



contribution to the improvement of pedagogy through the use of tools

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Abstract

Through this work, we will explain how to use survey tools conducted within an engineering educational institution to improve the performance of teaching, reform its education and advance learning.

Similarly, we will exploit a survey work done outside the school "extra school" to acquire useful information quantitatively and qualitatively. According to the results and the sampling carried out on a wide industry sector. We will proceed to a reform of the study plan.

Article info

*Received
January 20 ;2023*

*Accepted
May 26 ;2023*

Keyword:

- ✓ *teaching practice,*
- ✓ *learning,.*
- ✓ *performanc:.*
- ✓ *enhancing tools*

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1. Introduction

The word pedagogy originated in ancient Greece paidagogós. Initially, the term was composed by paidos ("child") and Gogia ("lead " or "drive"), its concept meant the slave who accompanied the children to school. [1] Currently, pedagogy defines the set of approaches and practices of education and teaching as an essentially social and specifically human phenomenon. It is a science applied to the psycho-social, whose object of study is education. Pedagogy is influenced by certain sciences such as psychology, sociology, philosophy, epistemology, anthropology, and others.

Naturally, according to several authors, pedagogy is not presented as a science but rather as an art or knowledge. pedagogy can be subdivided according to several criteria. Mainly talking about the general pedagogy that is to say how to act by action on lessons? Or more specifically pedagogy is related to the accumulation of experience.

It is essential to distinguish pedagogy as a science that studies education, and didactics, which is a set of processes that assist in learning. Hence it can be concluded that teaching is only a science included in pedagogy. Pedagogy has often been compared to adult education, which presents the science responsible for regular education during its formation by developing the skills required in its environment.

2. School Presentation

2.1 Esprit

ESPRIT private school of engineering and technology has as its slogan to train a new generation of engineers in a different way. The school has taken into consideration several measures to raise

the level of success and to get closer to the requirements of employers, and the ambition of the country. Our institution is valued in the face of increasing demands. It must take steps to improve its performance or risk being closed if it fails to meet its objectives.

2.2 The current system

In the current system, the school determines the subjects taught according to the requirement of the Ministry of Higher Education and Scientific Research. Student progress was previously measured in terms of knowledge skills and understanding expected in each subject, as acquisition targets. However, the school still has some flexibility in the organization and planning of teaching and learning. For each subject, the learning objectives are presented in module sheets written by the school's teachers. There is a detailed description of what needs to be acquired for each module. For example, in automatic, there are four learning objectives: use and application of various mathematical tools, servo systems, performance analysis, and performance improvement.

Today our students can have access to the web through new technological resources. The socio-economic changes driven by the remarkable evolution of development are direct to the educational material from which the obligation is to ensure a comprehensive change that allows students to cope with this change by creating a learning environment that is best suited to serve our students.

Our teaching activities take place essentially in «Electromechanical Engineering courses " (engineer cycle). Today at *ESPRIT* among

other existing channels within the school, we ensure the teaching of several courses. As far as methodology is concerned, it has evolved considerably but remains globally balanced: lectures at 50%, tutorials at 30%, practical teaching (TP, projects, and internship follow-up) at 20%, and we are trying to move to APP (Problem Based Learning).

As part of the pedagogical innovation, ESPRIT has adopted an active pedagogy APP Problem based Learning. This is a learning method based on the participation of students in the learning process. It encourages non-formal work and helps develop soft skills such as autonomy, teamwork, and communication, which are essential skills.

The average annual volume is around 390 hours per teacher. Overall, our actions are based on basic teachings and inverse problems, i.e. establishing appropriate prosits (problem situation), ... As in our interventions, we have contributed in various ways to the teachings themselves and their developments. We have proposed several new courses, about twenty new TP topics and projects.

Each time, we strive to build around practical applications and provide students with real problems. We have also designed an analytical Orientation Committee and examinations to analyze and improve the assessments. For example, we use questionnaires to measure the level of student satisfaction with both scientific and educational plans.

