UNIVEST 2011

MULTIDISCIPLINARY ANALYSIS OF CLINICAL CASES: A TRANSITION TOWARDS ACTIVE LEARNING IN DENTAL EDUCATION

Gaskon Ibarretxe * (1)
University of the Basque Country (UPV/EHU)
Department of Cell Biology & Histology
gaskon.ibarretxe@ehu.es

Maider Arizmendiarrieta * (1)
University of the Basque Country (UPV/EHU)
Department of Stomatology
maider.arizmendiarrieta@ehu.es

Miren Basaras (2)
University of the Basque Country (UPV/EHU)
Department of Microbiology & Immunology
miren.basaras@ehu.es

Itxaro Pérez-Urcelay (2)
University of the Basque Country (UPV/EHU)
Department of Physiology
itxaro.perez@ehu.es

Naiara Agirregoitia (3)
University of the Basque Country (UPV/EHU)
Department of Physiology
naiara.agirregoitia@ehu.es

Elena Díaz-Ereño (3)
University of the Basque Country (UPV/EHU)
Department of Physiology
elena.diaz@ehu.es

Elena Sevillano (3)
University of the Basque Country (UPV/EHU)
Department of Microbiology & Immunology
elena.sevillano@ehu.es

José Ramón Rueda (3)
University of the Basque Country (UPV/EHU)
Department of Epidemiology & Public Health
joseramon.rueda@ehu.es

Jon Jatsu Azkue (1)
University of the Basque Country (UPV/EHU)
Department of Neurosciences & Anatomy
jonjatsu.azkue@ehu.es

Contribution statement for each author

(*) These authors contributed equally to this work

(1) These authors contributed to the implementation of this methodology both in extinguishing and Bologna-adapted dentistry curricular plans.

(2) These authors contributed to the implementation of this methodology in extinguishing dentistry curricular plans

(3) These authors contributed to the implementation of this methodology in Bologna-adapted dentistry curricular plans

Summary

In the past 2009/10 academic year, we took steps towards introduction of active methodologies, from a multidisciplinar approach, into a conventional lecture-based Dental Education program. We consolidated these practices in the current 2010/11 year, already within a new Bologna-adapted scheme. Transition involved (i) critical assessment of the limitations of traditional teaching (ii) identification of specific learning topics allowing for integration of contents, (iii) implementation of student-centred learning activities in old curricular plans (iv) assessment of students' satisfaction and perceived learning outcomes, (v) implementation of these changes in new Bologna-adapted curricula.

Main text

Active learning models of instruction have been successfully implemented worldwide at the higher education level, including the Health Sciences (Hendricson et al., 2006; Mennin et al., 2003). Rather than being a homogeneous instructional model, active learning methods vary considerably and comprise a range of designs that, however, share a number of common characteristics, including but not limited to (i) reference to real-life situations to engage the students in the learning experience, (ii) an emphasis on topics that integrate curricular subjects, and (iii) a focus on the process of knowledge acquisition rather than the final product itself (Maudsley, 1999; Neufeld and Barrows, 1974). The deployment of such approaches as problem-based learning (PBL), case-based learning (CBL) and project-based learning (PrBL) in European universities has been ultimately encouraged by the Bologna Process, which aims at promoting learners' capabilities for critical reasoning and autonomous life-long learning ((AMEE) et al., 2010; Cumming, 2010). However, conventional lecture-based methodologies have been prevalent for years in many European universities, and in addressing the introduction of active methods significant difficulties often arise related to inadequacy of facilities and lack of familiarity with appropriate instructional design and activities on the part of both instructors and students. The pedagogies associated with student-centred learning require considerable time for faculty to learn, adjust their curricula and develop new assessment practices. Thus, the adoption of active learning methodologies demands deep transformation of the physical and academic structure of medical/ dental schools, and this may turn out to be a complicated task to accomplish and should not be implemented rashly (Farmer, 2004; Winning and Townsend, 2007). One strategy to ensure a smooth transition is to test educational active methodologies first and preferentially in small groups that are easier to handle, to use them as reduced model systems that may allow to carry out innovative experiences of active education and draw preliminary conclusions, with a long-term view towards the progressive implementation of these activities in larger student groups.

