Teaching portfolio - José Manuel Arroyo-Osorio

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Contents

1. Introduction

I am currently associate professor of the Mechanical and Mechatronics Department at Universidad Nacional de Colombia, Bogotá, Colombia. Where I have worked mainly in research and teaching in manufacturing systems and machining processes. I served as manufacturing engineer in the automotive assembly company CCA-Colombia (1995-1999). I have a B.Sc. in Mechanical Engineering (1995), a M.Sc. in Computer Systems Engineering (2003) and a Ph.D. in Mechanical Engineering with emphasis in Materials and Manufacturing processes (2009). The MPBL-Aalborg, which I am currently ending, is my first specific education in learning and teaching. My curriculum can be viewed online in Annex A. At this point, I inform the respected reader that most of the materials shown are in Spanish, but I have included the English explanations of the relevant selected materials in the main body of this document.

1.1. Earlier teaching responsibilities

At the beginning of my career at University as assistant instructor, between 2000 and 2002, I was in charge of the course "Basic Mechanical Technology" carried out in each period for 40 first-semester undergraduate students in Mechanical Engineering. The outcomes of this course focus on allowing students to recognize and experiment with manufacturing technologies. In this first teaching experience, I faithfully followed the program, contents and laboratory guides created by the professors of that time.

In 2003, I was in charge of the course "Experimental Project II" given in each period to 40 undergraduate students of first semester in Mechatronics Engineering. In this course, the students looked for and manufactured a replica of systems where were combined mechanical actions with electronic and programmable control elements. To achieve the learning outcomes, I enlisted the assistance of a master student in electronic engineering, who lectured and tutored students on topics of electronic technology for motion control.

From 2003 to 2004, I was in charge of the course "Machining Processes", carried out in each period for 80 students of seventh semester of Mechanical Engineering. The outcomes focused on learning to design manufacturing processes by machining. In this course, I kept to the contents and practices established by the more experienced professors of that time.

From 2004 to 2005, I was in charge of the course "Manufacturing Engineering", given in each period to 40 undergraduate students of eighth semester of Mechanical Engineering. The outcomes of this course focus on learning to manage a complete manufacturing system, including physical and human resources. This course is theoretical in principle, but I implemented fieldwork in manufacturing companies as well as production labs in the classroom based on the experiences reported by Simpson (Simpson, 2003) and by Ammar (Ammar & Wright, 1999).

1.2. My current learning-teaching concept

> *"I shall be for ever grateful to my first teacher, Emma Goldberger, who taught me the three R's [reading, writing, arithmetic]. They are, I think, the only essentials a child has to be taught; and some children do not even need to be taught in order to learn these. Everything else is atmosphere, and learning through reading and thinking."* (Popper, 1992, p. 7).

In agreement to Popper's excerpt, in my opinion, the fundamental resource of reading and understanding what we have read is the basis for learning. My practice is then to suggest to students that they read and try to understand the content before the class sessions. Although learning in community is important, I consider that in the case of science and technology subjects, it is always necessary an initial individual effort to understand and learn on its own.

Since August 2016 I started my master's degree studies in the MPBL-AUU program that allowed me to develop skills to plan and execute new engineering education initiatives, specifically in the areas of problem-based learning and project-based learning. My experience in the MPBL-AUU program helped me to develop the habit of periodically examining the literature relevant to the learning environments for which I am responsible. The areas that I am currently focusing on are the improvement of the team learning experience and the application of formative assessment in large classes.

2. Teaching competences

2.1. Projects and PBL

In the course "Manufacturing Processes II" currently under my responsibility, the project plays a significant role in the assessment. The projects carried out have been of different nature. Among others, production of manufacturing didactic material for Internet (an example in Annex B), the creation of a community of users of Siemens NX (specialized manufacturing software, see it in Annex C), the production of a news magazine about the Colombia's manufacturing industry, and more recently the use of specialized software Siemens-NX to design the manufacturing process of a real component.

2.1.1. Manufacturing news magazine project

The following paragraphs are an abbreviated explanation of the magazine project carried out by 78 undergraduate students at the course "Manufacturing Processes II". The slides used to explain the project to the students are in Annex D. The overall objective of the project was stated as follows: to collectively produce a news magazine about the Colombia's manufacturing industry, including a website to host the contents of the magazine. Figure 1 shows the main page of the magazine website developed by the students.

