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ENGINEERING HEALTH AND SOCIAL SCIENCES CURRICULUM: GOVERNANCE OF THE PEDAGOGY, PEDAGOGY OF THE GOVERNANCE. TOWARDS A HOLISTIC BEHAVIOUR OF TEACHERS & LEARNERS.

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ENGINEERING HEALTH AND SOCIAL SCIENCES CURRICULUM: GOVERNANCE OF THE PEDAGOGY, PEDAGOGY OF THE GOVERNANCE. TOWARDS A HOLISTIC BEHAVIOUR OF TEACHERS & LEARNERS.

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Abstract: The Higher Education in France is organised through 2 parallel ways. The Universities are enrolling the students with no entrances' examination. And the "preparatory classes" (CPGE) are preparing students to entrances' examinations in the Engineers' "Higher Colleges" (like École Polytechnique, École Centrale, ENSAM -a Mechanical Industrial Engineering School-) and in the Écoles Normales Supérieures (ENS -the Superior Teachers' Training Colleges-). But some Universities have just been creating intermediate structures with "Integrated Preparatory Classes" (UIPC), "classes" for preparing the entrances' contests of the Universities' Institutes of Teachers' Formation (IUFM) or of the Paramedical Professional Schools. The pressure of selective entry into those Schools is enormous, with usually more than 3000 candidates outside (for the most highly-rated ones) and only 30 places inside. What pedagogy to adopt (Bricage, 1993) to optimise the students' success? What governance (Collectif, 2007) and which structures to set up to support this pedagogy? The "experimentation" showed that only a "driving" behaviour of the teachers through a very "active", "local and global", coaching of the students (Bricage & al., 2006), with a very strong workload of training for both and a total, but "supervised", autonomy of the students, allows to optimise the success of each one: "A place for each one & each one at her/his place." Only the implementation of a continuous assessment and a "quality control approach", both internal -of the parts (the students, the teachers)- and external -of the whole-, allow to optimise the success of all the partners, with the most raised percentage of global success (Bricage, 1981, 1998) -Figure 1-. Nothing is obtained without big mutual (global) and reciprocal (local) efforts. "The student has the teachers whom he deserves and the teacher has the students whom he deserves too." The set up of an Association for the Reciprocal and Mutual Sharing of Advantages and DisAdvantages (ARMSADA), a "synallagmatic" deal, like in a biological system, allows the best successes of the partners and of the whole (Bricage, 2007) - Figure 2-. Thus even the formation of the first degree schools' teachers must take into account their initiation into the use of the systemic approach. Biology is very useful to do that (Sattler, 1986) because it needs the use of chemical & physical concepts and of mathematical & computing tools (Bricage, 1977, 1981, 2010).

Keywords: competition, engineering, higher education management, "parceners", quality control.

Introduction

In France, for 15 years the number of "professional" **"high school leaving certificated"** (baccalaureate graduates) has been continuously increasing. It has doubled, while that of the other **"general"** and **"technological"** sections did not change. In 2010 for the first time, the number of **"professional"** baccalaureate graduates has exceeded that of "technological" ones. And more, a reform of the French educational system will result in the next 2 years to a double of the number of "professional" baccalaureate graduates. A modelling is indicating that, in the next 10 years, for 3 "general" baccalaureate graduates there will be 2 "professional" ones and 1 "technological" one (Bignon, 2010). How to take into account this "professional" population that is increasing as a result of the failure of success of high

