EVOLUTION OF TEACHING STRATEGIES IN A FRENCH ODL UNIVERSITY COURSE

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The university course on statistical methods in health at the Bordeaux School of Public Health, University of Bordeaux, has been run as an Open and Distance Learning (ODL) program since 2004 on the basics of statistical reasoning in the health field. The course is mainly for professionals. In more than ten years, about 1,000 people have been trained with over a third coming from sub-Saharan Africa. The program aims to meet a growing demand for statistical training from professionals from the south whose mobility is limited. Each year a satisfaction survey is sent to students with a view to improving the program. Even though participation in the survey is anonymous and not compulsory, it is a valuable source of comments and ideas. These have led to innovative pedagogical practices such as "tutored exercises" with individual correction, the use of new statistical software, summary sheets and flipped classrooms. However, benchmarking of the program has shown that more could be done. Teaching strategies should evolve within the framework of distance learning in terms of content, form and interactivity. This article discusses the development of these new educational strategies from their inception as well as future projects.

CONTEXT

The Bordeaux School of Public Health at the University of Bordeaux (France) set up online "university diplomas" in 2001 in response to a request for proper education, training and adequate certification in public health from a French-speaking audience that could not be present for face-to-face training for geographical or professional reasons. University diplomas are institution-specific degrees presented as single subject courses that reflect the strengths of individual universities and offer students opportunities to gain university-level education in specific fields. The Open and Distance Learning (ODL) program was born out of political will, the commitment of the teaching staff and thanks to financial opportunities that, among other things, allowed the establishment of an information technology department that manages the learning platform.

Currently, ten online French university courses are available (http://ead.isped.u-bordeaux2.fr). University courses in Spanish are also proposed. Among the online university courses, two concern the biostatistics track (*Statistical methods in health* and *Statistical regression methods in epidemiology*) and four the epidemiology track. Indeed, epidemiology and biostatistics are one of the strengths of the Bordeaux School of Public Health, which is recognized internationally. The courses are run entirely online except for the final session exam, which is conducted in accredited centres around the world such as universities, French embassies, French high schools or centres within the University Agency for French-speaking communities (AUF). In addition, the online master's program in Public Health at the University of Bordeaux became effective in fall 2007. The master's degree is a more advanced program that has exam sessions but also two-week face-to-face courses organised in a few accredited centres (currently the University of Bordeaux in France, the University of Abomey-Calavi in Benin, and the Institut Pasteur in French New Caledonia in the Pacific Ocean). The master's degree is offered online- and campus-based while only an online program is proposed for the ten university diplomas.

The minimum admission requirements for the university course in *Statistical methods in health* are an undergraduate degree or at least five years of relevant work experience in the health sector. The university course *Statistical regression methods in epidemiology* and the master's degree are more selective with specific admission requirements. The subject courses programs are mostly included in the educational program of the Masters in Public Health. Thus, validating the single subject courses implies automatic validation of statistical or epidemiological courses in the interdisciplinary first year of the Masters.

STRUCTURE, FUNCTIONING, AUDIENCE

The university course on statistical methods in health at the Bordeaux School of Public Health, University of Bordeaux aims to teach the basics in statistical reasoning and methods in the health field. The course, which has been run since 2004, allows students to develop their ability to conduct data analysis as end-users.

The teaching period runs from mid-October to late May. The program involves 100 hours of teaching, plus personal study/work time (exercises, graded and non-graded assignments, and review for the final exam). This corresponds to a weekly work load of 4 to 5 hours. The course contains four modules:

- Descriptive statistics, introduction to general terminology
- Introduction to the fundamental concepts: random variable, basic discrete and continuous probability laws, population, sample and sampling fluctuation concepts, sampling distributions, central limit theorem, point estimation, confidence interval
- General principles of statistical hypothesis testing, one and two sample models, main parametric and non-parametric tests
- Introduction to simple linear regression and one-factor ANOVA

Each module is structured in three parts. First, the course introduces concepts, which are illustrated by several examples from health studies. Definitions and calculation methods are introduced as the need arises in a convenient, self-contained and intuitive way. Second, written exercises are proposed. Finally, lab exercises can be solved using software. Introductions to recommended statistical software and MS Excel spreadsheets are also provided.