The learning outcomes were stated as follows: (1) communicates in a clear and effective way the result of applying their knowledge in a context of dissemination of knowledge in engineering. (2) Is able to effectively integrate into a professional work team. (3) Is able to generate a management structure to handle complex projects.

Organization and planning of the project

At the beginning of the project, in agreement with the students, we decided the formation of a journalistic committee, an editorial committee and a publishing committee. The most of the students voluntarily assigned themselves the so-called journalistic committee. Inside this committee were formed teams of three members, and each team had to write an article on a negotiated topic that them either could propose or be assigned by me. In this way were defined the 24 articles that were finally written for the magazine.

Figure 1. Main page of the manufacturing news website developed in the magazine project.

Assessment of students work

Deliveries were made in a portfolio that each team implemented on google drive. There, the teams uploaded the documents and evidence of the process of drafting the articles, or of structuring the criteria and review rubrics, or of the website development process. For assessment, were used rubrics and three evaluation modalities: (1) hetero-evaluation, by myself for each scheduled delivery. (2) Peer-assessment, based on beta product deliveries of manuscripts, article formats, and website. (3) In addition, I asked the teams to submit a brief self-assessment in each delivery, detailing strengths, weaknesses and aspects to be improved at each stage of the project. Figure 2 illustrates an assessment rubric example of a team from the journalistic committee.

Figure 3 shows the heading of one of the final articles published in the magazine (a complete article example in Annex E). A peer assessment mechanism was implemented in the website of the magazine through the comments that registered users made. From the third delivery, also through this mechanism, the members of the editorial committee and myself emitted our concept on the articles, highlighted the strengths and pointed out the aspects to be improved. In addition. It was implemented a system of valuation from all the users for each article, whose average appeared in the heading of the article in a graphical scale of one to five stars (see figure 3).

ENTREGA 2					
Grupo: Sebastián - David - Samuel	**Contenidos del curso asociados: Nuevas tecnologías**				
Fecha evaluación: Semana 6 – 7					
Competencias a evaluar: Comunicación -					
	Valor				
Indicador a evaluar	**1 (No lo cumple)**	**2 (Cumple deficiente)**	**3 (Cumple Aceptable)**	**4 (Cumple Adecuado)**	**5 (Cumple Destacado)**
El estado del arte se refiere adecuadamente a los contenidos y trabajos en el área del artículo.			X		
Las referencias bibliográficas son suficientes y pertinentes.					X
Hay evidencia de información recolectada con empresas e instituciones.			X		
Avance		X			
NOTA	**3,7**				

Figure 2. Assessment rubric example of a team from the journalistic committee.

Figure 3. Header of one of the final articles published in the magazine.

Perception of the students about the project

This section describes, with trend measures, the results of the surveys applied at the end of the project to the participating students.

75% of the participants expressed their agreement with the statement that through the project they learned to create products to communicate the results of their research.

70% of the participants expressed their agreement with the statement that participation in this type of project required skills they normally do not employ.

60% of the students indicated their agreement with the statement that participating in the magazine helped them to understand how a project must being carried out.

75% of the students expressed their agreement with the statement that through the magazine they learned to create better quality products to respond to the guidelines of a project.

65% of the students expressed their agreement with the statement that the project was a relevant alternative of learning about manufacturing processes real context.

Most students considered that the use of a rubric as an assessment tool positively influenced their learning motivations.

Most of the students described the project as interesting, novel and formative, although a certain percentage considered it as too demanding.

Reflections on project coordination

The magazine project idea came to me after reading about the "Writing-to-Learn" concept (Reynolds, 2012; Daniell, 2003; Kalman, 2008), which consists of using writing as an integrative activity that require the students to apply the acquired knowledge. My activity at the beginning of the project was quite high because the students did not have much experience in a project with the characteristics of the magazine, nor in a project with such a large number of participants. In the first weeks, the students were interested in working only in their "part", but without major contributions to the overall success of the project. I reversed this situation, little by little, by implementing a greater specific weight in the individual assessment to the contributions of each student as a reviewer of the work of his colleagues. On this respect, the tool implemented to comment the work of each team on the magazine website was an excellent resource.