school people who has no satisfactory general or specialized skills (Bricage, 2008a)? How to "upgrade" this next University undergraduate population? How to re-orient aged people towards non-disqualifying and vocationally motivating curricula? What incentives can be found among both students and teachers (Bricage, 1978a, 1978b) to do so? What sorts of pedagogy to be implemented (Bricage, 1985, 1993) and for what purpose? This population is excluded from the way of excellence of the CPGE. - The CPGE are pre-specialized post-baccalaureate very high level courses, designed to train the best "general" baccalaureate graduates. Outside of the Universities, they are preparing their people for the competitive entrance exams of the Engineers' Colleges.- The "professional" students are also excluded from the IUT and IUP. -The IUT and IUP are post-baccalaureate specializing Academic courses that were originally designed to welcome people from "technological" high schools.- To meet this challenge, the University of Pau et Pays de l'Adour (UPPA) has established, 25 years ago, in its Faculty of Sciences and Technology, new structures. In the "initial teaching" way these are the APILS (a preliminary one year class for the preparative entrance as an undergraduate in Bachelor of Sciences) -a structure of upgrading towards a new orientation (but through the effort and the enthusiasm of the students) with a strong teaching accompaniment-, and the DUCSS, an University Diploma for the preparation of the competitive entrance of the Health & Social professional Colleges -careers in para-medical engineering: radiology examiners, ergo-therapists, psycho-motivetherapists, chiropodists, physio-therapists (http://webcampus.univ-pau.fr/courses/DUCSSSANITAIREWEB/ webcampus & http://dep-biologie.univ-pau.fr/live/diplomes universitaires/D.U.C.S.S./ web site), and -careers in societal assistance in social services (Bricage, 1998). In the "continuous formation" way these are the preparation for competitive entrance into the teachers' training Colleges (Bricage, 1985, 1993) -University institutes of teachers' training (IUFM)-, and the Bachelor of Health & Social Sciences (L3S) -for the validation of professional "engineering" competencies of people that are appointed with professional responsibilities for which they have the title(s) but not the diploma-. This was a "visionary approach", since for 20 years, whereas in all of the Bachelor Academic courses (except in Law), the number of enrolled students was decreasing, in Health & Social Sciences it was doubling in 10 years. The implementation and evaluation of this whole system, of both "upgrading for reorientation" and "preparation for competitive entrances", for the Health, Society & Education professions, at the all levels of the Bachelor of Sciences, has been done through the systemic & cybernetic approach to set up an "educative & societal engineering" (Hooman & al., 2010) of a training system of "engineering in sanitary, social & education sciences" (Bricage, 2003, 2007). But given the ergodicity of the education system (Andjel & al., 2002) that was done with the use of an "ergodic" model of living systems' cybernetic functioning (Bricage, 2001b, 2010).

1. The Building up of the Students' Team by the Teachers' Team (DUCSS).

• A cybernetic approach of the constraints' modelling based on previous assessments of pedagogic functioning -younger people are, better is their quantitative success (greater is their number of competitive accesses) and their qualitative one (more successes in more difficult competitions), -more their motivation is high (as measured by the number of competitive registrations), the higher is their probability of success (at equal skills level) (Bricage, 1998). Given the non-selective entry into the first year of the Universities of Medicine, the most skilled students, or the more motivated ones, will not come into our para-medical year, they will go into the medical Universities even if less than 1 for 10 will pass and go into the second year of medicine. Thus in DUCSS pre-recruitment we have been forced to make a wide master list (80 are retained for 15 to 30 available seats), with a complementary list acting as a buffer. During the selective phase of the population of the students that will be allowed to register it is necessary not only to take good candidates but also to recruit candidates with a "well balanced potential" profile and that have proved their motivation through additional or "unusual" extra-curricular activities. In biological, medical, or social sciences, women are more than 70% of the candidates. So it is necessary to recruit less motivated or skilled male candidates, particularly in the supplementary list. In IUFM and APILS all applicants are admitted without selection. • A systemic semiotic method of selection based on the up to date performances of the candidates -compared to the previous assessments of the functioning of the preparation (DUCSS) -or to the results of the professional validation (L3S). All applications are reviewed. All accepted students are simultaneously enrolled in DUCSS and in the first year of the Bachelor in Life Sciences (L1SDV) because any "DUCSS passing" student is passing also this first year.