The course schedule including the online availability of documents, theoretical courses, exercise corrections, assignment corrections and deadlines for graded and non-graded assignments, past years' exams etc., is announced at the beginning of the academic year. News and updates are posted using the news column or are distributed by email. The Bordeaux School of Public Health online degrees are offered using an in-house customised learning management system called Plei@de that is an intuitive and ergonomic platform. Like other learning platforms, for example Moodle or Dokeos, it provides technical support for exchange between teachers and students: repository for course material or web pages, upload of assignments, data files, quizzes, forums, technical assistance, space to share or store files, online resources and tools, student marks, etc. Plei@de offers a high degree of fluidity in the interaction between students and teachers. The use is simpler than Moodle in that sense that it offers, in the same space, educational, technical and administrative information. The platform also provides user statistics: number of visits, number of finished exercises and corresponding scores, downloaded documents, uploaded assignments, date of last access, etc. This can be used as a tool to assess the availability, motivation and serious-mindedness of students.

The final grade for a course is determined by a weighted average of the marks students receive on all of their course assignments and exams. To pass the course, students must have a weighted average of 50% or better on the exam and the graded assignments. There are two planned assignments (one for the first two modules and another for the last two modules) that are weighted equally and a final exam that accounts for two thirds of the grade. The final exam is taken in specific centres all around the world, where the presence of the student is required to ascertain his/her identity. After a decade, more than nine hundred students have participated, the number of students per year varying between 60 and 100. More than one-half of students are from Africa, the most numerous coming from sub-Saharan Africa (taken as the country of residence). Approximately a third of the students come from Metropolitan France (the part of France situated in Europe). In fact, a partnership has been established with the AUF which finances several students per year. Between 45 and 90% of the students per year pass the course, and the annual dropout rate (taken as the number of students absent for the final exam) varies between 12 and 30%. Table 1 presents differences in dropout rates and pass rates according to the region of residence for the last three years. Dropout rates are highly variable from year to year and intra-group variability is higher than intergroup variability. Metropolitan France residents group showed the highest pass rates; however the potential for confounding is obvious.

Table 1: Annual dropout rate, taken as the number of students absent for the final exam to N, the total of participants, and annual pass rate, taken as the number of students having a weighted average of 50% or better on the exam and the graded assignments to n, the number of participants present for the final exam. Rates are computed for participants coming from sub-Saharan Africa, Metropolitan France, and other regions for the last three years (course in Statistical methods in health, Bordeaux School of Public Health, University of Bordeaux, France, 2013-2016).

	2013-2014		2014-2015		2015-2016	
Residence	Dropout rate (N)	Pass rate (n)	Dropout rate (N)	Pass rate (n)	Dropout rate (N)	Pass rate (n)
Sub-Saharan Africa	8% (49)	56% (45)	24% (34)	65% (26)	21% (38)	50% (30)
Metropolitan France	26% (38)	75% (28)	20% (30)	92% (24)	12% (42)	81% (37)
Other regions	13% (15)	62% (13)	11% (19)	71% (17)	47% (15)	63% (8)
All	16% (102)	63% (86)	19% (83)	76% (67)	21% (95)	67% (75)

The vast majority of the students are in the health sector. For instance, in 2014-2015, only 13% of the students came from non-medical professions, 53% came from medicine and the remaining percentage came from dentistry, midwifery, pharmacy, nursing or associated health professions. Some of them are already experienced health professionals while others are still studying and not yet qualified.