Once the teams taken the initiative on their assignments and even them made modifications to my initial guidelines, my workload diminished considerably, and I essentially engaged in assessment and feedback in each one of the defined sessions for deliverables examination. This project was a great experience, and served me to experiment with the skills of contemporary young students with social networks and with information technologies.

2.1.2. Computer-aided manufacturing (CAM) project

I planned this learning activity, considering project-based learning (Frank, Lavy & Elata, 2003) in parallel with example-based learning (Jalani & Sern, 2015). Considering that it was a large number of students (77) distributed in 16 work teams, several examples were used, designed as a strategy of instruction and scaffolding of the basic concepts, to make feasible the realization of the projects of the students. This strategy was mainly due to the fact that it was not feasible to have enough facilitation time for each work team.

Intended learning outcomes

The project was aimed at achieving a part of the intended learning outcomes of the "Manufacturing processes II" course, related to the planning and execution of manufacturing processes by machining, using computer numerical control (CNC) and computer assisted manufacturing (CAM) technologies. The learning outcomes, enunciated with the support of the SOLO taxonomy of Biggs & Tang (2011) are:

1. Apply, either programming in CNC, or configuring in CAM, the drilling and milling operations of flat and curved surfaces to produce a geometry required in a work piece according to the design requirements.
2. Analyse the geometrical characteristics and the properties of the work material, to choose the appropriate cutting tools for machining operations, and to decide the setup conditions of the process (fixture, coolant, feed rates, cutting speeds, depths of cut, etc.).
3. Reflect about the dynamics of the machine tool, and about the setup of manufacturing operations by machining, to predict the quality and safety results of the manufacturing process.
4. Explain the relationship between workpiece geometric characteristics, the selection of cutting strategies (ramps, helical milling, arcs, etc.), the machine setup, and the global results of machining operations.

Teams assignment

Following the literature recommendations (Oakley, Felder, Brent & Elhajj, 2004), teams' formation was carried out by myself as instructor of the course. to do this I applied the UKCES - University of Kent Careers and Employability Service (2004) teamworking skills questionnaire, that allows to identify, among seven roles, the predominant ones that a person can assume in a teamwork situation. The criterion for forming the teams was that each team had the greatest possible diversity of predominant roles as recommended again by UKCES (2004).

Also, to motivate the interaction between the newly assigned teams, the activity known as the "marshmallow challenge" (Skillman, 2006; Wujec, 2010) was carried out. The activity consists in constructing in 18 minutes a structure with 20 sticks of spaghetti + one yard tape + one yard string + one marshmallow in which, the marshmallow should reach the highest possible height. The winning team is the one whose marshmallow registers the highest height in a self-supporting structure not stuck to the support surface. This was the first interaction between several of team members and it served to motivate the socialization among them. It was also an opportunity to reflect on the successes and mistakes in the mini project of the "marshmallow challenge" and on teamwork in general.

Team size and project specification

A group size not too large, not too small, of 4 to 5 students was chosen based on the findings of Dutson et al. (1997) about team size. On the other hand, Kirschner, Paas & Kirschner (2009) concluded that the learning tasks assigned to the teams (problems, projects, etc.) must be complex in nature and, therefore, should not be easily carried out by a single student. Consequently, the complexity of the project was also conceived so that 4 to 5 members had enough work. Considering the above considerations, the manufacturing project proposed to the work teams consisted of three stages:

1. From a real engineering system, the team must propose a complex component to be manufactured by using the computer numerical control (CNC) and computer-aided manufacturing (CAM) technologies covered in the course (see an example on figure 4).
2. By using the CAM system available in the manufacturing laboratory, teams must design the entire manufacturing process of the proposed component. This step involves using a large part of the content of the course, specifically: selection of cutting tools, determination of basic process parameters, calculation of operating parameters, definition of sequences of operations, determination of convenient machining strategies and process safety analysis.
3. Finally, using virtual models of numerical control (CNC) machine tools available in the laboratory and implemented in the CAM system, the teams must perform the modelling and simulation of the setup and the complete manufacturing machining process of the selected component.