2. The Building up of the Teachers' Team by the Head of the Educative Team (DUCSS).

Whatever is the class, "re-orientation" (APILS), "validation" (L3S), or "preparation to a contest" (DUCSS, IUFM), the inflow is anticipated by a few days for the tutoring and testing of the students' pre-requisites. Each requires a specific support (Bricage, 1998). Thus the pattern of the accepted applicants is inseparable from that of the involved

teachers (Bricage, 1999, 2003). The observation of the functioning of the webcampus has shown that the courses related to coaching students in difficulty or to the preparation of students for competitions are twice as popular as the traditional Academic ones -relative to research specialisation- (Bricage, 2008b). Thus teachers using the webcampus & Internet as a mean of communication, to supply documents, and to control the amount & the regularity of the students' works are specifically recruited. But only if they do not neglect the use of traditional action for all kind of students and with a personalised accompaniment of everybody: a co-educative inter-action, a mix of the experience & exigences of the teachers and the hopes of the students, allowing each of them to choose, given their aspirations and rank within the class, a reasonable choice of opportunities, depending of their self evaluation of their own skills.

3. The co-Orientation of the Students & Teachers co-Working (APILS & DUCSS).

The beginning of the DUCSS's "sanitary option" is anticipating the academic year beginning. Phase of pedagogic questioning and mentoring it has a first role into the educational and professional guidance. Obligatory, it will not be repeated. It helps to define the conditions of working -with their advantages and disadvantages, -with the rights and the obligations of both the students & the teachers, -with the types and the frequency of the controls, and -according to the "*a priori*" choices of the students. It is a very important phase in the context of the preparation for a competition, the success (or the non-success) of which will determine the whole future of the individual. The whole year training is first used to allow the student to be aware of the difficulty of the contests and to help him/her to self evaluate her/his potential for a "possible" success ... depending on her/his choices and efforts (Bricage, 2003).

• <u>A systemic educational training</u> with a humanistic approach based on the 7 educational principles of Edgar Morin (Juarez-Najera & al., 2006), but taking into account the different purposes of coaching for a competition ("to be among the best" -qualitatively & quantitatively-) or for upgrading ("validating a minimum" of qualifications).

• <u>A systemic approach</u> to the implementation of this training to ensure the best fitting between the teachers' staff & the students' group, based on the 10 principles of the systemic educational governance (Bricage & al., 2006),

• <u>A systemic approach to retro-control</u> this educational approach based on the objective of encouraging the students to make a whole for helping each other mutually and reciprocally: *"Un pour tous, tous pour un"*.

• <u>A systemic & cybernetic approach of co-interaction</u> between the teachers & students based on the principle of "<u>the systemic constructal law</u>" (Bricage, 2004, 2008a): "Causality is circular." (Sattler, 1986), "Interaction is construction & construction is interaction.". The whole's governance is managing the teaching and vice versa. The actions of the students are orienting that of the teachers who are orienting those of the students. The students' performances drive the recruitment of the teachers and the governance of the whole (*Figure 1*). The objective is to implement a durable & sustainable governance (Bricage, 2005) "as in a living cell" (Khoshmanesh & al., 2008).

• <u>A systemic approach for the accompanying of the semi-autonomy</u> of the students as in a biological system (Bricage, 1977) based on a continuous monitoring. Points are added (bonus) for the reward of the originality, quality or quantity of the student works. During the competitive tests (DUCSS or IUFM) or the competences' controls (APILS & L3S) the student is choosing herself/himself the level of difficulty she/he does want to perform and the number of points she/he hopes to win. To enable each student to build her/his own pedagogic governance, if she/he has improved him/her performance (bonus included) the only conserved note is the last one (the best). If she/he is falling, the final note is the average of the last note and the previous one. The important thing is not the individual local satisfaction of the students, but the need to implement "an increasing global forcing" to coach the students' group towards an increasingly larger and more rewarding global effort (Bricage, 2003; Bricage & al., 2006).