INSTRUCTIONAL DESIGN, EVOLUTION

Once the purely online approach was adopted, the pedagogical thinking had to change entirely. We could not limit ourselves to downloadable educational content but had to explore the best possible ways of supervising or advising students throughout their gradual learning process. We had to take into account the traditional constraints associated with e-learning student profiles: e.g. professionally active adults who want to acquire an advanced degree or new professional skills but do not have time to attend regular classes. In addition, constraints specific to the targeted audience had to be considered, i.e. professionals in the public health sector located in different countries worldwide with variable internet connection quality and living in different time zones. We also realised we needed to develop interactive web pages. Animations could be used to reinforce conceptual understanding by illustrating particular points and active learning that made the course dynamic. However, downloadable documents (handouts, exercises, etc.) were required because of unequal access to Internet.

A flexible schedule, freedom of action, reduced indirect training costs and a cooperative learning environment are all advantages of online teaching compared to traditional face-to-face classes. However, factors such as student isolation may lead to a high dropout rate (Packham et al. 2004, Park et al. 2009) and a high failure rate in distance learning. The most conventional ways to overcome this problem are forums, which we offered as part of each teaching module, or the use of email for direct contact with the teacher. In general, forum discussions dealt with misunderstanding of mathematical formulas or concepts, understanding the use and sense of statistical calculations and reasoning, particular problems when using statistical software, questions on particular steps when resolving exercises, etc. Forums are also conducive for exchange between students. Students can answer each other's questions, share difficulties, and give explanations and advice, which is beneficial for all students concerned (Hall et al., 2010).

To assess the quality and effectiveness of our courses and understand what has not worked in order to change it, a systematic annual evaluation is conducted. Mills and Raju, 2011 summarized effective practices for teaching statistics online, and in particular, they recommend conducting evaluations to monitor the teaching and learning process. The satisfaction survey that is sent to students contributes to improving the program. Questions relate to learning objectives (for each module and software training), interactivity (utility, effectiveness), visual impact, technical functionalities (interface and navigation effectiveness) and training tools, assistance quality (technological, pedagogical or administrative problems), time (real availability, real personal

study/work time), habits and environment (internet accessibility, material preferences). Tudor, 2006 showed the impact of interactivity on student satisfaction.

Since participation in the survey is not compulsory, a selection bias effect is more than likely, so caution is required when interpreting these results (Zumrawia et al., 2014). Roughly, students responding to survey questions are globally satisfied. Since participation in the survey is anonymous, comparisons in reactions to course innovations or in survey responses between different groups (according to residence region, dropping out, passing the course, etc.) are not possible. The interest is to gather comments and ideas that have led to the implementation of new pedagogical practices. First, the forum alone cannot meet the expectations of all students. As in a classroom, shy or unsure students may be reluctant to openly formulate their questions on a forum. After two years of experience, we decided to introduce the notion of "tutored exercises" which are non-graded assignments in every module that lead to personalized feedback. They allow students to train, to evaluate themselves and to receive personalized correction so that they can identify potential errors or misunderstandings and improve their writing. By providing personalized feedback that guides students towards improvement, student motivation is fostered throughout the year and the feeling of isolation is somewhat reduced. Furthermore, teachers receive quick feedback on learners'' difficulties. In fact, there is a close relationship between doing "tutored exercises" and results in graded assignments and at the final exam (Figure 1). This relationship should be interpreted cautiously since further research is required to establish whether doing "tutored exercises" has a positive effect on motivation by keeping students involved and active or whether it is simply a marker of motivation.