With the previous formulation, the intentional problems that the teams will have to face to complete the project are clear. However, it is very likely that unintentional technical problems arise that are also part of the intended learning.

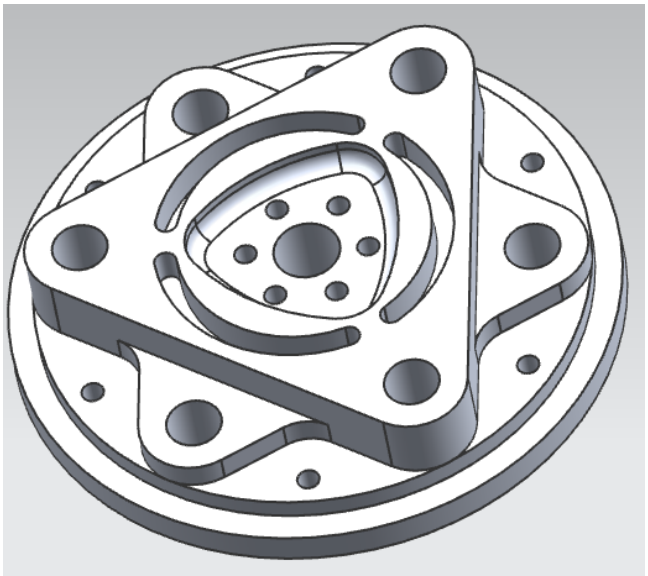

Figure 4. Example of complex real part proposed by a team for their project.

Assessment of students' work

Following the recommendations of Hellström, Nilsson & Olsson (2009) and Oakley et al. (2004), at the end of the semester, each student received a cumulative individual grade. In order to obtain the individual grade of the students' learning, were performed: an individual final CNC and CAM test (30%), team project and presentation assessment using rubrics (see Annex F and Annex G) (50%), and average self-evaluation plus peer evaluation (20%) in a questionnaire-based survey (see Annex H). Along with the report and the technical material of the project, the students were asked to submit a process analysis including: reflections on the management of the project, reflections on the individual and group learning processes, as well as recommendations for their future work in teams (see a process analysis report example in Annex I).

Students perception about their experience in this project

There were several positive comments as well as comments on aspects to improve.

"The idea of promoting learning not only with the teacher-student relationship, but also with the relationship between the students is very good and very useful, knowing that among us we use the same language and use different tools to explain."

"One of the objectives established by the teachers was to achieve good teamwork and learning from this relationship between the members. From the beginning of the course, activities were carried out, such as the formation of teams with members who fulfilled different roles. The emphasis in this teamwork throughout the course allowed a better acquisition of knowledge, since shared learning was fostered, there was greater involvement in the processes by the students and a greater number of ideas were generated."

"Excellent course, I have learned a lot and I have been passionate about working on these topics. The team was in accordance with my expectations, even though I did not know any of its members."

"As a recommendation to the class, it would be very helpful to emphasize the team's work and communication between colleagues, reinforcing the activity or workshop at the beginning of the semester. It is usual that engineering students are not familiar with teamwork and find it difficult to get used to the personalities and abilities of new colleagues."

"Generate some sessions where the team members can make themselves known in a better way, doing the teamwork in a more fluid way."

Reflection on project coordination

The learning through practical experiences of the fundamentals of CNC and CAM technologies is a real challenge considering that the number of students per semester in the course "Manufacturing Processes II" is always close to 80. For this project, designed examples were used, as a support to learn the fundamental concepts to achieve the development of the project. This strategy proved to be convenient for large groups of students.

In the project, special emphasis was placed on teamwork and it could be perceived that several students understand and value this aspect in particular. One challenge is to give students more opportunities to reflect on their teamwork, on the course and project development schedule.

The use of peer assessment was not very successful, in the future this aspect can be improved by giving specific instruction to students about the aspects of professional ethics involved in this activity.

2.2. Practice assignments

In my course "Manufacturing Processes II", in order to promote the learning of computer-aided manufacturing (CAM), the students can use the industrial NX Siemens software platform. Two teaching assistants who work for periods of one year support these practices. I take care of the learning protocol for the teaching assistants both in the use of the CAM system and in the methodology to guide the learning of the students. The sessions program for the practice can be observed in Annex J.