3. How to proceed with learning

While discussing with students, we have

found that they are sometimes remarkably misguided and indecisive when it comes to providing solutions or getting the right results from their work. Therefore, surprised by their phase shifts, students misinterpret their answers. Especially when the feedback does not contain the necessary and useful feedback to each student so that the help is constructive and detailed. There are also student disorientation and dissatisfaction with redundant negative feedback. This redundancy may discourage the student and lead to a total lack of interest in the subject and learning.

The Learning Research Project led by Professor Broadfoot and Professor Michael Crossley examined students' views of assessment and observed how it affected learners' identity. The researchers concluded that the assessments did not have a positive impact on learning [4] . They have also set the importance of communication between student and tutor to create a successful evolution to make learning more positive. In this context, we conducted an investigation that is part of the dialogue between the student and the tutor to improve learning and teaching. It is necessary to emphasize that communication is positive and significant for the student. Below we present a questionnaire to evaluate the APP.

Fig.1. PBA evaluation questionnaire of the 1st class

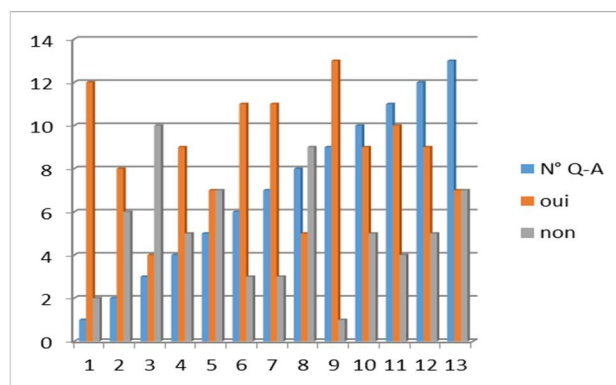


Fig.2. PBA evaluation questionnaire of the 2nd class

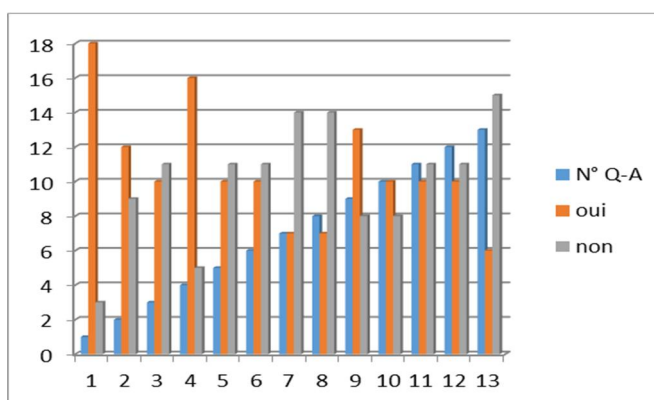


Table 1: Evaluation Questionnaire

Do you consider that the specific objectives have been achieved		Your answer	
		yes	no
1	Recognize a controlled system		
2	Inventorying the benefits of a closed loop control		
3	Move from EDO to a FT		
4	calculate the TL inverse of a function $f(s)$		
5	Model an EM system		
6	Simplify SF		
7	Place a temporal model in a block diagram		
8	Recognize a 1st order system and determine its parameters		
9	Recognize a system of 2nd order and determine its parameters		
10	Represented by SF EM system		
11	Tracer impulse and step responses of order 1 and 2 systems		
12	Identify a system of 1st order from impulse and step responses		

The above table presents the APP questionnaire Automatic continuous linear. Having gathered the results we proceeded as follows: enter here the text

- Improve Prosits (problem situation) to be more understandable.
- Consider their learning by steering students to acquire more skills
- Reforming learning techniques.
- Experiment with monitoring and evaluation processes.
- Modernize new leads for classroom practice.

The value of taking the measurement tools is not to evaluate the professor. During this investigation, we have explored the responses on what affects their learning and progress.

In order to deepen the performance of teaching, a reform of the study plan is needed. In the following, we present the objective, the approach and the measurement tools used.

