PGCAP Module 2 Summative Assignment

David Paredes
Atomic and Molecular Physics
Department of Physics
Durham University

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1 Introduction

The aim of constructively aligned teaching is to design, promote and assess deep learning (as opposed to "shallow" or "surface" learning); therefore, a better understanding of the factors that impact this approach to learning is of paramount importance [1].

While it is well known that there are different learning styles, there is still much to know about how to enhance a *deep* approach to learning.

Since the launch of the "learning styles" movement by Kolb in the 1980s with his work on experiential learning [2, 3], a wealth of different taxonomies have appeared to describe the way students learn, ranging from schemes that state that learning styles are constitutional, to others where the learning styles are just flexible preferences; or just approaches, strategies, or orientiations to learning [4]. These descriptions try to provide us with a framework to make teaching more effective.

Despite the critiques to the learning styles approach [5, 6] the categorization of learning approaches is still a useful tool for both learners and teachers to approach learning in a more analytic way.

The modern categories of intrinsic and extrinsic motivation derive from the definitions reported by Gibbs et al. [7], where he identified four educational orientations in students: vocational, academic, personal and social. Each of these can, in turn, be subdivided according the whether the students were genuinely interested in the material (*intrinsic*), or whether they use the courses "as a means to an end" (*extrinsic*). Intrinsic motivation has been identified as an important factor to promote deep learning (see, for example, [8]).

I interviewed Physics students of the "Bridge Project". This activity counts 20% towards the total mark of second year module "Laboratory Skills and Electronics" [9], so a clear academic, extrinsic motivation is in place. The project is a one-week creative activity that happens at the end of the first year. In each project, given in the form of a problem for groups of four, the students carry out unscripted research under the guidance of a member of staff where they learn new practical and theoretical skills. This is a complement to the scripted laboratory practicals that they have performed during their first year, and the first time they have the chance to do creative research. Students were intervewed twice: once at the beginning of the activity, and once after the assessment. The questions used can be found in the Appendix. I usually use a

question-driven approach, also called "Socratic method" [10, 11, 12], where the students are guided by questions from the teacher, rather than the teacher giving the answers. This method uses critical questioning (*elenchus*) which aims to help students to get rid of their "cognitive egocentrism", and to get them to a mental state of of confusion (*aporia*). This confusion intends to make the learners realise that they need new knowledge, inspiring curiosity. From Kolb's perspective [2, p.28] "[...]one's job as an educator is not only to implant new ideas, but also to dispose of or modify old ones", which seems to ratify this method as a possibility in the teacher's *repertoire*.

My aim is to better understand what role plays the initial intrinsic motivation in the dycothomy deep/surface approaches in a compulsory and creative activity, where the extrinsic, academic motivation is strong. I also want to learn about how the Socratic approach affects intrinsic motivation.

2 Interviews

2.1 John Doe

John uses a (seemingly) shallower approach when the set skills required are new to him. However, he uses a deeper orientation to learning when he has some familiarity with the material. John seems to lack intrinsic motivation from the outset, but once he is faced with an appropriate challenge, he dives into the content and starts using his deeper approach in a new context.

In the past, John had used different strategies to studying depending on the subject that he was dealing with. For example, when he learns non-laboratory subjects

> "They way I learn best is to teach somebody else something once I have a basic understanding of it or doing questions on the subject. This basic understanding I get either by reading or a lecture."

He seems to need a certain familiarity with the material to delve later into deeper forms of learning. Here, we identify an approach that is the informal analogue of "Lernen durch Lehren" (LdL) by Jean-Pol Martin. This approach shows social as well as academic motivations, and can be thought as belonging to the higher portion of the Maslow's hierarchy of needs [13].

However, this year was his first year with laboratories, and his previous experience is affecting the way he approaches the subject [Ramsden]:

> "I don't have that much experience on labs, only this year. I approach them literally going through the labs, going through the guides, writing stuff down. *Going through the motions* ."

This might explain why, in an interview carried out at the beginning of the module, he showed mostly extrinsic academic motivation to carry out the laboratory practice. He did not choose this project out of curiosity, but rather by necessity.

> "I did not look for information before, really. I signed up about half an hour since the sign up opened, but most of the projects were already gone ."

Nevertheless, in this open-ended, more independent laboratory, his approach tends to be "deep", being analogous to the third (acquisition of utilization of facts) or fourth (abstraction of meaning) conceptions in Säljö's classification [14],

> "I'm hoping to get insights of modelling, learn things about vibrations and magnetism. I'm just trying to keep my mind open."