The other fundamental practice is related to achieve the understanding of CNC (computer numerical control) technology for manufacturing. The students carry out experimental practices using the industrial CNC machines of the laboratory. The following paragraphs are an abbreviated explanation of the development of the CNC practice that I designed for the course (see the practice guide in Annex K). The technical engineer of the laboratory is the person responsible to support the practice of the students. The maximum of students working simultaneously in the practice is nine and the work teams are composed of three members. The dedication to practices are 3h per week.

The intended learning outcomes are: (1) to understand, through experimentation, the basics about using numerically controlled machines to machine a component. (2) To exercise collaborative work with colleagues. (3) To write effective technical guide documents.

The resumed methodology covers the next steps: (1) I explain the fundamentals of numerically controlled machine tool programming. (2) A CNC machine tool is assigned to each team. (3) Students of each team should read the operating manuals of the assigned machine prior to the practice session. (4) Taking into account the process capacity of the CNC machine, the team must propose the design of a component to be manufactured. (5) With the advice of the technical engineer of the laboratory, the team must manufacture the proposed component. (6) Parallel to the work in the machine tool, the work team must write a tutorial, which should be able to guide an engineering student without previous knowledge, to manufacture the same piece in the assigned machine tool (the practice guide also explain the expected minimum content of this tutorial).

The assessment percentages are: (50%) Didactic value of the tutorial as judged by myself, by the technical engineer of the laboratory and, by a first semester student (an example tutorial in Annex L). (20%) Quality of the piece manufactured in terms of surface roughness and dimensional tolerances. (30%) Face to face individual assessment of knowledge about operating the assigned machine.

2.2.1. Evaluation and reflection on practice assignments

My work coordinating the practices involves not only designing the work guides for students, but also managing a periodic training for teaching assistants and eventually for the technical engineer of the laboratory when we acquire new equipment. The above also makes necessary a process of permanent learning of the teaching assistants and of the technical engineer, along with the instructors sent by the equipment and software vendors. To orient the work of the teaching assistants and the technical engineer I have implemented weekly meetings to plan the work and analyze everyday problems.

2.3. Lectures

2.3.1. “Doctoral Research Seminar I” course

I was in charge of this course until 2017-01. Each term, on average 10 first-semester students take this course, they come from the doctorate in mechanical engineering and from the doctorate in science and technology of materials. This is a pass non-pass course. The proposed learning outcomes are: (1) to acquire skills to make scientific presentations; (2) to discover resources for bibliographic acquisition and management; (3) to reflect on the ethical dimension of academic and scientific work; (4) to discover the characteristics of a good bibliographic review; (5) as a course project, to write a review paper on the

student's research topic. Additionally, part of the content is defined by agreement considering my suggestions and the students' interests.

After teaching this course for 8 periods, the methodology I have developed is based on the permanent work of the students. The sessions are developed in a sequence of four steps: (1) before the session, all the students prepare in PechaKucha format (see it here) a presentation on the agreed topic. (2) The session begins with the students' presentations. (3) We continue with a discussion originated in the questions and ideas originated in the presentations. (4) Finally, we remember or define the topic for the next session. (5) I use to build a website of the course for each term, here the students share their presentations and, in this way, a reference material for each topic is constructed by the student's community effort.

As an example, in the "Doctoral Research Seminar I" course of 2015-02 semester, with eight students, I developed a website in Annex M. In the first session of the course, I informed the basic content and the students in turn proposed to exercise their academic presentation skills by presenting to the colleagues their master's dissertation. They also proposed a session to reflect on recommendations, implications and context for conducting doctoral studies and a session to present good examples of doctoral these proposals. The students also proposed that we ask their tutors to review and approve the final version of their review papers.

2.3.2. "Manufacturing Processes II" course

This is the undergraduate course in which I usually work. Each semester, 80 undergraduate students coming from mechanical and mechatronics engineering majors take this course. The focus of the course are the machining processes used extensively in contemporary manufacturing. The rationale for including this mandatory course in the curriculum is that a core competency in engineering is knowledge in materials and manufacturing processes to design and build new equipment or products and to manage manufacturing systems.