At the School of Medicine and Dentistry of the University of the Basque Country (UPV/EHU), adaptation of dentistry degree curricular plans to the Bologna Process has been carried out over 2010. In addition, from formal and informal meetings and discussions with former dental student as well as among academic staff, we had become aware of several pitfalls associated with traditional, lecture-based teaching in dental education. These largely concerned the perceived lack of connections between basic and clinical subjects on the part of the students, content duplication, and questionable relevance of covered contents to real dental practice. A survey conducted among Dentistry Degree students on first-year subjects during the pre-Bologna period

confirmed a significant failure of our conventional teaching scheme to promote critical thinking and to achieve satisfactory content integration.

Formal assessment of strong points and weaknesses of traditional teaching methods revealed a few recurrent points among the answers of former first-year students. Specifically, three open questions were posed: (i) What do you remember from your first year of dentistry studies?, (ii) What did you like best, and (iii) What would you change? The responses to these questions were somewhat confirming of a common feeling among the teaching staff. A recurrent point was the failure to recognize connections of basic, first year disciplines with current dental practice or with dentistry profession. Some significant comments relating to this point are highlighted below. Phrases of the sort of “Many contents are dispensable”, “We should deepen more into aspects realted with medical and dental practice”, “I missed contents more related with real dental practice” were commonplace. Some of the more senior students even confessed to have already forgotten many of the contents received during their first year: “(contents) didn’t really have much to do with dentistry”, “To tell the truth, I remember only few things (of the first year) regarding subject contents”, but they pointed out that everything could have been different if another teaching methodology had been employed: “Maybe it is our fault not to remember what we learnt, but maybe it would be easier for us to remember using another teaching methodology”. “It does not help to memorize things without a practical application”. Another issue concerned content repetition across subjects. Finally, students perceived little opportunity to perform activities requiring research/ consultation of external information sources as well as scarcity of practical evaluation methods.

These findings prompted the staff involved in first year teaching of dentistry degree in the 2009/2010 academic year to take steps toward the introduction of active learning methodologies. In our opinion, these answers largely reflected the need of an urgent action to make the importance of basic science disciplines more visible to the first year dentistry student. It was the outcome of the above questionnaire what prompted us to the introduction of active learning methods in our teaching programs. This was an issue of obviously deep implications, and we decided to make a attempt to address it as a team, with the collaboration of all the staff responsible of teaching to the same group of first-year dentistry students at the University of the Basque Country (UPV/EHU) during the 2009/2010 and 2010/2011 academic years. Teachers involved in almost all subjects covered during the first year of Dentistry degree, both in the context of old and new curricular plans, agreed to participate in this experience. The group of study consisted of students that decided to undertake their dentistry education program in basque language. Number of students of this group is usually very small, owing largely to very strict *numerus clausus* limitations. A total of 9 and 7 students formed the study sample for the 2009/10 and 2010/11 academic years, respectively. Although this is obviously a limitation for quantitative analysis of the obtained results, interesting conclusions can be drawn nonetheless from a qualitative evaluation perspective. Additionally, this group constitutes an ideal test center for new learning strategies, since its reduced group size makes it a near-ideal condition for implementation of student-focused learning methodologies .

We designed an new activity to be implemented in our dental education programs, which was based on a variation of clinical-case teaching methodology. Our innovation consists of a multidisciplinary and multicentered approach of clinical cases, whose success critically depends on a tight coordination among the teaching staff. This study was carried out in first-year dental students at the University of the Basque Country

(UPV/EHU) during the 2009/2010 and 2010/2011 academic years. All the subjects running during the second academic term of 2009/2010 and 2010/2011 courses took active part in this project.

Our learning activity is based on fictitious clinical cases inspired by real-life dental practice. New pieces of information were coordinately provided by the teacher(s) of different subjects on a weekly basis, following an agreed and predefined plan, and students would be instructed to solve specific issues and provide answers to a number of questions, largely linked to pathophysiology and clinical evolution of presented cases. Importantly, cases were selected that promoted content integration by highlighting areas of and multiple links and connections across subjects covered during the first academic year. Care was taken to only present one new cue a week for each case, in order to prevent information overload.