3.1 Objectif of the reform

The article collects the work of the study plan reform project of the private college of engineering and technology ESPRIT, electromechanical department. Furthermore, our work is based on tangible measurement tools. These tools are exploited through intra-school and extra-school surveys.

This project is part of the evolution of the training of the electromechanical engineer of ESPRIT, in the framework of the Bologna Process. Our school is a member of the CDIO (Conceive,

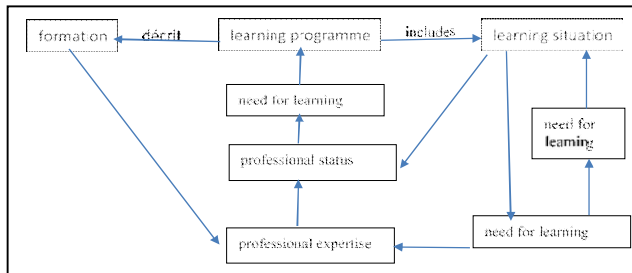
Design, Implement, Operate) consortium, and holds the EUR-ACE accreditation provided by the French organization CTI (Comité des titres d'ingénieurs). In this context, we wish to build a reference framework for the study programs, based on the competencies expected of the electromechanical engineer by the professional world, as well as with the competencies defined by the CTI.

In fact, the competency-based approach sets up an approach based on learning outcomes, contrary to the classical approach, which is based on contents and their duration. It mainly consists of identifying the competencies associated with the exercise of a profession and reforming them within the framework of the development of a training repository, in our case, the development of a study program.

This reference framework reconsiders the knowledge- skills relationship in a professional context that is likely to change. These competencies are indicated by action verbs by appealing to perceptions in the face of responsibilities. Indeed, we have adopted Bloom's taxonomy, which is widely known within the educational community, as the means of describing cognitive levels of knowledge acquisition and classifying objectives to identify the importance and complexity of an acquired objective.

The aim is to make the relationship between this theoretical knowledge and the implementation of professional practices functional. Below is a graphic diagram extracted from a study carried out by the EPFL École Polytechnique Fédérale de Lausanne, in this framework, which translates the relationship between academic learning and professional skills.

Fig ; 3: Relationship between Academic Learning and Professional Skills (Based on research by members of the Mechanical Engineering Department at EPFL)



3.2. Approach

Following the first results of the intra-school surveys, we developed several working sessions and meetings with teachers, researchers, and multidisciplinary consultants; in the fields of mechanics, electricity, electronics, automation and industrial production, etc. An increasingly clear and detailed construction process took shape. The objective was to articulate the skills and themes of the electromechanical field. Thus, we elaborated the first list of specific learning outcomes per domain in articulation with competencies, defined prerequisites for the domain's learning outcomes and expressed the professional situations that are specific to it. In addition, several meetings were held between teachers and students who had been promoted and were still in the course of their studies, in order to establish an information base that could consolidate the knowledge-competence relationship.

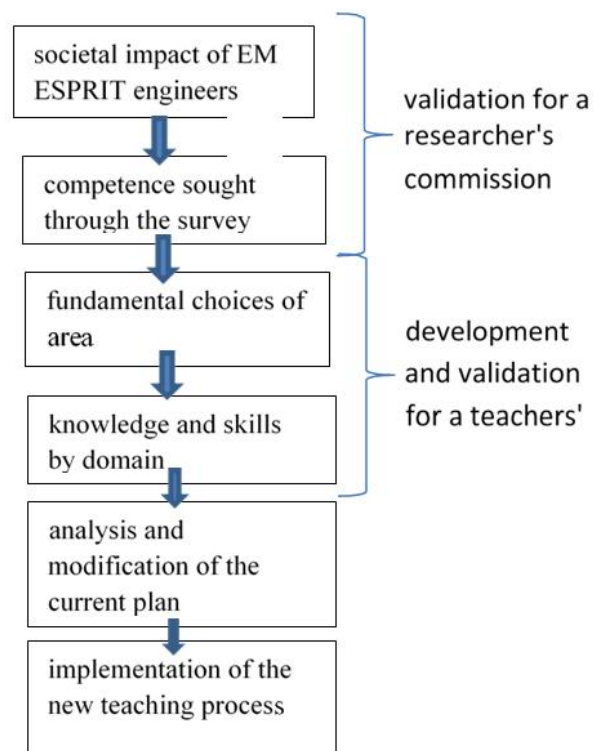
We focused on three main areas: taking into account the expectations of the professional world through a survey, developing an extended competence framework and defining the approach to transforming the study plan.