Even if it could be difficult to motivate, novelty and challenge seemed to be triggers of his personal motivation

> "In every subject, you can always find something tedious and boring.[...]. I like things that are new and challenging."

During the activity, it was decided in the group that, since he was interested in programming, he would write a program to analyze the data that the rest of the group would take. The task writing software to perform the analysis necessarily involves an understanding of the task at hand, which is different from "coding". It is necessary to understand the problem to generate the specifications for a program [15]. When asked about the things that he learned, he put more importance on the novelty of the material, and the significance of the results

> "The data analysis that we did I also find quite interesting, since we didn't do it to that extent before in labs, we didn't do as much error analysis, since we were more concerned in getting results, and how confident we were in these results"

However, he did not seem to be in complete control of his learning process, as he still finds dealing with new knowledge "confusing", but he seems to be transferring the learning-by-teaching (deeper) process to the laboratory

> "The resources available can be quite confusing, since I didn't have many examples, and needed to figure out how to use it..." "[I have learned] having to overcome different problems that I had with [programming language] helped me to better understand the programming language itself. Having to explain my program to the rest of the members, and how to use it, also reinforced that. Once I ended up explaining all the data analysis that we ended up doing also helped me understand data analysis."

Since the Socratic method is aimed at perplexity and confusion (*aporia*) by being presented with the limits of your own knowledge, it seems to be a good approach to John.

> "[the Socratic method] forced me to develop a greater understanding of the material that I've been asked about, by making me solve the problems myself, instead of being given the answer. It reinforced this behaviour."

2.2 Jack Doe

Sometimes, we can find strategic learners that are highly motivated. Jack is not only academically motivated, but he seems to be interested in the social aspect of the group activity.

In the interview previous to the activity, we can observe that he applies different learning styles depending upon the perceptions on the assessment. When asking about the way he learns

> " Learning for exams? During the year, learning by doing questions, but for exams I try to do notes, then go through the questions." "(In laboratory based subjects) I can do them based on previous knowledge, if not, internet, if not textbooks. [in the labs I] discuss possibilities with partner or just experimentally, taking different readings,.... "

His motivation to choose this activity seems to be curiosity and novelty (which are signs of intrinsic personal motivation), and it is possible to notice that he relates his experience to that of the rest of the people, trying to be *different* from them

> " [I] Enjoyed the labs at the end of the year more in that you can research an investigate things that interest you rather than follow the script. You can use your imagination more, and investigate stuff that is different from other the people. That's what I want: investigate what I am interested in about something. [...] I also want to work in larger teams, because in the labs were groups of two."

Jack seemed to be prepared for the activity, although from the context it would be difficult to categorize this approach, because this preparation can arise from either intrinsic motivations (to learn better) or extrinsic (to perform better):

> " I took some notes on the stuff I found on the internet. I got some ideas. "

Furthermore, he seemed to have developed a strategic approach to tackling complex activities, such as a laboratory practice, to minimize the time wasted

> "I found this year in labs, if you did not have a lot of understanding, because you haven't had time to look into it, it takes a bit of time during the labs to understand what you're doing, whereas if you have had time before, whereas it's a lot quicker if you know about the issue, the equipment,... and *you know what you're looking for. Then, you can highlight things.*" [complete this]

We can observe that he seems to be dealing with laboratory practicals as a *problem to solve*, where the activity has a very clear outcome. However, he can go beyond the prescribed activity; one can *highlight* things, understand them and bring meaning forward.

After the activity, he explains what he has learned

> "Stuff to do about the topic, the limitations of the equipment, which is quite common in experiments in general. Also, working with other people, get the best out of other people, help them do things for you, do things for them,..."

Obviously, he has understood what is the aim of the activity, which is to introduce the general principles of a real working experiment, without the stick and the carrot. Furthermore, he is very conscious of the social aspects arising from the work in group, and the role social interactions play.

His views after the activity show that he was even more motivated, even against extrinsic setbacks (the good weather outside),

> "I enjoyed it a lot more than I thought I would. I was looking for it in a way because I knew it was going to be better than labs normally, but it's a weeks work, and I did not want to be here (with the sun). Taking the data is a bit repetitive...you don't need to think, but in the past couple of days, analysing the data and looking into the physics behind it... it's been fun: quite enjoyable."

The Socratic method, in this case, seemed to be appropriate at eliciting intrinsic motivation.

> "I guess the way you do it, probing us to think about things. Whereas supervisors either not told you, or told you and do not make you think about the project itself, and by putting questions you give us ideas that we can follow through, like a snowball effect"

This quotation has to be contrasted with one by a Plato type learner (see [10]), which considers that the teacher "[acts] more like an 'arsonist' and not like a 'fire fighter' ".

