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Keeping Teachers Up-to-date is essential to reach and maintain a High Quality University Education

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Abstract

A multidisciplinary group of teachers and scientists from the Faculty for Higher Education (FES) Zaragoza from the National Autonomous University of Mexico (UNAM) is dedicated to the continuous improvement of biochemistry teaching within the programme of chemistry, pharmacy and biology (QFB) at our University. To provide our teachers with modern teaching abilities is our top priority. Therefore, we offer various activities to promote their continuous scientific and didactic updating. We also encourage self-awareness on the strong need for continuous adaptation and utilization of information and communication technologies (ICT) that have become very popular among young generations. Teaching is not an isolated discipline. On the contrary, teaching is intimately related with social and economic circumstances. Teachers and students must be aware of their social environment, continuously improving their capability to approach national problems with an accurate utilization of national resources. Research and development have to be linked to the best teaching techniques that stimulate teachers and scientists to grow as educators and experimenters. Our scientific meetings and courses on scientific topics and teaching techniques have contributed not only to promote individual teaching and scientific capabilities but also to update the study programme from the QFB curricula at our University.

Keywords

Biochemistry, ICT, Teaching updating

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1. Introduction

A strong knowledge of biochemistry provides the right foundations for a good education of students following the chemistry, pharmacy and biology (QFB) curricula at any University. Such kind of instruction requires in turn, professional teachers with a high level of theoretical knowledge and practical experience in science and education. To fulfil their mission and vision, modern universities require good educators, acting with passion and reason, with ability to act as role models, leaders and colleagues in order to develop proper and rewarding students-faculty interactions.

Those who wish to become teachers at primary or intermediate level must follow special education in specialized schools before they can actually work as teachers. However, no such demand for a special preparation exists to become a teacher at university level. Instead, university teachers must have a degree in the specialty that they are going to teach and prove that they possess the knowledge and the skills to teach it by being approved in an examination made by representatives from the Academy, School Directives and the Union. Professionals following this path in Mexico acquire the right to teach after succeeding on such examination and their efficiency as teachers is guaranteed by their experience in the field and the time they spend acting as educators.

However, modern education demands professionals critically aware of their own capacities, able to recognize valuable information, to learn new didactic strategies and evolve, improving their own abilities to continue a successful interaction with their students. It is not enough to obtain a degree and work for a number of years teaching what they knew when they obtained a degree. Modern societies change continuously, and education must also change, adapting to present needs and resources.

According to UNESCO, there is an unprecedented demand for a great diversification in higher education, as well as an increased awareness of its vital importance for sociocultural and economic development (UNESCO 1998 and 2008). In order to satisfy

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such demand, universities must employ well-prepared educators and life-long learners with a deep knowledge of the subject that they teach, and the skills to teach it. Therefore, we have been devoted during several years to provide the means to elevate and maintain a high level of scientific knowledge and didactic competence from QFB teachers at our university. Various activities have been scheduled to achieve these goals, including a number of courses, discussion meetings and support activities for students and teachers from the Faculty for Higher Education (FES) Zaragoza from the National Autonomous University of Mexico (UNAM).

1.1 Updating knowledge

An elevated quality of education is required to produce the critically thinking, creative, flexible and entrepreneurial young professionals who will shape our future. The quality of teaching and learning is vital for countries aiming to face modern challenges with success. Moreover, education should focus on curricula that deliver relevant, up-to-date knowledge and skills allowing the new professionals to successfully compete in the labour market (High Level Group on the Modernization of Higher Education 2013).

Teachers cannot accomplish their function if they are satisfied with the knowledge acquired at the time they graduated. On the contrary, they must constantly renovate and improve their knowledge. Nowadays, knowledge is everywhere, easy to get, and teachers must frequently evaluate the new information. Teachers must also be aware that the purpose of teacher-student interactions at university level is not only to set the basis for exchange of information but also to provide a suitable start for students that must become professionals with problem solving capability. Teachers must show their students how to perform critical thinking and to analyse great amounts of information before they adopt or reject some of that information. The experience of learning from well-prepared university teachers is crucial to make students to consider their school time as a motivating and rewarding period.