The first axis being the key phase, we start from the fact that this change does not evaluate the degree of acquisition and mastery of the study programs, but the acquisition of competencies in a

professional context. These competencies will be sought through a survey of professionals in the target occupations, to be able to articulate the core areas with a competency framework in order to analyze and redefine the current study plan.

We have drawn on the advice and experience of national and international research teachers and consultants.

Figure 4: Validation process of the reform based on the experience of the EPFL GM Department (Based on the work of the members of the Mechanical Engineering Department at EPFL)



On the one hand, it is a question of taking into account the expectations of the professional world while formulating objectives that can be supported and evaluated in the training. On the other hand, in a training usually assigned to disciplinary fields, the dilemma is to respond jointly to the need, by developing a common language. Thus, the plan was based on three main pillars. The first is the description of professional situations and associated competencies. The second is the identification of learning outcomes and their link with the developed

competence register. And finally, the development of the module and teaching unit sheets (basket of modules touching the same disciplines), by setting up a new evaluation framework per teaching unit. In what follows, we will deal with the structure and the development approach of the survey. And we will follow with an evaluation of the outputs, interpreting the results extracted from the survey, to generate the reference frame of competencies, to analyze the matrices of competencies, and to deduce the necessary elements for the development of the study plan of the electromechanical department.

3.3 Extra-school survey

The extra-school survey is the survey of the industrial world that constitutes an important link in the process of reforming the study plan of the ESPRIT Electromechanics Department. For this reason, a great deal of effort was put into drafting the survey, choosing the companies to be interviewed, contacting these companies, and finally analyzing the results quantitatively and qualitatively.

3.4 Drafting of the survey

The body of the survey was strongly inspired by the survey conducted by the Mechanical Engineering Department of EPFL in 2011, with the necessary adjustments to adapt it to the Tunisian industrial market and the electromechanical branch. In addition, as ESPRIT carries the CDIO label, a part of the survey was dedicated to questions related to the CDIO standard. The final version of the survey was the culmination of several weeks of work by the committee responsible for the reform of the study plan, with weekly meetings within the PSC.

3.5 Structure

The survey aims to prioritize and quantify the importance of "Knowledge", "Skills" and "Interpersonal skills" from the point of view of the industrial world. The general structure of the survey is summarized in the table below.

Table 1: Nature of the questions according to knowledge, skills and attitudes

Parts of the survey	Nature of questions
Part I: "Knowledge»	✓ Priority between disciplines ✓ Priorities within the discipline ✓ Priority between theoretical, experimental and numerical approaches ✓ Experience of the business world
Part II : « Expertise»	✓ Priority between disciplines ✓ Priorities within the discipline ✓ Specificity of ESPRIT engineers ✓ Importance of multidisciplinary
Part III : « How to be»	✓ The place of social skills in the engineering profession ✓ Priority between disciplines ✓ Priority within the discipline

For the "Knowledge" and "Skills" sections, the questions cover five areas:

- Basic sciences
- Engineering sciences
- Technology
- Related subjects
- Humanities