Furthermore, we can observe a hint of intrinsic motivation for laboratory subjects arising from the activity.

> "Q. Has this activity changed your views about experimental Physics'?
> Jack: Yes, a lot.
> Q: In which way?
> Jack: When we talked with our supervisor in normal labs, we were saying we didn't like the structure, you don't have any input at all, you just basically spend 3 hours taking data; and she told me that *it would get better*. And the fact that it was an experiment that wasn't like, widely known, there wasn't a lot about it on the internet, made us thing of the physics behind it, come up with new things: which I enjoyed a lot more than normal labs. And she said we would get more of those next year. *I'm looking forward to those*."

2.3 Jim Doe

Although Jim had some intrinsic personal motivations to carry out the activity, the Socratic method was not useful because he did not understand the learning outcomes of the activity. This is evidenced by him looking for "hints" to "answer" the problem.

Jim approaches learning by solving problems: he seems the need to go through the assignments and only when the problems are hard he will look for more information

> "I do the weekly problems, and the homework set, and try to read the text between lectures; anything I struggle with, I spend longer on, to make sure I get it right, things that I find the first time easy, I won't linger on."

And the process of solving problems he usually *looks for the answer*

> " I generally start just by trying the problems, and if I can't I will go to the text; if I cannot find the answer, I go to the wikipedia or the internet, maybe seek out someone who has been able to do it."

Looking at these extracts, it is difficult to infer whether he is taking a deep or shallow approach to learning. At least, he uses a strategic approach, trying to minimize the amount of time and resources required.

When asked about the previous laboratories, he does not find any techniques, but he reckons that in these labs he only used low-level techniques [1] (gathering and compiling information)

> "the stuff we've been preparing outside of the lab has been writing- condensing information, rather than sort of, answering questions. So it's just, I hadn't really any specific technique."

He thinks that, in previous laboratory experiences, he did not have independence. In the light of this, we can understand his personal, intrinsic motivations in this activity, although he recognises other academic motivations.

> "Hopefully... it's the first sort of more independent investigation. Sort of extended. There's a bit in labs, but it'll be interesting to see how I cope when I don't really... when there's no direction. I'd quite like to develop my skills and programming maybe a bit."

A strategic approach also corresponds with his preliminary preparation: he looked for information previous to the activity, but he admits not to have done it extensively.

In the beginning of the activity, Jim was very involved in analysing the data, this personal involvement has helped him the most.

> "Probably I learned most during the initial couple of days, sifting through the data, and then putting them into excel and seeing [some trends]..."

However, in his discourse, there is no mention of understanding at a higher level: he limits himself to practical and mechanical aspects of the activity.

After the activity, he has a more critical view of the Socratic method

> "Some times it's quite helpful, because it's better to try to understand something yourself than maybe just be told the answer; on other occasions maybe it hasn't... the question has been put out there, but we haven't quite understood the hint behind that question to investigate something. There were a couple of things that we realised we probably should have done. "

This situation can happen during the *elenchus* if the questions posed are not at the appropriate level, or are ill-formulated. That is why care should be taken when choosing the questions.

However, the fact that he was looking for 'hints', even though it was an open-ended activity, can lead us to think that there was a difference between the stated and the perceived learning objectives. More information about this communication issue was obtained when Jim told me what he would change of the activity

> "Maybe just a little bit more information at the start, as to how you might start. I mean, for example, we were kind of given [some materials], but I was never really sure whether that was all we've meant to use. I knew we were meant to start with that, but I didn't know whether that was the limit, or whether we were expected to use another method of analysing the data. "

When told that the course was based on the "independence" of the research methods, that it was part of their task to decide, to design the experiment

> " J: I wasn't too sure whether to try something else to see if we got better results, or to spend my time on ensuring that the data we had collected was processed correctly, as it were.
> Q: Why didn't you try to pursue your own, alternative path
> J: I guess... I assumed. [...] I didn't really give it much thought, because, as soon as I was there, and I saw the microphone and the oscilloscope, I thought, *that's what we've been given, presumably that's what we're meant to use* so, I just thought immediately to follow that path."

Finally, the highlighted text shows a common problem in (laboratory) learning activities: the difficulty of breaking the established barriers with learners that have potentially deep approaches to learning but that have not yet trespassed the established methodological and conceptual walls containing them.

3 Conclusions

The categorization of learning styles can be a useful concept to use when placed in a certain context. In the context of my teaching, intrinsic motivation seemed to have increased overall after the activity, although it would be difficult to assess what is the effect of my teaching in this process without a properly controlled experiment.