Students were instructed to carry out autonomous information searches, and conclusions drawn from these along with new findings regarding each case were to be included in weekly reports on each case. Group discussions were conducted and additional explanations were provided during lecture time of the subject(s) involved each week. Lecturers assumed the role of a facilitator during the activities, and an active involvement of the learner in the learning process was continuously encouraged. At the end of the lecture period, students were expected to produce a final report on each case, which should highlight main clinical features and complications of each of the four cases, as well as general therapeutic strategies to be adopted. All students succeeded to follow and process the weekly provided pieces of information, and all of them produced the required reports.

Assessment of learners' performance on this activity was based on marks obtained both in short weekly reports and a more extensive, final case report. In the former, an emphasis was put that students would interpret presented new information pieces correctly, whereas critical reasoning on presented cases and treatment outcomes were largely valued in the latter, including review and critical review of their own prior comments and conclusions on their weekly reports.

The cases selected for the 2009/10 academic year illustrated the following topics:

1. Complicated dental caries leading to root canal treatment.
2. Orthodontic issues caused by an odontogenic tumour.
3. Tooth extraction due to severe pulp chamber infection, followed by dental implant requiring maxillary sinus floor lift.
4. Periodontal disease.

In the next 2010/11 academic year, the topics selected were the following:

1. Gingival regression and problems associated with a lip piercing.
2. Tooth decay related with poor hygiene and xerostomia-inducing drug abuse.
3. Periodontal disease and diabetes.

Credit charge for each of the involved subjects, as well as the weekly schedule for information delivery of clinical cases to dentistry students developing this activity are summarized in Figures 1 and 2.

Academic staff involved in the experience consistently noticed high level of motivation among first-year students from the very beginning of the case analysis experience.

Promotion of critical reasoning and self-directed learning by the case analysis activity was also consistently noticed by all involved lecturers. Formal assessment of the implemented activity was equally positive, specially to what concerned aspects related to content integration across subjects, connection between theory and practice, and critical reasoning. Promotion of critical reasoning and self-directed learning by the case analysis activity was also consistently noticed by all involved lecturers.

In connection with this, and with the purpose of assessing students' satisfaction with the case analysis activity in a formal manner, we conducted a 20-item survey targeting features, including (i) promotion of significant long-term learning, (ii) encouragement of autonomous learning, (iii) promotion of collaborative work, and (iv) design and implementation (data not shown). We additionally posed two open questions to the students taking part in this program: (i) What did you learn from the activity, and (ii) What would you change. The evaluation was generally very positive, and largely confirmatory of the impressions of the staff. Students almost generally agreed that case analysis activities had promoted significant learning, especially with regard to linking theory to practice, content integration, and critical thinking. It is very noteworthy that none of the students participating in this experience declared that they would return to a fully traditional scheme based solely on lectures and presentations. Regarding most appreciated points of this activity, some significant comments were: "I think this approaches a lot to dentistry reality", "I have developed my critical reasoning capabilities", "I learnt that everything is interconnected and you need to take into account all factors to find out the source of a disease", "I have learnt that (dentistry) is not only a mechanical work, that it is very important to reflect on and choose appropiate therapeutic treatments as well", "I have learnt the causes and ways of diagnosing oral diseases from different approaches", "I have been able to learn a lot of new concepts in an easier and more understandable way", "It has helped me to search and understand new information on my own, no matter the situation, and to integrate information coming from different subjects."

Conclusions

1. We developed a new multidisciplinar case analysis activity in which, notably, all the subjects in the curriculum of the first year of dentistry took part, over two consecutive academic years, 2009/10 and 2010/11, both in the context of traditional and Bologna-adapted curricular plans. This was only possible thanks to a high degree of cooperation among teachers from different subjects. It constitutes also an unprecedented experience in our dentistry faculty.

2. Our activity differentiates from traditional CBL in that clues and new pieces of information are provided from different subjects running in parallel, following a predefined plan agreed by all teachers. This interdisciplinar perspective constitutes in our opinion a great added value to overcome some serious problems often associated to traditional teaching schemes, since it allows for better content integration of basic science subjects by the students, and it also helps to better show the relevance of a good basic science knowledge in the context of the dentistry profession.