While for "Knowing how to be", the questions concern the following areas

- Ethical values
- Spirit of innovation
- Critical thinking
- Rationality

- Group work

3.6 The design aspect of the out of school survey

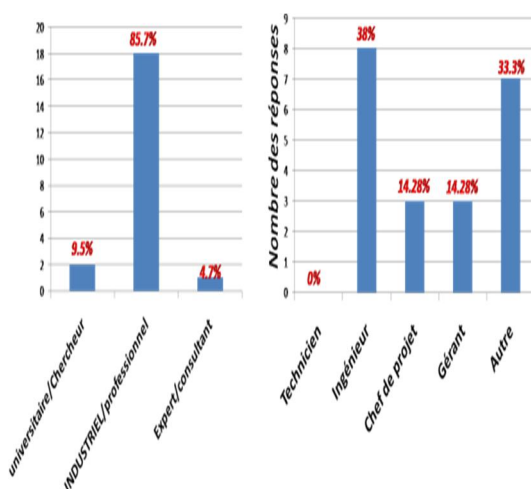
The survey was validated by a multidisciplinary committee of teachers and consultants. The teachers of the department were involved in the process and took charge of the visit of professional representatives to have the survey form filled in. In the end, a sample of companies was contacted, with different fields of activity:

Electronic equipment manufacturing, Public works construction, Robotics, Mechanical parts manufacturing, Parapharmaceutical, Electricity production, Paper transformation, Aeronautics, Mechatronics, ICT, Plastic injection, Packaging, Medical devices manufacturing, etc. The interviewees were either engineers, project managers, managers or directors of companies. In addition, the survey included academics.

4. Quantitative analysis

- The figures and results found in the quantitative analysis represent the opinion of a sample of people who work with electromechanics. The fact that the survey was carried out on a limited number of professionals forces us to take the quantitative analysis very critically.

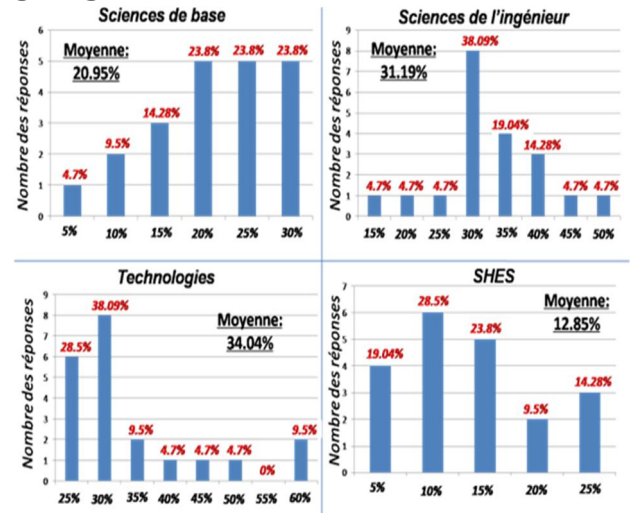
Fig. 5: Type of interviewees



5. Knowledge

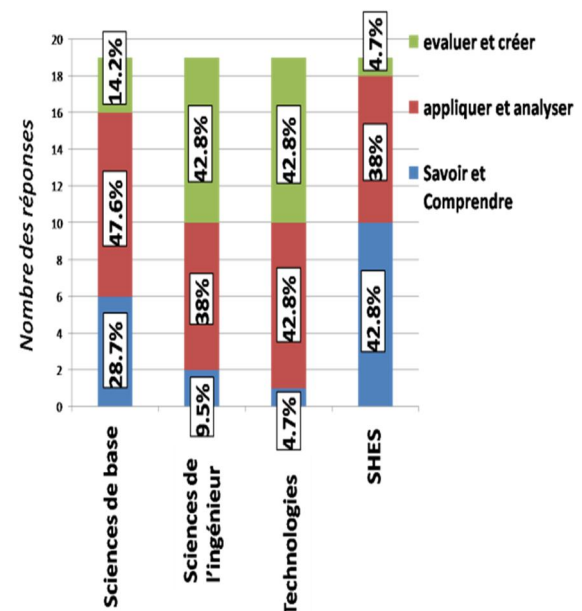
Prioritisation of « Knowledge » :

Fig. 6: Percentage distribution of relative importance between basic sciences, engineering sciences, technologies and SHES



