Digital Healthcare Empowering Europeans R. Cornet et al. (Eds.) © 2015 European Federation for Medical Informatics (EFMI). This article is published online with Open Access by IOS Press and distributed under the terms of the Creative Commons Attribution Non-Commercial License. doi:10.3233/978-1-61499-512-8-607

# The impacts of blended learning design in first year medical studies

Pierre GILLOIS<sup>1.a</sup>, Jean Luc BOSSON<sup>a</sup>, Celine GENTY<sup>a</sup> Jean-Philippe VUILLEZ<sup>b</sup>, Jean-Paul ROMANET<sup>b</sup> <sup>a</sup> UJF-Grenoble 1, CNRS, Public Health Department, TIMC Laboratory UMR 5525, Themas, Grenoble, F-38041; <sup>b</sup> Dean's office directory, Medical School, UJF-Grenoble 1, Grenoble. F-38041

Abstract: In the first year of medical studies in France, students prepare for a highly selective entrance exam limited by *numerus clausus* into the second year. We have discontinued live lectures, made maximum use of new information and communication technologies and introduced tutorials in an attempt to make the first year more equitable and to personalise teaching. The reform is based on blended learning with flipped classroom organized into a four-week cycles of different activities. Each cycle corresponds to a learning module. The teachers' and students' opinions were analysed to evaluate the reforms and allow teaching methods to be adapted accordingly. The student profiles at registration and success in the exams following the reform are described. The tutorial's notes are correlated to the final scores at the entrance exam. The keys to success seem to be modified by the reform providing greater equality of opportunity between students. The factors associated to success are baccalaureate highest grades, high School Specialisation (maths, physics or earth and life sciences) and repeating the first year class. The use of blended learning allows us to face the increase of student enrolment, and to facilitate the acceptance of these pedagogical methods for both students and teachers.

**Keywords MeSH**: [Education, Medical, Undergraduate], [Students, Medical], [Active, Learning], [Education], [ diffusion of innovation]

### INTRODUCTION

We have introduced blended learning with flipped classroom in the first year of medical studies in Grenoble in 2006 with our 1300-1400 students each year. Before these reforms there were major difficulties with the way in which the curriculum was taught and examined, which demanded a radically new approach to teaching and selection. Multi-media materials and web sites are currently used extensively in medical teaching to complement traditional lectures. However, years of teaching without innovations or improvements have seen working conditions deteriorate for both students and staff. The acquisition and transfer of knowledge had become inappropriate, making students passive and isolated before a task that could rarely be managed without help [1].

<sup>&</sup>lt;sup>1</sup> Corresponding Author: Pierre GILLOIS. Laboratoire TIMC. Pavillon Taillefer. CHU de Grenoble BP217. F-38041 Grenoble Cedex09. France; Email: pierre.gillois@imag.fr

In the first year, a competitive examination is held with a *numerous clausus* as a fixed and limited number of places, permitting, or otherwise, continuation of medical studies, or reorientation into related courses (dentistry, physiotherapy, midwifery etc). The success, for the student, was to be ranked with the best, beyond the limit of the *numerus clausus*. The examination for entry into the second year was supposed both to limit the number of students and to select the best ones. Thus, the content of lessons was modified with the level of difficulty used as a tool of selection [2]. Through an innovative pedagogy we aimed to provide personalized teaching and learning to all students. This would have been impossible with conventional teaching methods due to limited teaching time, restrictions in staff numbers, the limited capacity of lecture theatres, the availability of classrooms, scheduling problems etc. [3-5].

Our main goal is to provide predictive models of success and highlight several different aspects of learning and teaching with these innovative pedagogies. We present an assessment of the impact of these reforms.

## 1. Materials and Methods

The content of the first year curriculum and the entrance exam into the second year were not changed. Before 2006, larges amphitheaters were used by teachers for conventional lectures, lab classes and groups exercises. Teaching and learning methods changed in 2006 with included blended learning mainly based on flipped classroom. The academic year is divided into two semesters with a test based on multiple choice question (MCQ) examination at the end of each semester [6]. All thematic were divided in 4 weeks of 4 sequential activities:  $1^{st}$  : self-learning with knowledge capsules,  $2^{nd}$  : interactive online questions (IOLQ),  $3^{th}$  : interactive on-site training and explanation meeting (IOSTEM) with teacher by groups of 180 students and finally  $4^{th}$ : tutorials with MCQ with tutors students by small group of 40. Each module included 2 thematic lasting four weeks. In one semester 12 overlapping modules are studied (Figure 1). At the end of every tutorial terminating a learning module, students completed an anonymous survey from the proprietary pedagogical platform used "Learneos". This evaluated both the lesson contents and the teaching methods.