3. Our experience demonstrates that these seemingly complex CBL activities are not necessarily to be restricted to more advanced courses, but they can be in fact successfully implemented with first-year dentistry students. This helps to give further integrity to dental curricular plans and abandon the sometimes informally stated distinction between "preclinical" and "clinical" courses. It is critical however to present pieces of information always adapted to the level of receptor students, and that there

exists a clear connection between the contents running during the academic year and the clinical cases presented.

4. Finally, if properly applied, this CBL approach presents significant benefits from the perspective of: (i) connection between basic theory and dentistry practice, (ii) highlighting the relevance of basic sciences for dental profession, (iii) favouring content integration across subjects, (iv) promotion of autonomus learning, (v) promotion of critical reasoning, (vi) promotion of collaborative work. Those are all important aspects of learning that we formally detected to be deficiently adressed by traditional teaching schemes.

Questions and considerations for debate

We report here on the motivation, design, implementation and evaluation of a learning activity based on interdisciplinary analysis of clinical cases over 2 consecutive academic years, both within a context of traditional, teaching model, and a Bologna-adapted curricular scheme. This is the first attempt to implement integrated, interdisciplinary cross-subject activities for dental education in the Basque Country University (UPV/EHU).

1. Motivation for change

The conventional, lecture-based system is largely driven by rote learning and exam stress, rather than the promotion of real understanding and skills. Pressures for change include dissatisfaction of students, the desire by dental academics to deploy competence-oriented methodologies and, in the case of european universities, a practical need to meet the requirements of the Bologna Process. The consequence is the progressive implementation of active teaching methodologies, such as PBL and CBL, in new dentistry and medicine curricula (Haden et al., 2010; Pyle et al., 2006). Over the last years, there have been significant pioneering works in the dentistry field, relying mainly on hybrid models, that demonstrate the benefits of such approaches in dental education (Katsuragi, 2005; Matlin et al., 1998; Moreno-López et al., 2009; Rich et al., 2005; Tack and Plasschaert, 2006). Our contribution aims to share a new experience with the academic dental teaching community, using a model that had not been yet explored in our faculty. Importantly, this model succeeded in motivating first year dentistry students to take a more active role in their learning process. Almost all of the students declared that this activity had helped them to boost their deductive and critical reasoning capabilities, and see better the connection between basic theory and dental practice. We believe that these kind of transitional experiences are not only useful but necessary to set the foundations for a succesful transition between traditional and active learning methodologies.

2. Are basic science topics covered during the first year superfluous?

One of the most striking results of this study is the apparent perceived lack of connection between basic disciplines and real dental practice by first year students following a traditional teaching program. This is an issue of deep implications, since it can be expected that a student failing to appreciate links between basic science and dentistry profession is more likely to lack motivation to perform well in the first years of studies. Although in principle it can be considered pretty normal that a dentistry student feels more motivated by topics/ subjects in their curricula that relate more directly to their future day-to-day professional practice, we find it a very dangerous consequence

that student attention is drawn away from basic disciplines, since a sufficient knowledge of these disciplines is also necessary to properly understand the basics of modern therapeutic and diagnosis techniques in dentistry (see also Callis et al., 2010). It is also our responsibility as teachers of basic subjects to present our contents in a way that connection with clinical aspects of dental practice is maintained. In this regard, we find this multidisciplinary CBL model a very good and effective alternative. We full-heartedly tackled this issue when we decided to implement this innovation in our study plans.

3. Quantitative limitations. What about group size?

A major limitation of this study is that the student group engaged in this experience was limited to only nine and seven student fellows over two academic years, which is obviously too small a sample for any quantitative analysis. On the contrary, this constitutes a near-ideal size for a CBL-like approach, in which group size is critical for success (Barrows, 1998). Thus the following straightforward question would be: Can this activity be applied to larger groups of students? We firmly believe so, specially in the context of new Bologna-adapted plans that require to fragment the groups to carry out specific teaching modalities, such as seminars and classroom practicals. In the Basque Country University (UPV/EHU), the maximum amount to carry out a seminar under Bologna's guidelines is limited to 18 student fellows, which we think it is already a quite suitable size to adopt this kind of approaches, provided there exist a sufficiently large number of already pre-designed cases available, to be distributed among the different groups. Of course this brings us to another concern regarding repetition of the same cases across different years, which would lead to an eventual *"case burnout"*. Thus, it is critical for the teaching team staff to be capable to continously design new sets of cases, and modify preexistent ones when necessary, which is a big task not to be taken lightly. Finally, the more students to take this learning methodology, the bigger the number of teachers to be coordinated in the same way. Although the challenges are considerable, there are some recently reported cases of success of similar PBL approaches with much larger student numbers than ours (Wang et al., 2008).