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Which ones are the most important capabilities of university teachers? Firstly, they must have high levels of expertise and subject knowledge. Secondly, they must possess effective teaching strategies to transmit relevant information. Thirdly, they must appear not only as authority figures but also as educators. Science, technology and pedagogy become all together essential components of the processes of teaching and learning. Teaching at university level demands a great capacity to adapt and face contemporary challenges. Therefore, continuous updating of knowledge is the first step to reach a position where teachers may act as a positive influence for their students (Romeo *et al*. 2012).

Unfortunately**,** the quality of universities is often overlooked and undervalued (High Level Group on the Modernization of Higher Education 2013). Universities must struggle to adopt efficient mechanisms for reaching and maintaining the high level of education that our society demands. Teachers must be subject of a never-ending professional development, and they should always have an active role in their own process of learning and teaching (Bushati *et al*. 2013).

1.2 Updating communication skills

The competence of university teachers goes along their willingness to communicate their knowledge. Transmission of information often also conveys thoughts and emotions to the receivers. In order to effectively communicate, we have to take advantage of every didactic tool available to transmit our knowledge and promote development of our students. Understanding how is that our students understand the knowledge that we provide is a key factor to achieve our goals (Felder and Brent 2005).

Sharing information with the general purpose of education and specific purposes oriented to particular topics is easier when we have developed a personality that gives the impression of being both knowledgeable and approachable. To achieve this kind of personality, university teachers must be well informed and experienced but also have to

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develop effective communication skills (High Level Group on the Modernization of Higher Education 2013, Ihmeideh *et al*. 2010).

To listen and to be able to interact with students is as important as having good theoretical and practical knowledge. University teachers must constantly gather, analyse and sort relevant information. Then, they should be able to present it as easy to assimilate information. To build up skills for effective communication is an important task and university teachers appreciate all the help they can get in form of courses, lectures and meetings with their fellow teachers in and out from their own university. To increase the potential to communicate among university teachers is as important as having well prepared, knowledgeable and experienced teachers. Such kind of personnel constitutes the basis to sustain a high level of education at any university.

1.3 Forming professionals

Academic and scientific professionals require an excellent basic formation, continuous update and development. Forming professionals must be understood as a limitless, wide and complete activity for educators. Teachers and universities are responsible to warrant that the person obtaining a university degree has the corresponding knowledge, experience and merits to function as a professional. Then, the graduated professional is responsible for keeping himself able to perform at the expected level and to increase continuously his/her knowledge and aptitudes. Forming professionals with the ability to take right decisions is probably the most important goal from universities working to get the best from the individuals in benefit of the society (Ferreira *et al*. 2014).

In Mexico, the National Association of Universities and High Education Institutions (ANUIES) has been determined to find out the most efficacious ways to constantly improve the formation of professionals. Among other strategies, ANUIES is promoting a better use of information and communication technologies (ICT) to reinforce the acquisition and transmission of knowledge at university level. Although must youngsters

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are nowadays acquainted with digital cameras and phones, not enough students (and teachers) have a good knowledge and utilization of ICT. Excessive use of electronic means often deteriorates students' skills for learning, when they just copy and paste instead of read and analyse. Taking a photograph instead of trying to understand the topic is another detrimental activity. Many students even lose their abilities to read and write as well as to make basic calculations, since they prefer to copy, to take a photograph or to use a computer instead of using their own brain. The extensive use of videogames and electronic devices often undermines mental abilities instead of improving them for learning "real life" issues. Well used, radio, TV, internet and all kind of electronic devices are fantastic means for learning and stimulating the brain function but they are too often unduly used, replacing cognitive and physical functions and leading to mental disabilities (Drain *et al*. 2012). In consequence, and despite of extensive nets of communication in the country, electronic means are still not fully exploited with educational purposes.

