TEACHING PHYSICS IN HIGHER EDUCATION: AIMS, EXPERIENCES AND STRATEGIES

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1. INTRODUCTION

I am lucky enough to have experienced higher education in several different formats, as both a learner and teacher. In this portfolio I present examples of how I have sought to build on these experiences, in particular those as a teacher. My ultimate aim is to improve my teaching, but this necessarily involves identifying teaching goals and methods, as well as understanding students' perspectives and the learning process. The reflective process was greatly aided by attending the day-long 'Teaching Practices in the Sciences' course and the six-week Mathematical, Physical, and Life Sciences Reading Group. Additionally, I was fortunate to have Stephen Clark, a member of my research group, acting as my mentor. He has recently submitted his portfolio, working towards a Postgraduate Diploma in Learning and Teaching in Higher Education.

The structure of this portfolio is as follows: I begin in section 2 by describing my teaching experiences, directly motivating the later sections. Section 3 contains a discussion of the aims of higher education teaching, using the University of Oxford undergraduate physics course as an example. I then analyse the responses of undergraduate students to a questionnaire that asked them to rate the importance of different sources of learning. This evaluation of learning from the students' perspective is presented in section 4. In section 5, I look at the benefits of teaching through a mini project, discussing my observation of a project run by my mentor. Section 6 then discusses the design of problem sets through the lens of threshold concepts.

2. A BRIEF ACCOUNT OF MY HIGHER EDUCATION TEACHING EXPERIENCE

My first teaching responsibility was on behalf of St Anne's College, tutoring six third-year undergraduates in quantum, atomic and molecular physics. The course comprises a sixth of the syllabus assessed in their end of year examinations and the role of the tutor is to complement the 24 hours of lectures provided by the Physics Department.

My specific instruction from the College was to teach the pupils through hour-long paired tutorials. I was to set and mark problems before each tutorial, it being recommended that I use the problem sets provided by the Department lecturer. There were six problem sets in total, and therefore six groups of three tutorials. In addition, I was to set and mark an examination (provided by the Department lecturer), and two revision problem sets (not provided), going over each of these in a two to three-hour class.

Given this task, my initial focus was on what I needed to know (reading the syllabus, textbooks, notes, and past examination papers) and what I wanted to say (identifying what I thought were the key points to get across in each tutorial). However, I quite quickly realised that I was having more of an effect when reacting to the students' work or what they asked about in the tutorial. Prosser and Trigwell [1] studied the difference between teaching that focusses on the teacher and teaching that focusses on the student and, commensurate with my own findings, they showed that:

> "teachers who focus on their students and their students' learning tend to have students who focus on meaning and understanding in their studies, while [teachers] who focus on themselves and what they are doing tend to have students who focus on reproduction."

The goal of my teaching, as I will discuss in section 3, is overwhelmingly the former, and as a result I now put much of my time into trying to see my teaching from the students' perspective. In two studies, Martin and Ramsden [2] and Dall'Alba [3] argued that a conception of teaching that addresses the students' perspective includes and surpasses conceptions focussing purely on the teacher's perspective, thus offering a more complete outlook. It was with this in mind that I sought the feedback presented in section 4 to help me understand the students' perspective on the role of my teaching in the context of their course.

Beginning in a few weeks time, my second teaching role within Oxford University will be to tutor eight third-year undergraduates at Keble College in condensed matter physics. This role is similar in size and scope to that of a tutor at St Anne's. The main differences are that the College has encouraged me to both be more varied in my teaching style and prepare my own problem sets.

The first of these two freedoms allows me to explore different forms of teaching, going beyond traditional class or tutorial teaching. With the aim of trying out novel approaches, I peer-observed a class mini project, and this is the subject of section 5.

The second freedom gives me more control over which areas of the subject matter the students spend their time thinking about. This motivates section 6 where I discuss how problem sets can be adapted to steer students towards and force them to address so-called threshold concepts, rather than more repetitive and purely knowledge-based tasks.

Finally, I have also had the opportunity to teach outside the University of Oxford. Specifically, I was employed by the Stanford University Programme in Oxford, for which I was asked to tutor a single student in quantum mechanics and information through eight hour-long tutorials spread over eight weeks, and assess him over this period. No resources or further instruction were given to me and my teaching was to be the student's sole source of learning.

