# My quest on trying to be a Research Advisor

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A couple of months ago I had a talk with my Advisor about how to handle the research group (GISCIA - Student Research Group of Control Systems and Artificial Intelligence) I'm currently running as President. After various remarks and positive and negative comments on what I was doing based on what he observed, as my lab is next to his, he told me some good advice on what I should improve, and what I should re-frame - for I thought, that the first of the two semesters I had as President of GISCIA, I was doing a good job.

Apparently I wasn't, and I had still a long road for improvement. The first thing I was told about was, despite my leadership and self-confidence as President of the group, I was missing the whole point of actually being President - or the non-political and yet academia equivalent - Lead Researcher. The group dynamics of working as a team was giving us good results, but we forgot about mentoring and teaching the new-coming generations: The Sophmore's and Junior's that would take our place once we graduated with our B.S. in Mechatronics Engineering.

I think that mentoring is a very difficult and important task. One is often confused at the beginning about the mentoring dynamic due to the fact that one thinks that "I do not know enough". This is probably the reason why Professors are expected to have a PhD in there field of expertise, so that they can teach and mentor undergrad and grad students for research purposes, and because they too have once been students who needed guidance to perform research correctly. The Advisor invests the first years in teaching the Grad-student this task, and expects that he has learned from these initial years, so he can continue independently and complete his Dissertation in a successful manner.

Artificial Intelligence and Machine Learning at Peru is still emerging as a research field, so it is rather difficult to find a Professor who not only knows about those subjects, but who has already passed through a PhD program where the research methodology is developed - and thus can run the lab. This is where I had to play the role of a pseudoAdvisor for most of the group members. I noticed that even though I could talk to them about there projects and research and got some feedback and insights on their new ideas, what I hadn't been doing is giving them specific recommendations or teaching them explicitly some tricks on performing better research. This also made me realize that I hadn't been doing research with a group Most projects involved groups of 3 students, my research project was a team of one: myself. I needed to get out of this selfish circle, so I decided that I would grab and find a group of students and teach them what I had learned about Computer Vision and Image Processing in a self-taught fashion.

So now I had to do 2 improvements :
- **Teach** a group of students, so I can work with them on a future project.
- **Mentor** this same group of students, so I can expect that the Research Group can move on.

Both goals might seem straightforwardly selfish yet again (notice the 'so I' phrase in both

statements). Nevertheless, the idea of teaching implies passing on knowledge to the future generations, to prepare them for the world, while mentoring is more about sharing experiences and the wisdom one has acquired after spending more years at academic training to the future generations. Ideally both investments would have a retribution for the Research group later on, but most importantly for the students themselves.

Mentoring before Teaching

Maybe it is just the idea that mentoring before teaching is a way of seducing the young minds, to make them actually pay attention and understand the value of what they are about to learn. I was never explicitly told this, but I guess my Advisor did the same thing with me. First, a true, honest, and in-your-face chat on personal goals, motivation, accomplishments and ideas of life, with my 'students' is what I did. I will try to use the buzzword/slang 'padawans' for them, as I am not officially a teacher and do not want to seem too impetuous, but I also want this reading to seem playful and dynamic. The padawans are asked one by one about these subjects, and they are off to explain there reasons on why they chose a specific Major, how good of a student they are, what they want in life, what they like, what they DON'T like, how and where they imagine themselves a couple of years from now, etc.

I pre-selected a group of 4 students by previous reference of a friend of mine who told me that he, along with the other 3 members of the gang, were training for ACM computer programming competitions, and they wanted to improve their rankings and placement in the tournaments. Fascinated by their initiative, I decided to cite them in for a group meeting, and that's how I recruited my first group of padawans.