4. Qualitative limitations. Requisites and necessary conditions for success.

This experience has only been possible thanks to the tight cooperation between different teachers coming from different discipline backgrounds. Given that our design consists of a modified CBL activity, we find it necessary that at least one member of the teaching staff composing the group has a sufficient expertise and direct knowledge of real clinical practice, since many clinical issues for each of the cases need to be fine-tuned before their presentation to students. We had a better chance to carry out this activity because one of the subjects running during the first year presented a chief clinical orientation. This might not always be the case in other dentistry faculties.

Contrary to what expected, the context of undergoing curricular and institutional change (adaptation to Bologna schemes) did not negatively affect the implementation of this activity. We have applied this methodology for two consecutive years, in the context of traditional and new study plans, with positive results. The real concern here remains to be the need of caution to prevent overload of information/ homework to students. The stablishment of new Bologna-adapted curricular plans, with the corresponding increase in work to be made out of the classroom, makes this another point of consideration.

Acknowledgements

The authors thank their students for their collaboration in this study, and the UPV/EHU Service for Educational Advicing (SAE/HELAZ) for technical and institutional support. This project was partly funded by a Educational Innovation Project from SAE/HELAZ.

Bibliography

(AMEE), A. f. M. E. i. E., (EMSA), E. M. S. A. and (IFMSA), I. F. o. M. S. A. (2010). The Bologna Process and its implications for medical education. *Medical Teacher* 32, 302-304.

Barrows, H. (1998). The essentials of problem-based learning. *Journal of Dental Education* 62, 630-633.

Callis, A. N., McCann, A. L., Schneiderman, E. D., Babler, W. J., Lacy, E. S. and Hale, D. S. (2010). Application of basic science to clinical problems: traditional vs. hybrid problem-based learning. *Journal of Dental Education* 74, 1113-1124.

Cumming, A. (2010). The Bologna process, medical education and integrated learning. *Medical Teacher* 32, 316-318.

Farmer, E. (2004). Faculty development for problem-based learning. *European Journal of Dental Education* 8, 59-66.

Haden, N. K., Hendricson, W. D., Kassebaum, D. K., Ranney, R. R., Weinstein, G., Anderson, E. L. and Valachovic, R. W. (2010). Curriculum change in dental education, 2003-09. *Journal of Dental Education* 74, 539-557.

Hendricson, W. D., Andrieu, S. C., Chadwick, D. G., Chmar, J. E., Cole, J. R., George, M. C., Glickman, G. N., Glover, J. F., Goldberg, J. S., Haden, N. K. et al. (2006). Educational strategies associated with development of problem-solving, critical thinking, and self-directed learning. *Journal of Dental Education* 70, 925-936.

Katsuragi, H. (2005). Adding problem-based learning tutorials to a traditional lecture-based curriculum: a pilot study in a dental school. *Odontology* 93, 80-85.

Matlin, K., Libert, E., McArdle, P. and Howell, T. (1998). Implementing the problem-based curriculum at Harvard School of Dental Medicine. *Journal of Dental Education* 62, 693-708.

Maudsley, G. (1999). Do we all mean the same thing by "problem-based learning"? A review of the concepts and a formulation of the ground rules. *Academic Medicine* 74, 178-185.

Mennin, S., Gordan, P., Majoor, G., Osman, H. and TUFH, N. (2003). Position paper on problem-based learning. *Education for Health (Abingdon)* 16, 98-113.

Moreno-López, L., Somacarrera-Pérez, M., Díaz-Rodríguez, M., Campo-Trapero, J. and Cano-Sánchez, J. (2009). Problem-based learning versus lectures: comparison of academic results and time devoted by teachers in a course on Dentistry in Special Patients. *Medicina Oral Patología Oral Cirugía Bucal* 14, e583-587.