There is a common aspect, in terms of learning, present in the three case studies: people tend to learn things that they did "most of the time". That is, practice of the relevant skills will open up new possibilities and understanding related to these skills. However, it is problematic to assess deep/surface learning from the outcome of the particular module that I was teaching, since it involved several different activities, and every student presented different levels of understanding related to different concepts and skills [16].

The Socratic method seems to be ideal in small groups, and adopted (even if not by method) by other people in tasks such as tutorials. Students seem to benefit from this approach, as it seems that the "Socratic method" worked by driving people towards their particular "unknown", thereby bringing them closer to a source of intrinsic motivation. This method has several drawbacks:

- This questioning method might fail depending upon the different learning styles. In my experience, Physics students are normally driven by curiosity', but it is not possible to generalize, and different learning styles can react differently to the method (see the answers of 2.3 and [10, 16]). Therefore, adopting better questioning strategies is paramount [17, 18, 19], and I should spend more time on this issue.

- It is not possible to implement the method directly when working with larger groups, since a teacher cannot provide with customized interactions in a moderately sized classroom. An alternative to this approach is the so called Question Driven Instruction [20], where this problem is solved by seeking the cooperative learning among students. This item I am particularly interested in, and future research will be done on the subject.

Finally, the last student made me think about the natural barriers to learning that prevent students from learning more deeply. Some of these can, of course, be attributed to a lack of appropriate motivation (intrinsic vs. extrinsic) and some to a deficient communication or inappropriate method of teaching. But we shall not forget the context in which learning takes place. A gap between learning requirements and expectations can be palliated by better communicating the assessment process to the student, and by a constructive alignment between the assessment and the learning outcomes. Nevertheless other deeper barriers (*that's what we've been given, presumably that's what we're meant to use*) could be approached by enabling people to learn deeply from an early age.

A Questionnaire

In order to assess the role of intrinsic motivation, I need to understand the mindset of the student before carrying out the activity, and assess how that has changed at the end.

Obviously, since this activity has a limited scope, a small set of questions would suffice to get an idea about the issue of motivation. Under each question I state the motives behind them, although a whole picture can only be obtained by integrating the answers to all the questions.

A.1 Before

- *What is the subject that you have enjoyed the most during the past year? And why?*
  The aim of this question is to get them talking.

- *In terms of the learning approaches (very abstract concept) that you have used until now, how would you say you approach non-laboratory subjects?*
  The idea is to get some information about how the student learns. This will possibly trigger some reflection that can be interesting. However, since the student might not know what I mean by that question, it can have some follow-ups, like "do you prefer studing in a group or alone?" or " do you read thoroughly the theory, or prefer problem-solving activities?".

- *The previous question dealt with non-laboratory subjects. How do you approach laboratory modules?*
  Once we are in the mindset of learning styles, I want to learn how did the student approach the laboratory based activities that have been previously undertaken.

- *What do you want to get out of this course? What do you think you will learn?*
  This question is important, in that it tackles the issue of motivation. What motivates the student to learn? The question is formulated so as not to force "motivation" to appear directly, to avoid bias in the answer. However, the question is sufficiently open to allow for it to come through the conversation.

- *Have you looked for additional information about the problem you will be dealing with?*
  Just as a check, if the motivation is more than extrinsic, the student might have possibly done some previous research on the subject. If that is the case, it is a clear indicator of intrinsic motivation, be it because the student is a good strategic learner or a deep one.

A.2 After

These questions will be asked just after the project examination has taken place. This will relief the students of any pressure related to the contents of the activity.

- *What did you learn during this course?*
  Again, a question to obtain some words from the student, but also a measure of the enthusiasm after the activity.

- *How have you learnt this? Which activities helped you the most?*
  This deepens into the learning style, and how the students see the different activities.

- *Can you tell me in which activities were you involved? What percentage of your time was devoted to each of them?*
  This is a subjective measure of the students' focus while learning. I expect them to stress more importance in the tasks that they found more difficult.

- *Has the question-driven approach been useful? What differences can you find between this approach and others you have found previously?*
  I want them to think about my teaching critically.

- *Do you think you needed more support in any particular area?*
  Obviously, if they are resentful for anything, the answers will be biased.

- *How did the course fullfil your expectatives?*
  This question has the double intention of extracting information about the satisfaction and a possible change in motivation.

- *Has the course changed your view about experimental physics?*
  If it has made a positive impact, I consider the activity successful.

- *If you could change something about the course, what would it be?*

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