4. The Influence of the Type of Pedagogy on the Students' Results (APILS & DUCSS).

Every year since 1984, the DUCSS (Pau campus) was "hosting" in its *sanitary option* 20 students -from 15 to 30, depending on the number of good pre-registration forms- and 40 students in its *social option*. In the sanitary option they wish to compete for the entrance into professional paramedical Colleges of formation of nurses, radiographers, ergo-therapeutists, chiropodists, orthoptists, psychomotor therapists, and physiotherapists. Students are enrolled "automatically" both in DUCSS and in the first year of the Bachelor of Life Sciences (L1SDV) because passing the DUCSS (with all the disciplines of the sanitary option: chemistry, physics, biology and French -with eventually a professional stage-) is also validating this L1SDV. This allows them to not lose a year if they fail to enter into a professional College. But this failure is "very rare" for the students that have passed the DUCSS (*Figure 2*). And this inscription in L1SDV does allow them to apply for an Academic scholarship. The purpose of the DUCSS is not to prepare for a competitive entrance rather than another but to coach for obtaining a "high level" for being able to win

the competition but "according to her/his ability". The student must become aware of her/his limitations, to make a "taught & thought" reasonable choice! Attendance (Bricage, 1993, 1998) is the key parameter for the effectiveness of an upgrading (in APILS) or the preparation for a competition (in DUCSS). It is natural that some candidates drop out. The absenteeism is a key parameter of both the stress of the students and the effectiveness of the coaching. Students may have erred in assessing their potential and teachers may have done so. Motivations may change. It is inevitable to lose students and this loss is greater when the stress imposed by the teaching method is greater. The upgrading pedagogy will be "designed" to reduce the stress but not to delete it -"*nobody does learn without effort*"-, but it will be gradual. Preparing for a contest will immediately introduce the stress as a key factor of learning and achievement, but by compensating it both by an individual local support of each student by each teacher and by a global accompanying of the group (Bricage, 2007). To avoid the passive tracking we must <u>find a medium situation</u>, which may differ from a discipline to another (Bricage, 1993, 2008b). The teacher should not be put in expectations of the students, what is the best guaranty of attendance but no one of a good success (both in re-orientation or competition). But gradually we can bring the students to be put in expectations of the teachers, what is the best guaranty of students' successes. The goal is to get students to trust together, to co-operate even in competition (King & Marks, 2008) and to their self-assessment by trusting in the experience of the teaching team (Hsu & al. 2007).

5. The Influence of Students' Behaviours on their Results (APILS, DUCSS, L3S & IUFM).

Students that passed DUCSS are usually entering at least 1 Health or Social School. The results have been showing, whatever is the discipline, that the use of audiovisual tools is encouraging students to act themselves -not copying but writing, creating diagrams, charts & curves, drawing, calculations, construction of tables of contents & indexes-. Not only monitoring but often preceding the teacher is the largest success' factor and the only one that leads rapidly to autonomy in situations of competition. Thus the DUCSS class is running only with using competition problems and by following a way that students have to discover. Having built their plan themselves, they can de-construct it to the re-use of its modules in the re-construction of other plans. They do learn less amount of knowledge but better habits of thinking, and a higher amount of know-how & quality of skills (Toomela, 2008). They are preparing both to problems' solving and topics' synthesis. Their skills' development is two times faster than in a traditional Academic curriculum (Bricage, 2001a, 2008a). The health option of DUCSS' success rate (statistics from 1988 ago) is "usually" at least 95% (19 entering a paramedical School out of 20 passing DUCSS), but often 100%. But this rate is provided by the run to a minimum number of contests! And this minimum is increasing more and more. One that could spent 5 competitions 10 years ago, she/he must spent 10 or more now, with the corresponding costs growing. In any case, she/he would, if they can not spent all the contests of their main choices, move to other contests based on their real "taught" potential for success... so to guarantee their fate! Students that have passed APILS have a reserved place in DUCSS the next year. This does not mean they will have no trouble in keeping up biology and French, which are taught by teachers of CPGE origin. But if they will pass DUCSS they will also enter a School.