Therefore, my task was to identify the prior knowledge of the student, as well as his specific interests, and design a course around him. This involved preparing a syllabus, eight problem sets (with solutions), and recommended reading. In order to do this I was immediately required to address several questions that had not been raised during my tutoring for St

Anne's: should the course be focussed and detailed or more broad; what is the right level of difficulty; what pace is appropriate; what do I assess? The answers to these questions were not easy for me to judge, and I certainly didn't get them right immediately. To find them I had to address the more fundamental issue of what outcomes I wanted from my course, which I explore more generally in section 3.

Moreover, being given total control over a student's education inspired me to consider the student's learning environment and resources. For instance, I needed to address the practical problem of how he accessed the books I recommend. More importantly, what channels could the student use to give feedback on the course and teaching, or how would the student make progress between tutorials if he was stuck? In fact, the possible problems faced by the student are made clear by feedback in section 4, where we see that many of the contributors to the learning, motivation and enjoyment of students of the University of Oxford were not available to this Stanford University student.

3. THE GOAL OF A PHYSICS DEGREE

There have been several attempts to catalogue the objectives of higher education. Here I analyse the aims of a physics degree within a structure provided by Eisner, who stated five directions for higher educational teaching: development of the cognitive process, social adaptation and reconstruction, academic rationalism, curriculum as technology, and personal relevance [4].

The University of Oxford's Physics Department clearly states the aims of its undergraduate course in a handbook given to all students [5]. High on the agenda are the aims to "develop independent and critical habits of thought and of learning" and learn a "wide range of problem-solving skills, both analytical and computational, and how to apply them in contexts that may not be familiar." As such it is clear that the Department places significant emphasis on the importance of developing the cognitive process.

The goal of social adaptation and reconstruction is equally emphasized. For example, the handbook states that an aim of the course is:

> "to ensure that, on graduation, all students will be in a position to choose from many different careers, and have the skills, knowledge and understanding to make a rapid contribution to their chosen employment or research area, and that those with the aptitude are prepared for postgraduate study in physics, and thus contribute to the vitality of UK research."

To some extent it is possible to confirm whether this aim is achieved. For instance, one can look at whether students are following career paths that would be aided by their undergraduate degree. On the Physics Department's website [6] they point to a survey by the Higher Education Statistics Agency, looking at the destinations of those leaving higher education after the academic year 2006/07 [7]. They report that:

> "[The] destinations of Oxford Physics graduates were:
>
> - Further Study: 33% (e.g. PhDs, teacher training)
> - Study and Work: 17% (e.g. industrial work and research, professional qualifications)
> - Work Only: 41%

- Unavailable/Unemployed: 9%

> Of the students who go into work only, the most popular professions are finance/investment analysts, software professionals and management consultants, actuaries, economists and statisticians."

As hoped, a large majority are either entering further study, which would mostly require an undergraduate degree in a related subject, or work that strongly benefits from a background in mathematical physics or "transferable skills related to communication, computing, and problem solving", to quote another aim laid out in the undergraduate handbook.

It is more difficult to assess a second part to the aim, evaluating the impact of graduates in their careers. One could look at the crude indicator of pay. On the same webpage [6], the Physics Department states that "in 2006/2007, the average graduate starting salary was £19,300. The average starting salary for Oxford Physics graduates was £24,800."

As would be expected from any course run by academics, academic rationalism is a key motivator. For example, the handbook states that "students should have developed a thorough understanding and broad knowledge of the general theoretical and experimental scientific principles of physics", and "learned the techniques required in a modern mathematically-based physics course, gain[ing] an understanding of the conceptual structure associated with the major physical theories". Clearly, they feel that modern physics merits study, to some extent, purely because it is of academic importance.

Aspects relating to curriculum as technology are not so clearly observed in the aims of Oxford physics course. Most objectives are the development of skills and understanding that, while assessed, cannot be measured individually. Also, the orientation of personal relevance is not as prominent as the other objectives. For example, undergraduates are given the opportunity to choose few of their examinable subjects before their final year (for an MPhys student this might be one sixth), which contrasts with students at Stanford University who pick from hundreds of courses throughout their degree. However, personal relevance is likely to feature more prominently in UK undergraduate degrees in coming years; students investing up to £9000 per year in their education might expect to have more control over their learning.