6. Prioritisation of "Knowledge"

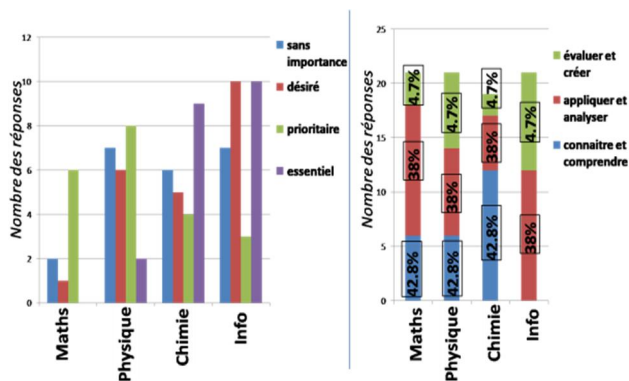
Fig. 7: Depth level for basic sciences, engineering sciences, technologies and SHES



According to the quantitative analysis, the basic sciences should be 20% of the Electromechanical Engineer's training, with a significant level of depth in "apply and analyze".

7. Basic science:

Fig. 8: Importance and depth of selected basic science modules



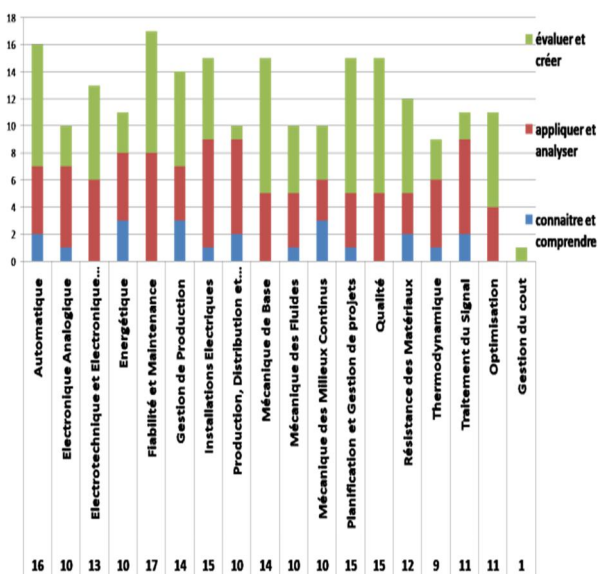
The basic science requirements according to the industry recommendations are

- Maths and Physics: priority,
- Chemistry and Information: essential

Indeed, on these modules we must review the content of the mathematics module and orient it towards Applied Maths (applied to the know-how of an electromechanical engineer) and strengthen the computer module, essentially algorithms and spreadsheets, and lastly strengthen the chemistry module, oriented towards the know-how of an electromechanical engineer, by setting up chemistry practical work.

8. Engineering sciences

Fig. 9: Level of the depth of selected engineering science modules



Engineering sciences should constitute 30% of the total training of an Electromechanic with the depth level "evaluate and create".

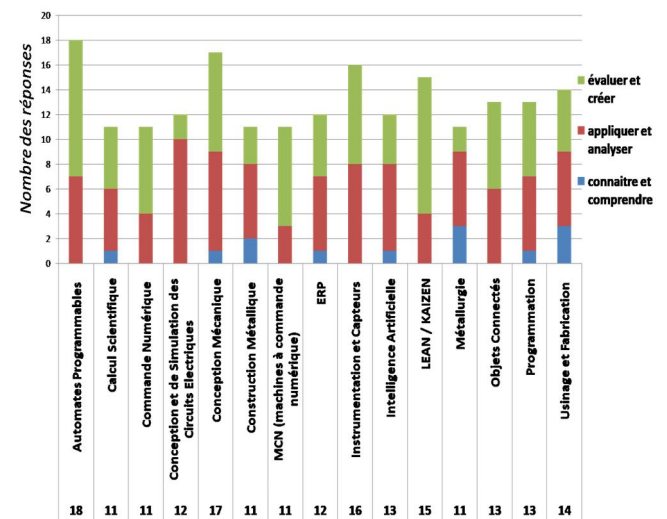
The most cited engineering disciplines are

- Automation
- Installations
- Basic mechanics
- Reliability and maintenance
- Project Management

For these modules, it is essentially necessary to increase the hourly volume, to add the notions of matrix calculation to prepare the knowledge in automation and to add a module of probability to prepare the reliability module.