Figure 1. The four activities of the learning cycle

The student characteristics were collected at registration and the results of the competitive examination were obtained from the administrative databases. All data were analyzed into R-Software (http://cran.r-project.org/). The approximate normal distribution was assessed for quantitative variables. Results for continuous variables are expressed as mean  $\pm$  SD. Significance was set at p $\leq$ 0.05 level for all comparisons. The independent risk factors influencing success in medical school were determined by multiple logistic regression analysis. Variables were eligible for entry into a multiple logistic regression model if they were significantly associated with admissions at a p < 0.20. The final model was presented with Adjusted Odds Ratio and IC95 for each factors.

# 2. Results

The size of the pluri-annual student cohort was 10 995 and cover reference years 2000 to 2009. Over the past 10 years, the number of students fully following the first year of medicine has increased from 858 to over 1253 per year. The numerus clausus has followed this trend, from 98 in 2000 to 169 admitted to the second year of medicine in 2009. The proportion of women registered has remained high, 2 out of 3 students were girls (66.0% n=10 995). Students come mainly from upper socio-economic families (52.6%) with less than 12% from the lower socio-economic classes. These numbers stayed more or less stable (2000-2005) up until the reforms. Most students (87.3%) have followed scientific courses at high school, in particular the "Earth and Life Sciences" (biology and geology) course (51.3%). Only 12.7% attempt medical studies with a non-scientific baccalaureate. The proportion of first year students with a "mention" grade in the baccalaureate exam (>12/20 weighted average mark) has been increasing from 54.4% in 2000 to a highest 70.8% in 2009. More and more students continue to live with their parents and the proportion living independently in the same agglomeration as the parental home has decreased. Despite the reforms, the large proportion of students repeating the first year (37.8%, n=10 995) has remained stable.

The personal MCQ score, for each module, should be used by each student as reflection of the effectiveness of his own learning. Based on the final evaluation of each cycle, more than 85% of students satisfied with self-learning with knowledge capsules that replaces traditional lectures and more than 90% attending at least one of the interactive on-site training and explanation meetings or MCQ tutorials. This weekly student survey system is used for the debriefing meeting as quality indicator of learning and training.

Although most of students were female, the results of the tutorial MCQ tests and the final examination were proportionally no better than for males. There is significant correlation between final examination ranking and the scores and mean rank obtained in tutorials during the year: 0.75 by Spearman's Rank Correlation Test (Figure 2). Only 8% of successful students never participated in the tutorial system.

An analysis before the teaching reform (over the period 2000-2005) showed that the following variables influence success, in the competitive examination: socioprofessional category of parents, score >12/20 ('mention') in baccalaureate, high school specialization, how studies and/or maintenance during studies are financed and repeating the year [9].



Figure 2. Correlation between final examination ranking and mean rank obtained in tutorials (ex. in 2009)

Five years before the reforms, students from the upper middle class had more chance of success of gaining a place in the second year of medical or dental school than students from lower socio-economic backgrounds. In 2006-2009 this inequality appears to have decreased (Table 1). The variables that have remained significant in the model are a good baccalaureate grade (>12/20) and whether the student is repeating the year. The better the grade obtained in the baccalaureate the better the chance of success in the medical school examination. The parental socio-economic category, the type of high school specialization, the rating of the high school and whether the student was on a grant do not intervene anymore.