• <u>A holistic approach</u> regardless of the discipline and <u>across the disciplines</u>. The student must understand that no discipline is secondary (Sattler, 1986), that all are necessary & complementary, although not all are present in each exam. That is from the inter-disciplines-integration that will "emerge" improved & improving skills (Bricage, 2010). Thus the DUCSS degree is obtained only if attendance first in all disciplines (biology, physics, chemistry, French, -mathematics being present through the tools they provide to the other disciplines, computer being present through the tools it provides for the production of documents or the report of a stage-). The disciplines are equally important and mutually offsetting. As a professional motivation a stage is to be validated, as a bonus when it is optional.

• <u>A Learning for valuing individual local effort and community global participation</u>. More the students are involved in voluntary activities more they may acquire more bonus. Because individual participants, by distributing their works, will improve the overall skills of the group. More progress towards the difficulty is the better to a next fast success of the group (Bricage, 1993). Individual differences are inevitable (Toomela, 2008) and <u>requisite variety</u> is desirable (Bricage, 2010)! There is never malus. Just as there are different speeds of individual achievement of physical efforts (Ria, Bouvard & Bricage, 1993), there are different rates of learning. The difficulty is to find the speed of local progresses that best describes the group. The learning of the group can help the individual learning, but only if the group is a wholeness: *"E Pluribus Unum"* (Wadsworth & Khodjakov, 2004). Motivation involves the recognition of all the others, it is a *"synallagmatic"* deal : *"In Varietate Concordia"* (Bricage, 2005).



- Figure 1. MultiFactorial Analysis of Correlates -a 25 years Long Study-. 1a.(left) Enrolment & Fate of the **Students.** Students that passed DUCSS with 10/20 (P) are entering at least 1 nurses' School (IFSI) & the waiting lists of medical radiographers' Schools (MR) and therefore "passing". Students passing DUCSS with at least 10.5 are entering at least I MRs' School (usually 30 seats for a few hundred candidates). Students passing with at least 12 (AB) are entering at least 1 School of podiatrists or orthoptists (very few places) or ergo-therapists (E). Students passing with 14 (B) or more are entering at least 1 School of chiropodists or psycho-motor therapists (PP) -nowadays more than 1,500 candidates are contesting 30 seats-. Students that passed with at least 16 (TB) have the chance to be in the waiting list of 1 School of physiotherapists (K) -nowadays 30 seats for 3000 to 6000 candidates-. It is impossible, even with a very strong motivation, even with a baccalaureate in Sciences (S), to enter such a School without a special preparation (which is not at all an upgrading!). Never people with an other baccalaureate (SMS, ST2S, L or ES) will enter without passing a previous "successful refreshment". That's why there is the APILS, for upgrading! APILS is bachelor -3 (pre-undergraduate year, L0), DUCSS is bachelor -2 (first undergraduate year, L1), IUFM is bachelor year (initially it was bachelor -1, L2, but now L3), L3S is L3. AJ: DUCSS failing students. M & F: sex of students. Disciplinary limiting results: BIO biology, CHEM chemistry, FR French, PHYS physics, MAT use of mathematics tools. (Students' behaviours & results are in Figure 2) 1b. (right) Correlated Teachers' **<u>Recruitment</u>**. Added in regard of the previous students' types (progressing, industrious, followers, non-assiduous) are the teachers' types: AGM & AGF aged male & female, YM & YF young male & female, experimented in CPGE teaching **CPGE**, experimented in students' upgrading **NIV** or in stages' tutoring **STA**.



- Figure 2. <u>From Statistics to a Regulative Feed-Back -a 25 years Long Result-</u>. (P, AB, B, TB, L1, MR, E, PP, K as in Figure 1.) 2a.(left) <u>The Students' Behaviours</u>. The efficiency of the pedagogy (here in biology) is measured by the comparison of the slopes 2b. (centre) <u>DUCSS Passing & the Correlative Fate of the Students</u>. Only industrious students may enter a School, progressing ones have better results (in black more than 50% of the students of a class of note, in white less than 20%, in grey % in between) 2c. (right) <u>Regulative Management</u>. The previous result (2b is green arrow) serves as a global control. If the year's arrow is below (red arrow) the ending year was too weak, if it is above (blue arrow) the pedagogy was in progress. For complementary data do see at: - <u>Advanced On Line publication</u> of the associate talk <u>http://www.armsada.eu/files/HSSengineeringSLIDES.pdf</u> (creative commons) & - <u>Advanced On Line publication</u> of that paper <u>http://www.armsada.eu/files/HSSengineeringTEXT.pdf</u>