The planned learning outcomes are: (1) to develop competencies for planning machining processes; (2) to obtain an insight about research in machining processes; (3) to develop competencies to use computer-assisted numerical control (CNC) and computer-assisted (CAM) manufacturing technologies; (4) to exercise self-learning, writing of technical documents and collaboration with other colleagues.

The face-to-face activities are a 2h weekly theoretical lecture for the 80 students and 3h practice in groups of 20 students at the Machine Tools Laboratory.

A typical lecture has three moments: (1) before the session, the students should do a preparation activity; (2) I make a brief lecture of the subject during the session; (3) the last part of the session is an individual or group assessment activity on the topic addressed that day. Students record their preparation activities in an online patchwork document in which they receive feedback (see an example in Annex N). The course is managed through a website that is actualized each semester (see an image in Annex O).

2.3.3. Peers visit to a lecture of "Manufacturing Processes II"

At National University of Colombia, it is not usual that we review the teaching practices of colleagues. As part of our activities at MPBL-Aalborg we decided to visit one of our colleagues' sessions and share our

impressions. Since we decided this when the 2016-02 semester was closing, we did not have enough time to prepare a detailed rubric and the observations were then made freely.

In my case, the comments that I thank my colleagues are: (1) since the class is in a large auditorium, I always should use the sound system of the room so I do not have to raise my voice too much. (2) The slides I use might have a more eye-catching design. (3) Videos used in that session were a good resource for attracting student attention. (4) I should implement more activity for the students so they do not get distracted at the lecture. Now I use a sound system, the slides have been redesigned (an example in Annex P) and I have implemented peer instruction activities, but surely for this point there is a lot of room for improvement.

2.3.4. Performance evaluation

The academic direction of the University implemented a system of evaluation of courses and teachers (see it here and a translation of the survey in Annex Q).

The Figure 5 shows my scores for 2018-01 semester. As can be seen, I have a good performance but still much room for improvement.

Periodo	Cursos	Participación	Global	Factor 1	Factor 2	Factor 3	Opciones
Periodo 2018-01	○ 2017274-1 PROCESOS DE MANUFACTURA II ○ 2017274-2 PROCESOS DE MANUFACTURA II ○ 2017274-3 PROCESOS DE MANUFACTURA II	46.75% (36 de 77)	**4.42**	4.38	4.55	4.39	Abiertas Detallado Ver encuesta

Figure 5. My quantitative score in the teaching evaluation system (2018-01).

The major improvement issue detected in the most recent evaluation where about the dynamics of the large class in the auditorium. On this respect I am working on the use of elements of the flipped classroom method.

A representative sample of a student's answer to the question: what was the aspect that most influenced you or the main strength of the teacher that helped you to learn in academic activities?

> *"He is a teacher who likes to be at the level of his students, making his classes, despite being masterly, are closer and allows a space for reflection and criticism to be generated in the classroom. His professional experience inspires his students in a good way, because it shows that he really knows what he is talking about."*

A representative sample of a student's answer to the question: what could the teacher have done to improve your learning or what should be the aspect in which the teacher should improve his / her teaching process?

"A little more dynamism in the class."

2.3.5. Reflections on lecturing

If before each session, the students have done the reading-workshops assigned. They have a mental scheme that allows them to complete in the lecture the full picture of the topic. An important element of the process are the reading-workshops, which in many cases are of my authorship, and reflect on my experience teaching the topics and my own research on some of them. I am implementing more class activity by getting insights of works like Felder & Brent (2009).

Often in the sessions, we also work on solving issues in cooperative work, at this point the interaction with others becomes a fruitful activity, because everyone has made an individual effort to understand. On this respect, I am making improvements based on the Mazur's (1997) suggested strategies to promote peer learning. Eventually the session is enriched with videos and animations. This taking into account that the current generation of young people is usually an intensive user of video, online social networks and video games.

2.4. Individual assignments

I have supervised 20 undergraduate degree projects, 8 master's dissertations and one doctoral thesis. I am currently supervising an undergraduate degree project, two master's dissertations and one doctoral thesis. Additionally, I am co-supervising another doctoral thesis. No one candidate supervised by me have failed in obtaining its degree.