Multiplicative factors of success (Adjusted Odds ratio [CI 95])	Before the teaching reform (2000-05)		After the teaching reform (2006-09)	
Parental Profession: Upper class vs Others	1.69 [1.21-2.35]	S	1.26 [0.85-1.86]	NS
Parental Profession: Middle class vs Others	0.74 [0.47-1.17]	NS	1.30 [0.81-2.08]	NS
Parental Profession: Working class – farmer vs Others	0.86 [0.60-1.21]	NS	0.77 [0.51-1.15]	NS
High School Specialization: Maths vs Others	5.78 [3.83-8.73]	S	1.84 [1.32-2.56]	S
High School Specialization: Physics vs Others	3.71 [2.46-5.59]	S	1.64 [1.21-2.22]	S
High School Specialization: Earth and Life Sciences vs Others	2.75 [1.86-4.08]	S	1.45 [1.11-1.90]	S
Baccalaureate grade: B ( $\geq$ 12) vs C(<12)	3.99 [3.16-5.04]	S	4.63 [3.24-6.61]	S
Baccalaureate grade: $B+ (\geq 14)$ vs C	12.30 [9.59-15.78]	S	13.76 [9.69-19.55]	S
Baccalaureate grade: A(≥16) vs C	51.38 [36.15-73.04]	S	50.24 [34.02- 74.20]	S
Student grant holder vs none	0.76 [0.59-0.98]	S	0.78 [0.60-1.02]	NS
Repeat vs. First attempt	7.17 [5.94-8.64]	S	4.43 [3.62-5.41]	S

Table 1. Multivariate logistic analysis with Odds Ratio and CI 95

# 3. Discussion

Through our teaching and learning reform, we show that lectures in large packed amphitheatres can be successfully transformed into teaching in smaller groups associed with. While students repeating the year exhibited relative nostalgia for the old style lectures and the working conditions of large amphitheatres, they acknowledge the high quality of the rich media lectures and appreciate the more personal follow-up. One major advantage of the regular MCQ tests and the tutorial system is to provide personalized pedagogical follow-up by the MCQ results. Students appear strongly motivated by the tutorials based around a series of MCQ answered under the same conditions of time, paper etc, as the exam. They can judge the effectiveness of their study methods and compare themselves throughout the year to other students taking the same examination. They have a formidable tool to perceive the effectiveness of their methods of learning right from the start of the course. The students quickly become aware of the disciplines in which they are in difficulty and thus can adapt methods of working accordingly.

The number of registered students in Grenoble is in constant progression, has doubled in just few years. Recently students with specific profiles, such as high-level sportsmen and handicapped students, have started to register in the first year of medicine in Grenoble. Flipped classroom methods allow them to better organize their workload and other activities. Likewise, interactive on-site training and explanation meeting and tutorial timing permitting, the reforms could enable students from modest backgrounds to work part-time to support themselves. The educational condition doesn't change over the years since the flipped model was introduced. The same topics has been teaching for over 10 years.

The Grenoble reforms show that the enthusiasm and conviction of a teaching team make it possible to carry out a joint, challenging and innovative project with success. We hope that the action taken by the Faculty of Medicine in Grenoble will be a starting point and will encourage other faculties to become involved in similar projects. Other major faculties of medicine are negotiating to implement solutions similar to ours. One prerequisite for such reforms is that in the 21st century it is essential that teachers, as well as students, are familiar with the latest technology and communication tools.

### REFERENCES

- Link TM. Marz R. Computer literacy and attitudes towards e-learning among first year medical students. BMC Med Educ. 2006 Jun 19; 6:34.
- [2] Durak HI. Törün SE. Sayiner A. Kandiloglu G. Description and evaluation of an innovative course on learning and study skills for the first year medical students. Tohoku J Exp Med. 2006 Nov; 210(3):231-7.
- [3] Platt MW. Anderson W. Obenshain SS. Use of student-centred. computer-mediated communication to enhance the medical school curriculum. Med Educ. 1999 Oct;33(10):757-61.
- [4] Gjerde CL. Pipas CF. Russell M. Teaching of medical informatics in UME-21 medical schools: best practices and useful resources. Fam Med. 2004 Jan;36 Suppl:S68-73.
- [5] Kerfoot BP. Masser BA. Hafler JP. Influence of new educational technology on problem-based learning at Harvard Medical School. Med Educ. 2005 Apr;39(4):380-
- [6] Renard JM. Pagonis D. Vuillez JP. Romanet JP. Sele B. E-learning for students in their first year: a French experimentation at the medical school of Grenoble. Stud Health Technol Inform. 2007;129(Pt 2):1362-5