Neufeld, V. and Barrows, H. (1974). The "McMaster Philosophy": an approach to medical education. *Journal of Medical Education* 49, 1040-1050.

Pyle, M., Andrieu, S. C., Chadwick, D. G., Chmar, J. E., Cole, J. R., George, M. C., Glickman, G. N., Glover, J. F., Goldberg, J. S., Haden, N. K. et al. (2006). The case for change in dental education. *Journal of Dental Education* 70, 921-924.

Rich, S. K., Keim, R. G. and Shuler, C. F. (2005). Problem-based learning versus a traditional educational methodology: a comparison of preclinical and clinical periodontics performance. *Journal of Dental Education* 69, 649-662.

Tack, C. J. and Plasschaert, A. J. (2006). Student evaluation of a problem-oriented module of clinical medicine within a revised dental curriculum. *European Journal of Dental Education* 10, 96-102.

Wang, G., Tai, B., Huang, C., Bian, Z., Shang, Z., Wang, Q. and Song, G. (2008). Establishing a multidisciplinary PBL curriculum in the School of Stomatology at Wuhan University. *Journal of Dental Education* 72, 610-615.

Winning, T. and Townsend, G. (2007). Problem-based learning in dental education: what's the evidence for and against...and is it worth the effort? *Australian Dental Journal* 52, 2-9.

Figure 1. Curricular design of 1st year of dentistry in the UPV/EHU by the old extinguishing plan (2009/10), and new Bologna-adapted plan (2010/11). List of subjects, their respective credit charges and corresponding academic term (first or second semester) are specified. 2009/10 course was the last sticking to a traditional program, and 2010/11 was the first to adapt to Bologna scheme. The period of application in both cases was the second semester, although subjects running during the first semester also participated in the activity, via online support platforms and guided tutorships.

2009/10

Subject	Credits	Academic term
Human Microbiology	5.5	1
Human Anatomy	7.5	1
Biochemistry	5	1
Cell Biology	3.5	1
Applied Physical-Chemical Principles	4	1
Human Histology	6.5	2
Human Physiology	7.5	2
Applied Anatomy	5	2
Tooth sculpting	5	2
Introduction to Clinical and Laboratory Practice	8	2

2010/2011

Subject	Credits ECTS	Academic term
Human Anatomy I	6	1
Human Anatomy II	6	2
Biochemistry	6	1
Cell Biology	6	1
Ergonomy and Introduction to Dental clinic	6	1, 2
Human Histology	6	2
Human Physiology	9	1, 2
Microbiology and Immunology	9	1, 2
Epidemiology and Public Health	6	2

Figure 2. Weekly delivery schedule of our interdisciplinary case analysis activity during the second term of 2009/2010 and 2010/2011 academic years. The group of application consisted of 9 and 7 first year students of dentistry in basque language during the 2009/10 and 2010/2011 academic years, respectively. New pieces of information on each of the clinical cases were provided to students on a weekly basis by lecturers in different subjects, most of them running during the second academic semester, which are coded as follows: **C**: Introduction to Clinical Laboratory Practice. **TA**: Tooth sculpting and Anatomy. **P**: Physiology. **H**: Histology. **M**: Microbiology. **EDC:** Ergonomy and Introduction to Dental Clinic. **E:** Epidemiology. **A:** Anatomy. Occasionally, information came from more than one lecturer. Students were expected to provide critical answers to specific questions posed along with the new information.

2009 / 2010

Week	Case 1	Case 2	Case 3	Case 4
1	C	C	C	C
2	C	C	C	C / TA
3	P	P	P	P
4	H	H	H	H
5	M	M	M	M
6	C	C	C	C
7	C	C	TA	C
8	H	C	C	C
9	P	C	TA/ C / H	P
10	TA	C	C	H
11	C	C	C	M
12	TA		C	C
13	TA			C
14	C			

2010 / 2011

Week	Case 1	Case 2	Case 3
1	EDC	EDC	EDC
2	H	EDC	EDC
3	M	H	EDC
4	P	M	P
5	E	P	EDC
6	EDC	P	H

7	M	EDC	A
8	H	P	EDC
9	EDC	EDC	A
10	EDC	H	A
11	EDC	M	E
12	EDC	EDC	
13	E	E	