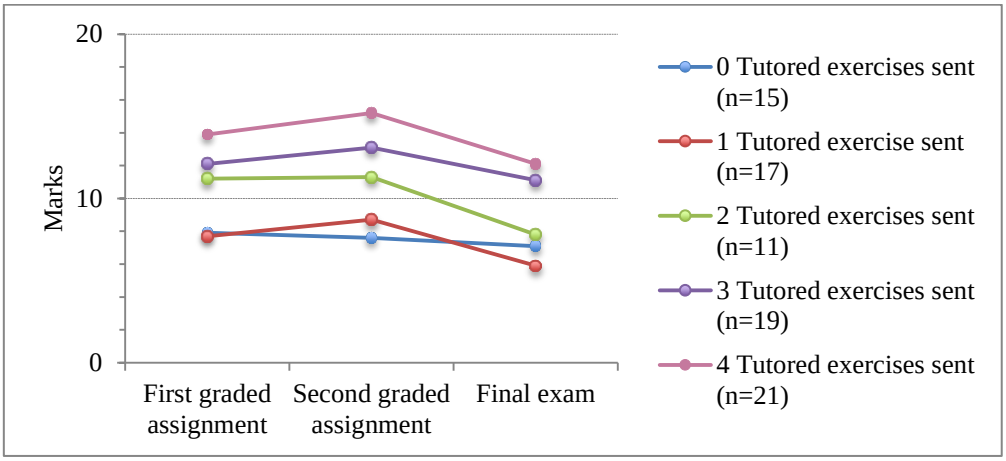

Figure 1: Average marks (the higher the better) of graded assignments and final exam per number of "tutored exercises" sent among the four "tutored exercises" (course in *Statistical methods in health*, Bordeaux School of Public Health, University of Bordeaux, France, 2014-2015, 83 students). n indicates the number of participants in the group.

Examples used in the course, "tutored exercises", graded assignment and final exam questions are based on real publicly available data or real data with restricted use. Also, simulated data based on health studies are used. Real data with restricted use came from studies conducted in the Bordeaux School of Public Health, e.g. the intima-media thickness measurement study (Mercié et al., 2002) or the PAQUID cohort of individuals aged 65 years or older followed from 1988 until present to study the effects of different environmental, behavioural, and social vectors of age-related medical conditions and diseases (Lemeshow et al., 1998). Simulated data are based on epidemiological research articles or on studies conducted in the Bordeaux School of Public Health that are not available for educational purposes, such as data coming from the i-Share cohort aimed to gain better knowledge and understanding of students' state of health over a period of at least 10 years (Guichard et al. 2016).

All the modules now start with a video presentation of the teacher who concisely summarises the course content. This provides learners with eye contact with the teacher. We recently introduced virtual classrooms by means of the Adobe Connect web conferencing software using a flipped classroom style. In general, students appreciate real-time contact and oral communication to ask

questions (instead of writing questions using the forum, which needs precision and involves non-instant feedback). Furthermore, discussions are more fruitful and students' errors of interpretation or understanding are identified more quickly and easily. At least one virtual class per module and statistical software are planned and announced from the beginning of the academic year. Different Internet connections or equipment quality, time zones and availability are still a problem with synchronous online classes in which all students need to be online at the same specific time in order to participate. A brief summary of questions and discussions is posted on the forum especially for absent participants.

Initially, EpiInfo, an easy-to-use database and statistical analysis program widely used by epidemiologists, and MS Excel spreadsheet were the only programs taught in this university course. While they are well suited to our audience, neither EpiInfo nor MS Excel spreadsheet allow the implementation of all the methods taught in this course. R (R Core Team, 2013) offers greater scope and its fast-growing popularity makes its use mandatory. In recent years, the introduction to the R module has been improved and virtual classes allow direct explanations. It has become more and more difficult to propose multiple software solutions to resolve data analysis exercises. Consequently, we now focus on R mastery. However, students' results are still unsatisfactory so considerable effort needs to be made by students to master this software.