My own opinion is that the primary aim of a top general physics undergraduate degree, such as that from the University of Oxford, is to give the student a tool-kit that they can apply to their lives. This, of course, includes mathematical, computational and problem-solving skills, required for many vocations. It also must contain a thorough knowledge of physics that will allow them to thrive if choosing to continue into research. However, these must be accompanied by a capability that is more difficult to define, to do with the ability to learn new and difficult concepts, or to evaluate and use knowledge presented to them (I would place this in two of Eisner's categories, development of the cognitive process, and social adaptation and reconstruction.) Several people have tried to define such a skill. In the context of engineering, Bowden [8] coined the term 'knowledge capability' which he defined as:

> "[The] ability to handle previously unseen, real-life situations, to make sense of them, to figure out what the relevant aspects are, to relate them to what you know and to find out what you don't know but need to use […] to define the problem and only then solve it […] You still need to be able to do the quantitative solution but

> only after you've figured out what is needed. Mere knowledge acquisition is one thing; the capacity to use it in this way is both more complex and more powerful."

Wieman and Perkins have instead focused on 'expert thinking' [9]. While this is a very general concept, they describe the difference between expert and novice thinking in the specific area of physics as follows:

> "Experts see the content of physics as a coherent structure of general concepts that describe nature and are established by experiment, and they use systematic concept-based problem-solving approaches that are applicable to a wide variety of situations. Most people ('novices') see physics more as isolated pieces of information handed down by some authority and unrelated to the real world. To novices, 'learning' physics simply means memorization of information and of problem-solving recipes that apply to highly specific situations."

I personally see expert thinking and knowledge capability as two sides of the same coin; a student couldn't develop one during a physics degree without developing the other. It is to achieve this aim of giving a student knowledge capability, or training them to think like an expert, that motivates section 6, which discusses problem set design.

4. A STUDENT PERSPECTIVE ON LEARNING

With the aim of understanding students' perceptions of different sources of learning, I created a questionnaire that was completed by 21 physics undergraduates at the University of Oxford (from Keble and St Anne's Colleges). More specifically my intention was to encourage the students to compare how relatively important different factors are to their motivation, enjoyment and understanding, and also how much time they spend on each. The factors compared included lectures, lecture notes, problem sets, written feedback on work, college tutorials/classes, recommended textbooks, other textbooks, academic papers, fellow undergraduates, College examinations and University examinations. The complete questionnaire and collated responses are contained in the Appendix.

Below is a table showing averages of students' responses for a subset of factors. A score of zero meant that they thought the factor did not affect their learning, enjoyment or motivation of physics at all, and a score of three meant they thought it had a significant effect. The time given is how many hours students spend weekly on each factor (excluding vacations).

Factor	Learning	Enjoyment	Motivation	Time[hrs]
Lectures	2.57	2.62	2.62	10.05
Lecture notes	2.86	2.20	2.30	4.50
Problem sets	2.81	2.90	2.81	22.40
Written feedback	2.10	1.58	1.86	--
Tutorials/classes	2.62	2.48	2.57	4.30
Recommended textbooks	2.33	1.95	1.81	2.80
Fellow undergraduates	2.71	2.14	2.05	6.40
Academic papers	0.68	0.78	0.72	0.16
University examinations	1.88	1.13	2.32	11.29

The first thing to notice is that they score problem sets the highest, or second highest for all categories. This is in keeping with the fact that they spend on average 22.4 hours a week completing them, twice as much as any other activity. This really means a lot of effort should be put into problem set design. The aim of this would be to make the students' main activity enjoyable and interesting. More importantly, since students spend most of their time thinking about physics in the context of problem sets, the problems must be chosen such that they focus the student on the important topics. Moreover, the problem sets must be one of the main vehicles through which to promote expert thinking or knowledge capability. In section 6 I discusses how to implement this.

Perhaps surprisingly, students highly regarded the importance of fellow undergraduates. In fact, peer learning has been recognised as a highly effective tool in education literature, as students often find it easier to ask questions to and learn from someone in the same position. Boud argues further, [10] stating that:

> "Not only can [students] provide each other with useful information but sharing the experience of learning also makes it less burdensome and more enjoyable."

Tutorials and classes are the natural place to encourage peer learning, because they take place in a College environment, where the students are most likely to work together. Fostering peer learning by asking students to work together was one of the key aims of the mini project discussed in section 5. Another aim for that mini project also sprung from students' feedback. They rated academic papers very low (several students marked 'not applicable' next to academic papers), partly because they are written for other academics in the field and also because students are normally not encouraged to read them. The mini project then offered students an opportunity to read and analyse journal articles.