After listening to their different opinions and some light debate on technical, and philosophical issues, I go for the computer and show them videos and webpages they will find helpful. These include:

www.ted.com
http://academic.research.microsoft.com/
www.youtube.com : Relevant videos
www.google.com : Relevant searches
www.arwu.org
www.scopus.com
www.eigenfactor.org

Themes I talk to them about to awaken their knowledge of state-of the-art research are, but are not limited to:

Parallel Programming Paradigms
CUDA
Quantum Computing
Augmented Reality

Boston Dynamics - Robotics
The Darpa Challenge
University World Rankings
Computer Science Research Fields (depends of University)
Startup Companies
Gradschool 101 : The Ph.D. and the M.Sc.
Research opportunities abroad
Academia and Industry: The Pro's and Con's

These themes vary depending on what are the interests of each of the Padawans. For example, padawan A had an interest in Robotics for grad school, so I showed him a video about UC Berkeley's Towel Folding Robot. On the other hand, Padawan B was more interested in 'wanting to program something and see more than just numbers on a terminal' , so I showed him Pranav Mistry's Sixth Sense Augmented Reality concept. These videos catched their attention, and I verified that later on as they showed a big amount of interest during the classes and assignments.

My next step was a realistic approach towards research. In this final phase, I talked to them about how Research works in Peru, how we are still a long road from research done in Europe, United States and other Asian countries. But despite multiple drawbacks, there are ways to stand out and ways to make the difference for grad school or industry. **Perseverance** and **Interest** are two basic characteristics padawans should have. The next weeks involved monitoring where their perseverance and interest levels stood.

Teaching Computer Vision

So I waited for the padawans to arrive on friday afternoon after lunch. Classes are only once per week, and I leave them an assignment at the end: a simple and fun assignment, rather than something relatively complicated that can ultimately lead to boredom - a point of no return. Classes last between an hour or two and they end whenever I feel there is no point in continuing, which my be an excuse for saying that I ran out of ideas! But seriously, to me teaching the Sophmores something is like having a long conversation where I do 80% of the talking and they do the other 20%. Since they are three and they sit down at the Lab where I explain with 2 acrylic boards, they are given the freedom to go beyong asking questions, but actually standing up and doodling on the boards proposing interesting questions.

I also think that while I'm at it, eye contact always plays an important role. Are they looking at me with enthusiasm? boredom? intrigue? are they confused? are they getting everything too fast or am I explaing too slow? Most of these questions require some sort of perceptual social cues that go beyond teaching but are actually observable in any social encounter.

I started out by teaching them the basic principles in a dynamic order, leaving mathematical formalities for later. Explaining the essentials of how pixels work and how color works comes first, only then can one start commenting about RGB and CYMK, HSV color spaces. While

each definition is made, analogies and examples should be constantly throwed at them so that they can actually see the importance of Color and understand how color works. For example: The RGB additive color system that is the basis of how our computer monitor works, where it is a huge conglomerate of RGB microleds grouped in triads, compared to how the CYMK substractive space works, where artists combine different colors to get a specific tone, just like our color printer.

Moving on to other subjects is comparing Histograms to those used in statistics, and how Photographers use histograms to obtain different contrasts. Usually when I explain these concepts to a small audience there is nothing better than explaining it “hands on”. In other words, opening MATLAB and coding the different techniques , like Histogram equalization or Gaussian Blurring. Parallel to the hands on approach, I usually doodle the pixels and masks on the board to give the mathematical intuition, only after showing the MATLAB coding outputs. I belive that this reinforces their attention on the math, usually teachers go the other way around,first the math and then the application. While this is ‘correct’ under some logical order, the marketing mindset of the student might ignore the mathematic formallities at the beginning, just because he or she is not driven by a curiosity of the value it can have, in this case in Computer Vision and Image Processing.

The first two classes covered the previous topics as well as histogram based segmentation and some basic notions of image classifications. The idea is NOT to teach them profoundly each subtopic, but rather to give them a broad look on how various techniques work as well as the Computer Vision buzzwords. I also included some coding guidelines in OpenCV, where I explained how the IplImage class worked and how image data is stored in the library. For this group of students, because as I previously mentioned, they were training for the ACM tournament, I preferred teaching them OpenCV so they could improve their implementation techniques and also work on pointer coding.