9. Technologies

Fig. 10: Level of the depth of some technology modules



TP instrumentation et capteur et mettre en place un atelier Lean/ Kaizen

Industrialists are asking for technologies to form 34% of the total engineering training with an "assess and create" level. The most cited disciplines are:

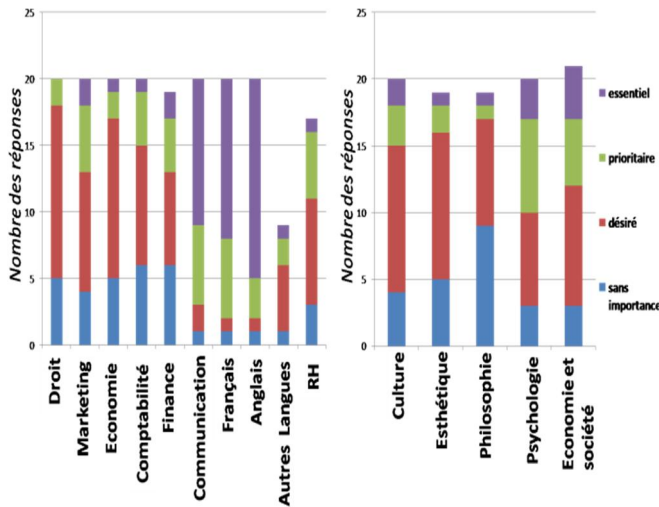
- API
- LEAN
- Instrumentation and Sensors
- Mechanical Design
- Machining and Manufacturing

The department intends to equip itself with high- performance PLC models,

review the content of the instrumentation and sensor

courses and set up a Lean/Kaizen workshop.

Fig. 11: Level of the depth of selected modules in SHES

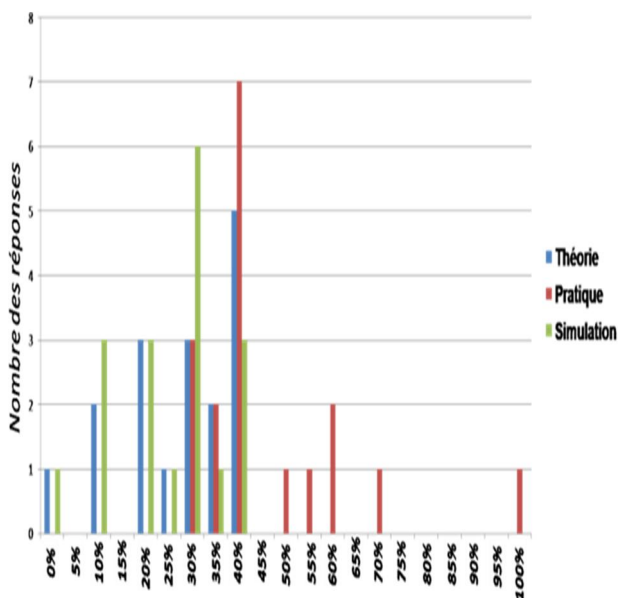


Human and social sciences represent 12% of the training, with a level of depth in "knowing and understanding".

Thus, we have focused on the notions of communication for the language modules.

3. The three pillars of engineering

Fig. 12: Percentage distribution between Theory, Simulation and Practice



Generally speaking, the training of an electromechanical engineer is done via 3 types of teaching, in fact: (1) By theory (2) By practice (3) By simulation. The

percentage of the three pillars of teaching:

- Theory: 25.8
- Practical: 46.38
- Simulation: 25%.

Therefore, more volume should be given to the practical part, which does not represent a significant percentage at present. Consequently, practical work will be given priority in the new study plan.