1.4 Teaching and searching

Collaboration between educators and scientists is critical to maintain a high level of education at any university. More often than seldom, teachers at our university are also involved in research activities of various kinds, from basic to translational science. Teaching and searching are complementary activities that benefit from each other, summarizing knowledge, solving problems and discovering many more questions that need to be solved. Interest and curiosity from teachers and learners grow as result of being permanent or temporarily associated with adequate research environments.

Countries are nowadays as developed and independent as they have invested in scientific research and high-level education. Mexico has understood that and it is trying to catch up through research and development in education. Universities are demanding higher levels of knowledge and promoting collaboration between multidisciplinary groups of teachers and scientists, in and out the academic institutions. At FES Zaragoza, we have an

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institutional program giving high priority to good organization and proper use of resources. Accordingly, to develop collaboration between teachers and scientists is an important goal of this project.

Linking research and teaching stimulates teachers and researchers with new study fields that help to maintain both teaching and searching as critical, demanding and motivating activities. A combined teaching and research interest also provides feedback for educators and scientists. Giving the students the possibility to participate early in scientific projects helps them to reinforce the importance of their professional formation and to direct their interests to particular fields of knowledge.

Educators who are simultaneously devoted to pedagogic and scientific activities also need institutional support and guidance. Teaching and searching give structure to the institution. Universities having both activities in the same group of individuals, elevate the quality of the institution, renovate teaching and help their academic personnel to keep the highest possible level. This is a phenomenon that has marked the universities in modern times, making a great difference between those institutions that evolve positively and those, which do not do it.

2. Objectives and methodology

- To increase awareness on the need for continuous updating of knowledge and skills from biochemistry teachers at the Faculty for Higher Education (FES) Zaragoza from the National Autonomous University of Mexico (UNAM).
- To examine and evaluate the program of Cell and Tissue Biochemistry at the FES Zaragoza in order to identify areas requiring modifications and modernization.
- To integrate multidisciplinary groups actively working for exchange of information with renowned scientists and teachers experienced on biochemistry and education.

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- To design and offer courses, workshops and discussion meetings with focus on modern molecular biology and technology.
- To obtain additional didactic resources and make them available to our community.

Joined efforts of multidisciplinary groups are required to approach the vast number of technological and scientific advances that exist today. Academic groups with various specialties must work together, gaining information through combined efforts to maintain a high scientific and educational level. Biochemistry requires continuous experimentation to confirm, rectify and evolve before a concept can be considered established. New methodologies are important to maintain a high level of experimentation. Newly formed professionals need to master established technologies as much as new ones. Cell biology has made an enormous progress during the last century but there are even more immense amounts of knowledge missing in cell and molecular biology, pharmacology, medicine, phytochemistry, nanotechnology, genomics, proteomics and others.

We started with workshops to analyse the content of the program of Cell and Tissue Biochemistry at FES Zaragoza. Then, we detected topics and laboratory sessions that were missing or old-fashioned. Our laboratory had sessions teaching basic techniques but missed modern techniques to study DNA and proteins. Feasible modifications were selected in order to renovate our practical sessions, with diminished production of chemical and biological waste (Table 1). Discussion meetings with scientists from our own and other universities were essential to develop new techniques and sessions to be included in the modified program.

