the newspaper.

Withdrawn drugs.

This activity learning strategy is carried out by individual students and it is not compulsory, being carried out only by those students who volunteer to do so. Each student was randomly allocated a drug which had been withdrawn form the market (in Spain or elsewhere) due to its toxicity or the presence of adverse reactions; some classical compounds such as thalidomide, diethylstilbestrol and others were also included (Table 1). .

Table 1. List of the withdrawn drugs investigated by our Toxicology students in 2005-06.

Acetylsalicylic acid (children)	Chloramphenicol (food-producing animals)	Methaqualone	Terfenadine
Alatrofloxacin Trovafloxacin	Chlormezanone	Mibefradil	Ticrynafen
Alosetron	Diethylstilboestrol	Natalizumab	Tolcapone
Astemizol	Ebrotidine	Nefazodone	Troglitazone
Benzbromarone, benzdiodarone	Fenfluramine Dexfenfluramine	Nimesulide	Veralipride
Bromfenac	Benfluorex	Pemoline	Ximelagatran
Cerivastatin	Phenformin	Rofecoxib	Zimelidine
Cisapride	Phenylpropanolamine	Sertindole	
Clioquinol	Grepafloxacin	Thalidomide (new uses)	

Each student had to research the literature and write a short, critical report on the drug, its therapeutic uses and the reasons for its withdrawal from the market with a maximum extension of a two sided A4 page (11 or 12 pt font), including any relevant bibliography and the sources of their information. A compilation of all the reports was then presented to their peers and a lecture session used to discuss all the drugs considered and the reasons for their withdrawal

Practical items.

As part of the practical program and to carry out one of the practical sessions, each student had to search, find and bring to the laboratory five toxic items including one medicine, one plant and one pesticide; the other two items were of free choice but had to belong to different categories of toxic substances (for instance a metal and a household product) to a laboratory practical and give an oral presentation to their colleagues on them and their toxic effects. In practice, and because of time constrictions, the oral presentations were limited to one or two items per student with the presentation of each student not exceeding 10 minutes. In this activity, the originality of the items brought, the difficulty in obtaining them, as well as the audiovisual aids used and clarity of the presentation made by each student were assessed. The written descriptions for each item including the toxicological aspects were then compiled by the lecturer, and after eliminating repetition, were photocopied for all the students in the class.

RESULTS AND DISCUSSION

Figure 3. Bottles of Formigal (AsO_4Na_3), an obsolete preparation used to kill ants brought by students to the practical.

With the newspaper experience, the students became motivated in the study of Toxicology probably because they realize that it is a discipline "real" and of "current interest", as it was revealed when this activity was assessed by the one-minute-paper technique (Stead, 2005) and also by the comments the students made. Our students see now the Toxicology as "modern" and "making the news", rather than something theoretical and difficult that they have to study and learn. The students who participated manifested that they learnt the topics they covered in the news better because they had to find out, compile and elaborate the information by themselves. As such, we are implementing, outside the laboratory experimental learning by enquiry which has been strongly supported by some authors (Tamir *et al*., 1998; Schwab, 2000). In our opinion, this activity goes beyond mere group work since it has all elements necessary to be catalogued as

Figure 4. Photograph of a scorpion (*Buthus occitanus*) inside a glass jar containing ethanol.

collaborative learning amongst the students. (Watson, 1992). Furthermore, the students had to investigate the mechanisms of action and other aspects of all toxins they considered, even if for space constrictions or interest they did not include them in the newspaper. Their colleagues seemed interested in reading something that their peers had written (Rodilla 2004). This type of group work allows the students to teach themselves part of the subject, encourages their ability to synthesize information and promotes their writing and communication skills. In addition, the students participate in the evaluation process. It is argued that peer assessment is of adequate reliability and validity in certain circumstances, and may have a positive formative effect on the students' achievements and attitudes (Topping, 1998).