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Conclusions, Applications and Implications for Research

"Il faut un gouvernail à la gouvernance. "(Bricage & al., 2006). The management of the groups' progress requires a control of the quality & quantity of individual acquisitions during the training process and the subsequent monitoring of the individual fates (Bricage, 1984). While the rate of the first year students who will get a degree in 3 years is around 35%, the rate in DUCSS of the students that get L1SDV and a School's entrance, is from 70% to 90%. "A good tool does not exist for itself, it is there according to the results that we want to achieve." (Figure 2). The OCDE three-years study on the skills' acquisition of 15 year old people (PISA) shows the decline of Europe and the rising of Asia (Bricage, 2008a). Why? In our global world, it is the local advance in knowledge, skills and attitudes that will ensure the fate of the next generation (Bricage, 1981). Today there is no other thoughts than to focus on education! Ever more numerous culturally & socially acculturated people give no meaning to the concept of the "mutual reciprocal rights and duties". There are never any advantages without disadvantages. In a "hungry for equality" Country such as France, the number of the tomorrow less-educated people is ever-increasing with the number of "substandard" rebels of today. Democracy as established by the Greek civilization is inconceivable without a strong education of those who are participating in doing it. Family instability has weakened the need for education and consequently undermined the principle of authority in the family first, then in the education system too, then with the State so. Which in turn has amplified the collapse of both the education system and family groups. The industrial education has removed the virtues of effort and the respect for work, these education bases which allowed the master to give each of the students their needs. And the today permissive society has valued the effort in areas that make money (sports, media) but has completely devalued it in areas that do not make money, it to say "services"! The first societal service is education! The Self equal opportunity -"Everyone is entitled to the same societal services and has the duty to respect them."- was confused with the illusory individual equality -"Everyone can win the Lottery"-. Every child is not able to build herself/himself her/his own knowledge. Her/his effort must be accompanied and supervised. In all the best ranking nations of the international PISA, China in Asia, Finland in Europe, the education system does not merely learn to learn, but first does learn to respect not only the right to know but the duty to know. Therefore a strong educational system makes a strong State and vice versa (systemic constructal law). The difficulty is finding a balance. That requires preparatory classes (CPGE, UIPC) as well as upgrading & re-orientation classes (APILS). A sufficient pre-requisite variety so that everyone may find a place according to her/his abilities and motivations (Bricage, 2007). It takes all kinds of people to make a world. "A place for everyone and every one at a place she/he could find". We must first make efforts in advocating the acquisition of knowledge and in giving respect for those who want to acquire it, and those who can help to acquire it, like in sport (Ria, Bouvard & Bricage, 1993)! And the solution is the same as in sports: many levels of orientation and reorientation, with their own outlets and rewards (prizes, awards) are necessary. What was formerly the education system in France! But it will soon no longer remain only the extremes, the industrial high level competitions, which give people money -regardless of the cost of the training- and the others, what do not give money. It is urgent to restore the in-between structures, to restore the "traditional" variety. Education, with its requisite variety, is the heart of any civilization. Education, like health, can not be satisfied by the ready-to-think, or the ready-to-heal, as well as many people are not satisfied with the ready-to-wear. But the "standard" people has not the money to pay for better individual-made solutions. Maybe ready-made solutions are necessary for a lot of people but they are neither factors of progress nor of success. Progress is always at the margins, in the "hobby crafts". Any researcher is primarily a craftsman. Nature itself creates new life forms from "the crafty pottering" of ancient ones, but respecting mandatory rules: -there are never any advantages without disadvantages, -there are never any rights without duties, -nothing is got without effort, -to survive is to turn disadvantages into advantages and to avoid benefits become disadvantages, -only will survive the associations for the reciprocal and mutual sharing of advantages and disadvantages.

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