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Table 1. Cell and Tissue Biochemistry laboratory		
Laboratory session	Former techniques	Additional techniques
Instruments	1. Analytical scale 2. Clinical centrifuge 3. Spectrophotometer 4. Potentiometer	1. Micropipettes 2. Biophotometer 3. Gel electrophoresis of proteins, DNA and RNA 4. ELISA 5. Nucleic acids extraction. 6. Nucleic acids purification and quantification 6. cDNA and PCR
Proteins	1. Standard curves - Lowry - Biuret	1. Microscale techniques 2. Analysis of plasma proteins - Gamma globulin precipitation - Protein quantification - Immunoelectrophoresis - Immunoprecipitation
Carbohydrates	1. Demonstrative extraction of rat liver 2. Identification of polysaccharides with lugol 3. Hydrolysis and identification of monosaccharides with Benedict	1. Extraction of rat liver 2. Identification of polysaccharides and monosaccharides
Lipids	1. Quantification of phosphorus by spectrophotometry	1. Microscale techniques 2. Phosphorus content in phospholipids 3. Thin layer chromatography
DNA	1. DNA extraction from wheat germ	1. DNA extraction, purification and quantitation from human leukocytes 2. Electrophoresis of normal DNA 3. Electrophoresis of fragmented DNA
Mitosis	1. Observation of acetocarmin stained nuclei	1. Technique explanation 2. Description of mitotic phases 3. Microscopic and digital observation of stained nuclei from mitotic onion cells
Enzymes	1. Observation of enzyme activity - Starch degradation by salivary amylase - Effect of temperature and heavy metals on salivary amylase activity	1. Determination of enzyme activity - Optimal invertase activity 2. Enzyme properties - Invertase activity under various pH and temperature conditions - Invertase activity in relation to substrate and enzyme concentration. - Plotting enzyme activity - Determination of velocity curves - km constant - Results and discussion

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3. Results and discussion

We have organized courses in experimental biochemistry, with particular attention to the detection, analysis and quantification of proteins, lipids and carbohydrates, enzyme pharmacokinetics, ELISA, Western Blot, cell culture, cytometry and apoptosis. We also introduced practical sessions of molecular biology where students at pre-graduated level learn to study nucleic acids with PCR and various other techniques (Table 1).

ICT have also been studied and adopted by our teachers and students in the middle stage of their studies, learning to elaborate and use digital materials, as well as exploiting all kinds of possibilities of using electronic materials, digital graphs, posters, presentations and other resources such as electronic files and platforms (Table 2).

Table 2. Continuous education activities

Courses & Workshops	Discussion Meetings	Continuous support
1. Biochemistry - Cells, eukaryotes and prokaryotes - Cell structure - Organelles and function - Molecules - Enzyme kinetics	- Cell biochemistry - Proteins - Carbohydrates - Lipids - Antigen-antibody reaction (Ag-Ab)	- Optical microscopy - UV microscopy - Cytometry - Samples with different cell types
2. Experimental biochemistry - Spectrophotometers - Standard curves - Protein quantification - Lipid quantification - Enzyme kinetics	- Biomolecules structure and function - Methods to study biomolecules - Ag-Ab clinical applications - Clinical Drug Development - Liposomes - Microorganisms, environment and industry	- Samples and reagents - Assistance for developing good laboratory practices (GLP) and use of equipment
3. Microscale techniques - Proteins, lipids, carbohydrates and nucleic acids.	- Basics of microscales - Technique applications	- Equipment, reagents - Assistance for developing GLP

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Table 2. Continuous education activities

Courses & Workshops	Discussion Meetings	Continuous support
4. ELISA - Methods, practical work - Antibodies, antigens, enzymes - Antibodies and antigens detection - Clinical and research applications - Results and discussion	- ELISA methods - Sensitivity, reproducibility, research and clinical applications - Cell and molecules separation - Agglutination and precipitation - Immunoprecipitation - Immunofluorescence and cytometry	- Equipment and reagents - Assistance for developing GLP
5. Western blot - Sample, cell sources and purpose - Denaturation, solubilisation, protein determination - Basic set-up. - SDS-PAGE, transfer and detection - Enzymes and chemoluminiscence	- Antibodies, antigens and the Ag-Ab reaction - WB clinical and research applications - Power Blot and other alternatives	- Equipment and reagents - Assistance for developing GLP
6. Human DNA	- Human genetics - Forensic genetics - Genes and sex - Molecular biology techniques - PCR applications - Apoptosis	- Assistance for better utilisation of molecular biology techniques and study of human DNA
7. Information and communication technologies (ICT) - Digital tools demonstration	- Microsoft office package - Information systematization - ChemSketch for creation and handling of 3D chemical structures - Prezi, Calameo, Blogs - Electronic presentations	- Graphs, drawings, texts and posters - Chemical structures - Presentations, data bases, analysis and publication of results
8. TIC. Advanced course - Digital tools training - Electronic files and mail - Posters (creation and editing) - Digital material (power point and Prezi) - Digital platforms (Moodle)	- Learning Management System (LMS) - Platform Moodle - On line courses - Blogs, discussion sites - Electronic publications - Reusable digital materials	- Assistance - Access to platforms and blogs - Assistance for preparation of digital material