After the 2 classes we took a break on the Computer Vision principles and went for global research awareness. I told them to gather at the lab and to do the following assignment, during the hour and a hald period:

1) Go to www.arwu.org or http://academic.research.microsoft.com/
2) Find the Computer Science Rankings list
3) Select 5 universities from each of the 1-25, 26-50, 51-75 ranking group.
    Condition 1: Of the 15 universities selected, 8 must be American and 7 non-American.
    Condition 2: You cannot pick a ‘known’ university ex: MIT, Harvard.

*No offense to MIT or Harvard, it’s just that sometimes students believe that those are the only good universities out there, and they completely ignore all other options.

I was amazed at some universities they picked, but rather than that, the idea is to awaken their knowledge of other prestigious universities world wide. After this list was made, the had to do the following steps:

4) Open a new google tab and search for “Name of University” + Computer Science Research
5) Create a new google Docs SpreadSheet and make a table with the following columns: University, Country, Webpage

This last part took more than a while, and the fun part was that as they actually searched for the research webpage, they automatically started surfing each webpage for their research projects and Professors. The idea is that not only to get them used to finding about research done at each university, but to make them unconsciously used to the Computer Science Jargon. Eventually they started talking to me about how some research interests correlated between universities and after the hour and half had passed, I gave them the freedom to keep on reading it at home.

For the next class (or being more realistic the next month), they are supposed to start to bring in research project proposals. Even though I am no Comptuer Vision expert, I try to filter or scan quickly which project is more feasible for there starting level. What I expect to see is that they team-up on a small research project, once this project is done, they can try to go for a harder one. Once the harder one is achieves they will probably already be at the Junior or Senior year and they might consider writing a paper on their project.

It is important to state that, I did not want them to start with any project beforehand, in other words, they first had to revise carefully a vast variety of research projects and do some brainstorming and web checking for tools, and only then can they start their project. If done the other way around, students (like myself in previous occasions), begin with a project too hard to be done, or rather too simple that library functions already exist to tackle the problem.

Social Dynamics and Unexpected (Positive) Results

Because GISCIA Lab is small and is the size of an average 10 person class room, whenever I was teaching, other lab members were working and some were fussed about the noise, because independant of whomever is speaking, noise tends to break someone’s concentration, while others popped out their earphones and continued coding / reading. I moved round and about the classroom explaining my ideas, and throwing some jokes from here and there just to make sure no one would fall asleep and to be sure that I had the padawan’s attention.

Nothing interesting really happened until after a month of the first class I gave. Where one day I arrived early to the Lab, and a friend of mine whose interests lie more in the Mechanical Engineering realm was debriefing some details of Internal Combustion Engines to another new group of Sophomore’s willing to participate in research. I arrived and left my bag silently, and opened my laptop to check my email and continue working, still paying attention to what my friend Juan was instructing to the young padawans. I was surprised that the lesson on engines lasted for about half an hour, and they probably were already half way through the moment I arrived.

And yet again, only 1 week after that another friend of mine accepted my proposal of teaching

another new group of Sophomores about Computer Vision too, as both he and I share the same research interests. Even a couple of days ago, the Vice-president of the group commented that he was trying to look for a small group to teach them the basic notions of Control Theory.

The Teaching initiative definitely proves the hypothesis or should I say “popular folklore” of leading from the front. Hadn’t I started to teach, maybe neither of my friends would have been interested in teaching/mentoring too. I myself was a little doubtful at first because I thought I wasn’t ready, or that I was going to make a fool of myself, but now that I look back after the first month of Teaching, it was worth it. Not only do I feel accomplished by sharing what I know with my peers, but I also feel that I am performing the role I should as research group president, and even though we might not have a mentor (now we do!), I think we are doing a really good job. We are now starting to develop a feeling of camaraderie, where those who are leaving the university share their experiences with those who arrive : a research group and fraternity.

www.giscia.wikidot.com/english