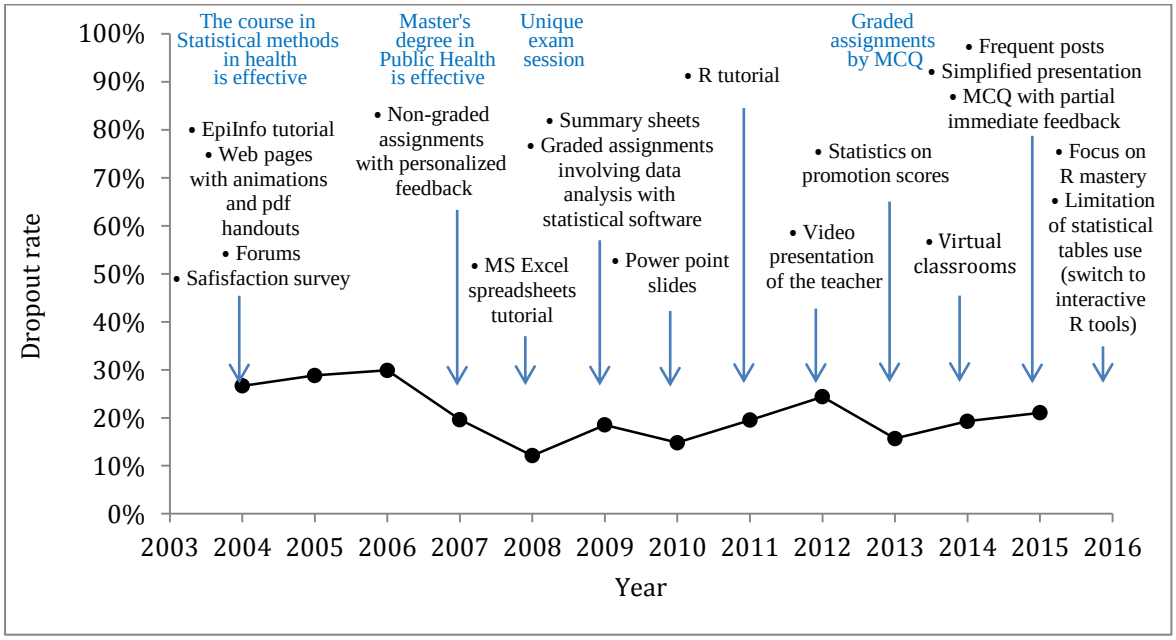

Figure 2: Dropout rates and innovations adopted over time from 2004 to 2016 (course in *Statistical methods in health*, Bordeaux School of Public Health, University of Bordeaux, France).

As a result of students' requests or remarks concerning their habits, we introduced changes to the presentation. First, summary sheets were provided for each module. In addition, the redundant content available as web pages and power point slides was deleted and only downloadable pdf handouts were kept. Web pages were still useful for the animations they contained. This led to a simplified presentation. The homepage is now animated and frequently renewed to encourage users to return regularly. Multiple-choice questions (MCQ) have been added to each module with partial immediate feedback that encourages students to search for the right answers in the course. However, compared to popular e-learning platforms like Moodle which allowing for fast developments and the integration of new functionalities, our platform lacks modernity. Since Moodle has been widely adopted by the University of Bordeaux, we now need to create a link between the platforms in order to capitalise on what Moodle has to offer, e.g. the wide variety and potential of its evaluation tools.

Figure 2 shows annual dropout rates from 2004 to 2016 and summarizes innovations adopted over time. Also, organizational modifications are indicated. For example, the suppression of the second session exam (because of the organisational burden and small effectiveness) and the graded assignments using a MCQ system that improved timing of notification of results to students. In these

graded assignments students are expected to solve each MCQ by conducting data analysis using software. In general, the relationship between innovations adopted and dropout rates are not conclusive and confounding is more than likely. However, adoption of "tutored exercises" shows a positive effect on the decrease of dropout rates.

CONCLUSION

Distance learning has become a great tool for gaining access to knowledge and diploma courses. It particularly encourages the professional development and improvement of public health in Southern countries while contributing to maintaining the integration of their health managers in them. Since its inception, the educational strategy of the *Statistical methods in health* course has not been limited to the launch of downloadable educational content but also included exploration of the best possible ways to supervise and counsel students throughout their gradual learning process. Thanks to feedback from annual training satisfaction surveys sent to students, we have introduced several changes, e.g. "tutored exercises", virtual classes, new statistical software training and supplementary MCQ. Because of the importance of provision to Southern countries, it would be useful to analyse feedback by region of residence. The assessment of R courses is still a challenge for students attracted by the course. Furthermore, it is difficult to keep abreast with other learning platforms such as Moodle that are developing innovative tools at a fast pace thanks to the heavy financial investments made in them. Nevertheless, after a decade, we now have sound experience in ODL, even though this sector requires constant re-evaluation, re-adaptation and re-thinking of the best educational strategies and learning tools.

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