The main drawback of this and similar initiatives, is that the lecturer cannot select the topics the students are learning, but this is compensated by the interest that it generates not only amongst the registered toxicology students but also on other students not undertaking the course.

The students considered researching the toxicity or adverse drug reactions of previously marketed drugs a very interesting task which helped them to understand the importance of toxicology as well as pharmacovigilance in ensuring the safety of medicines. However when we evaluated this activity (one minute paper method) (Stead, 2005), many students (40% of respondents) were in favour of carrying out an oral description or presentation of the drug and the reasons for its withdrawal. The students feel that they obtain a deeper knowledge of what they are studying, that they learn more quickly and that they are able to relate theoretical concepts with their practical applications. We feel that this type of assignment provides the students with a very clear view and understanding of risk assessment, a concept otherwise difficult to pass onto them. They also become very much aware of the work carried out by the regulatory agencies internationally and the differences between them. In summary, it gives Pharmacy students a very real point of view when it comes to evaluation of the safety of medicines and the work involved in their regulation.

The practical laboratory was also an interesting experience for the students and certainly for the lecturer. That interest can be explained at least in part, because originality and the difficulty in obtaining the toxic products, as well as the presentation given by the student were assessed.

Items not difficult to obtain but of considerable toxicity were brought to the laboratory, amongst them, *Nerium oleander*, *Echballium elaterium*, several specimens of the *Datura* genus, *Viscum album*, medicines (barbiturates, benzodiazepines, propanolol, antidepressants, etc), methanol and ethylene glycol Amongst the most extraordinary items brought to the laboratory were several arsenical preparations (Fig 3) (some obsolete like the one shown in figure 3; others now prohibited based on sodium arsenite, but which were, until recently, used as fungicides for vines), exotic or rare plants such as *Thevetia peruviana* or *Œnanthe crocata*, common scorpions (*Buthus occitanus*) (Figure 4), a salamander (*Salamandra salamandra*) , and several vipers (*Vipera latastei*), and even a radioactive necklace detected at the nuclear plant at Cofrentes (Valencia) during a secondary school visit, and which remains in the possession of one of the workers of the plant, who lent it to the student, together with a laboratory printout with the radioactive isotopes it contained. In our opinion, this practical is worthwhile and highly recommended since it promotes amongst our students an active learning strategy. In order to bring five products to the lab, the student, who has very little or no prior knowledge of the subject, has had to research the literature, to find and identify substances which are toxic and which he/she can obtain. Because both originality and the difficulty in obtaining the item are part of the final mark given to the student, they actually cover a lot of ground in toxic materials or toxic substances, to finally come up with their five best items.

As with the newspaper, the main disadvantage of this method is that the teacher cannot select the items the students were covering and some articles and products such as certain plants, bleach, lead or mercury for example, became very repetitive.

CONCLUSIONS

In the preparation of the newspapers and the study of withdrawn drugs the students have to synthesize the information and this is undoubtedly a task that promotes the development of the students' writing skills. The students teach themselves and their colleagues some important aspects of the curriculum. Furthermore, we think that these activities make the students aware of the importance of Toxicology in their chosen degree. We believe that the generation of a newspaper (magazine, or news digest of some sort) by a group of students is an activity that can be easily extrapolated, and it would be applicable, to almost any scientific discipline and even to certain areas of the humanities.

The practical experience develops their research abilities and at the same time it makes them become aware of the availability of toxic substances. With this experience the students develop

their oral and presentation skills as well as teaching their peers by engaging in collaborative learning. Some reported that they had difficulty in selecting the materials, particularly when they had no extensive knowledge of toxic substances and some complained because they found it very competitive.

In general the students like these activities, probably because collaborative and self-learning strategies emphasize learning that is meaningful and enjoyable and in which the students are actively involved. Furthermore, those who participate (some activities are voluntary) realize that they acquire better and deeper knowledge which helps them to understand the subject and it helps them to advance their chosen career.

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