Discussion meetings have been organized with the purpose of bringing updated information into our program. Scientists and teachers have come to discuss their work in biochemistry, molecular biology, pharmacology, genetics and immunology. As a consequence, a number of students have got the opportunity to work during several weeks between semesters in research laboratories around the city. This experience is

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called “youngsters towards investigations” and has allowed many students to get in contact with several groups of investigators in various hospitals and institutions, participating with small but rewarding tasks which have produced the most positive impact in our future professionals.

Limitations that we encountered during our work were due to lack of time (from teachers) and resources (from the Institution). However, this was compensated by enthusiastic collaboration and interest shown by all the participants (Institution, Teachers and Students). We are indebted to all scientists, educators and administrative personnel that made our work possible and contributed to positive results.

Our contributions to elevate the standard of education at the FES Zaragoza can be summarized as follows:

- Increased awareness of the necessity for constant improvement of knowledge and didactic capacity.
- Integration of a multidisciplinary group that provides multiple forums for exchange of information with distinguished scientists and educators.
- Increased availability of ICT and technical support to use it.
- Teachers have been updated in various topics of biochemistry, cell biology and molecular biology.
- Teachers have shown personal commitment to assiduous learning and education. More than 80 % of teachers working within the program have participated, forwarded their interests and learned diverse techniques that have widened their professional capacity as scientist and educators.
- Teaching and searching are closer than before and most teachers participate somehow in both activities.

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- Our activities promoting up-to-date knowledge and communication based on tight collaboration between science and education are contributing to improve the level of education of our students in an extent that will be very much appreciated afterwards, when they act as professionals, problem solvers, educators and scientists.

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5. References

Bushati S, Ninka I, Bushi F. (2013). Assimilation Techniques and Technological Methods, Implements in the Teaching and Learning Process. Mediterranean J Soc. Sci. 4: 763–767.

Drain TS, Grier LE, Sun W. (2012). Is the growing use of electronic devices of benefit for academic performance? Issues Inform Systems 13: 225-231.

Felder RM, Brent R. (2005). Understanding student differences. J Eng. Edu. 94: 57-72.

Ferreira N, Haddad M, Faria A. (2014). Educational Technology and Educational Management in the Higher Education: New Ways of Forming Professionals. Open J Soc. Sci. 2: 7-11.

High Level Group on the Modernisation of Higher Education. (2013) Report to the European Commission on improving the quality of teaching and learning in Europe's higher education institutions. Available at Modernisation of Higher Education - European Commission - Europa Accessed on July 8, 2014.

http://dx.doi.org/10.4995/muse.2015.2204
EISSN: 2341-2593

Ihmeideh FM, Al-Omari AA, Al-Dababneh KA. (2010). Attitudes towards communication skills among students-teachers in Jordanian public universities. Australian J Teacher Edu. 35: 1-12.

Romeo G, Lloyd M, Downes T. (2012). Teaching Teachers for the Future: Building the ICT in education capacity of the next generation of teachers in Australia. Australasian J Edu. Technol. 28: 949-964.

UNESCO (2008). ICT Competency standards for teachers. Available at http://unesdoc.unesco.org/images/0015/001562/156207e.pdf Accessed on July 8, 2014.

UNESCO (1998). World declaration on higher education for the twenty-first century: vision and action. Available at http://www.unesco.org/education/educprog/wche/declaration_eng.htm Accessed on July 8, 2014.