3. Know the business world

Fig. 13: Appropriate measures to improve knowledge of the business world

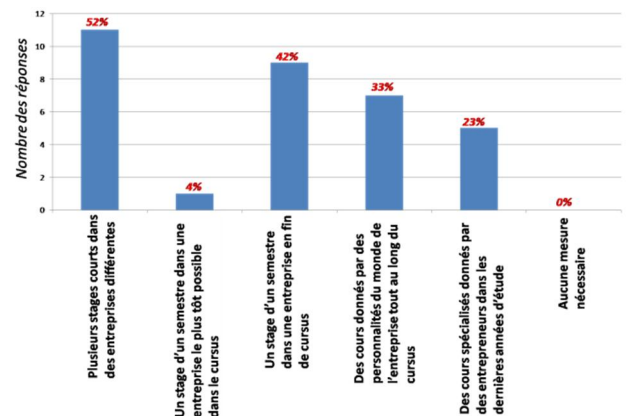
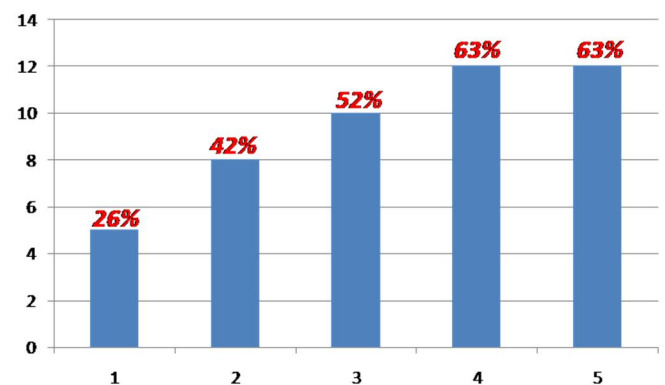


Fig. 14: Conditions and competences of the company to supervise internships



CONCLUSION

Remarkably, knowledge occupies a small amount of time in the current study plan, so according to the survey, we have to increase the load of this knowledge by adding the following knowledge

- Matrix calculation
- Probability
- Applied mathematics
- Computer science (Algo and spreadsheet)

- Chemistry applied to EM
- API practices
- Instrumentation and sensors
- Lean practices
- Communication
- What is the essential message of this Article?
- This article is considered as a tool for educators to see more clearly, precisely, what they can contribute, individually and collectively, to give the learning keys to students. [3] Currently, we need to deepen our research on the issue of measurement exploitation tools to improve teaching well.
- Our concern is also better to quantify its measurement tools for use in the right direction and then not to stay in the simplistic basis.
- The improvement of teaching is also part of the direct use of the improvement tools
- It should also be beneficial from its results to help improve the methodology; it is the need of using reflective activity from the students. Communication between teachers and students must be present for it is always difficult to talk to the students about how one learns. Finally, active learning increases student autonomy and their skills
- The realization of educational tools through the participation of students, educators and teachers is an interesting method that enables the school to measure its teaching approaches.
- These measurement tools allow us to perform and reformulate a study plan
- This dynamic between the school component is beneficial for students and especially businesses. In addition, in our case, the tool is used to evoke certain shortcomings that limit the progress of the student in his field.
- The continuation of the investigation procedures allows us to accurately measure the quality of teaching and examine learning. Consultation with students regarding teaching and learning

is the first step towards the implementation of new approaches. As this article has tried to show, this is an important step for schools that seek to prepare young people for the industry requirements.

-By objectifying the analysis of an evaluation tool, and by carrying out the intra-school or extra-school surveys, we lead to a process in which we have analyzed these tools. We essentially contribute to the clarification of what "quality of training" means, by methodologically questioning certain criteria. This approach aims at a better understanding of the tools and allows us to question their relevance. We have partially associated this with the indicator of the degree of coverage of the different dimensions. Depending on the degree of coverage obtained and the objectives of the evaluation, a training institute may have to develop the tool used.

Moreover, engaging in such an analysis contributes to reinforcing the credibility of the tool, from the point of view of the actors, and thus fighting against the taboo of evaluation by sharing with the trainers and students the approach and the results that emerge from it.

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