Generally, with each supervised student, we held a weekly half-hour coordination meeting and we manage all project documents in a google drive portfolio. According to the experiences and expectations of the student, I recommend readings to guide him to select a project topic that is feasible and appropriate with the academic degree to achieve. Parallel to the selection of the topic, I make an evaluation to make sure that the strategies of search of information that the student uses are appropriate.

To start structuring the project, I encourage the student to start by collecting as much bibliography as possible and analyze it in an annotated bibliography document. This process lasts until I observe that the student understands the important aspects of a work of the nature of the one that him tries to approach (statement of investigation problem, experimentation, methodology, resources, analysis, and presentation of results). Once the pupil has successfully completed the annotated bibliography process, I instruct him to start writing his project proposal based on good models. We continue with writing and review iterations of the project until it meets the standard required for the academic degree in question.

Once the project is ready, we begin execution. From this point forward in the meetings, we evaluate the progress with respect to the planned so that the student makes the adjustments and decision making pertinent to go ahead. From the beginning of the execution, I ask the student to start with the writing of his thesis report. Generally in this way, we have well-structured material to present manuscripts to journals and conferences. Each student and his project have unique characteristics that I manage

according to the circumstances, in some cases when the student is stressed by the natural pressure of a project, we have talked about how to harmonize the demanding academic life with our personal and familiar dimension.

2.4.1. Feedback from a supervised student

One of the students who made his undergraduate project under my supervision and who was teaching assistant for the CAM practices of my course "Manufacturing Processes II" sent to me the following message on 12-dec-2016:

> *"Good morning Professor José Manuel. I hope everything goes well and that this semester everything has gone the way you planned it. I would like to express my gratitude for the experience with regard to the article in which we work together (see it in Annex R). It has been very valuable and it has generated interest to me to continue working and encourage me to make more developments and to be able to publish them. Among other things, the subject of teaching-learning in manufacturing motivates me enough to be able to contribute within the possibilities, and I want to do postgraduate studies in this area. As always, it is a true honor to be able to continue learning from your contributions and experiences. Next month I hope we can meet and be able to share the progress in FMB, which incidentally, has come out longer and more complex than I imagined, but very entertaining. Cordial greeting for you and your family Professor José Manuel."*

2.4.2. Reflections on individual assignments

> *"....it is hard to have a good idea if we have little knowledge of the subject, and impossible to have it if we have no knowledge. Good ideas are based on past experience and formerly acquired knowledge."* (Pólya 1945, p. 9).

The previous quote from Pólya is quite close to the philosophy I apply to the students I am supervising. For this reason, I dedicate a good part of the supervision process to assessing the critical reading ability of the student. I also carry out a very close accompaniment with his first manuscripts, in order to achieve an adequate level of academic writing.

I ask the student to make a written report of each supervision meeting, in order to have a record of the decisions and tasks, but mainly to ensure that we understand well the points of view of the other.

3. Personal development plan

My current development plan is grounded in introduce elements that I discovered with the development of the MPBL-Aalborg program. One of the essential strategies is to use the research literature in engineering education to inform the decisions of planning and execution of my courses in charge. I also intend to maintain a scholarship of teaching taking, on a regular basis, relevant data in my courses as inputs to implement actions to improve the learning environment of the students.

In the large theory class of the course "Manufacturing Processes II" that I dictate in an auditorium I propose to implement elements of the flipped classroom methodology, promoting much more student

activity during class sessions. For this, other sources of inspiration are important as Mazur's (1997) strategies to promote peer learning and Felder & Brent (2009) active learning recomedations.

In the section of laboratory practices of this course, I intend to continue with the development of team projects using as reference the literature in terms of formulating increasingly weakly structured problems, formative assessment, structured strategies for assigning students to teams, as well as follow-up, support and feedback to the team processes of the students.

Regarding the use of curriculum models, I consider Cowan's proposal (Cowan, 2004) very promising to evolve from Biggs' well-known constructive alignment (Biggs, 2003) towards an integration of outcomes, assessment, and learning-teaching activities from the beginning to the end of the course. I realize that the curricular process must start by analyzing what skills, what knowledge and what attitudes I wish to develop in my students. In this analysis, I will now get insights in the four types of learning defined in Illeris' (2009) theory and in the Bloom's taxonomy (Bloom, 1956).

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