A further interesting feature of the students' responses is the discrepancy between their evaluation of the importance of University examinations and the time they spend working towards them. Of course, this time is heavily weighted towards the final term when the exams take place, and a student's estimate of average time spent is unlikely to be precise, probably depending on the individual's interpretation of the question. Examinations do appear to be a strong motivator, though still not as important as other factors. I am not the first to make the complaint that assessment is not formative enough, for example Astin [11] writes that his experiences of assessment in higher education have convinced him that:

> "[Although] a great deal of assessment activity goes on […] much of it is of very little benefit to either students, faculty, administrators or institutions. On the contrary, some of our assessment activities seem to conflict with our most basic educational mission."

While this statement might seem extreme, the feedback does suggest that in the Oxford Physics course students are spending a lot of time preparing for something they feel contributes to neither their learning nor their enjoyment as much as other factors.

5. OBSERVING A MINI PROJECT

As part of my drive to consider different methods of teaching, I observed students' presentations at the end of a mini project. The class tutor was my mentor Stephen Clark. Eight second-year undergraduate students were divided into two groups of four (mixing abilities), each group assigned a seminal research paper on a topic in the field of quantum information, namely quantum teleportation and the no-cloning theorem respectively. Three weeks later each group was required to put together a 10-minute presentation explaining the content of their research paper to the others (this is the part I observed). To aid them, the tutor had heavily annotated the two research papers, explaining any difficult terminology. Additionally, he had written further notes to provide any necessary background material that they would not have covered before the presentations.

Prior to setting up the mini project I met with the tutor to discuss our aims. We agreed they were to:

1. provide students with an opportunity to plan and give a presentation, developing familiarity, confidence, and proficiency in this transferrable skill;
2. give them a chance to work as a team, honing another transferrable skill they are likely to need in their careers;
3. force students to interact with their peers, hopefully leading to peer learning that continues beyond the mini project;
4. teach in a different style, as a bit of variation might be more enjoyable for both students and teachers;
5. expose students to research papers, to help them appreciate a resource that will be valuable later in their degrees, further education and possibly their careers;
6. give students flexibility in what they do, a chance to work without such strong guidance; and
7. teach the students about two very interesting parts of physics.

Aims 1, 2 and 5 relate to Eisner's social adaptation and reconstruction objective of higher education, while aim 7 is more to do with academic rationalism. Aims 3, 4 and 5 were in reaction to students' feedback. I feel aim 6 is of particular importance. In a sense, the students were asked not only to answer the question 'what is the no-cloning theorem/quantum teleportation?' but also to define the precise form of the question, identifying for themselves the key parts of the idea that are necessary to explain it. This is effectively asking the students to demonstrate aspects of Bowden's knowledge capability. Broadly speaking, a general aim of project-based learning is to provide a more student-centred learning experience, and one that requires active input from the student. Davis and Wilcock have discussed the different ways a project (they call it a case study) can work, and identify precisely these benefits, as well as others [12].

It was clear, from observing, that each student understood their role in the group's presentation, so discussions must have taken place within each team (aims 2, 3). There was one interruption from the tutor, when someone had said something clearly incorrect, but on the whole the students were left to explain the topic as they wished (aim 6). Aim 1 was satisfied by default, and since all students showed a reasonable understanding of the topic, this suggests they had read and understood their group's research paper (aim 5 and 7). Questioning students after the class they described it as enjoyable (aim 4), although it is not clear how reliable students' feedback is when their tutor is in earshot!

In discussion with the tutor after the class we did identify some. The main problem was that following each group's presentation there were no questions from the others, and it was difficult to spark a discussion between the groups (aim 3). As a result, there was no way of discerning to what extent each group understood the other's topic (aim 7). In the future, these problems could be addressed by leading a class discussion on the contradictory nature of the two topics, which would require students to acquire an understanding of both, therefore promoting inter-group discussion. Equally, for the same reasons, each group at the end of the presentations could be asked to summarise the other's topics.

6. DIRECTING THE LEARNER THROUGH PROBLEM SETS

Answering problem sets takes up the core of a student's typical day, therefore the problems must be chosen carefully so as to ensure the time spent on each part of the syllabus reflects its importance and difficulty. Meyer and Land wrote a seminal work identifying 'threshold concepts' as an area on which to focus [13,14]. They presented several characteristics shared by threshold concepts:

- Transformational – understanding a threshold concept involves an ontological as well as a conceptual change.
- Irreversible – a student tends not to forget a threshold concept they have learned.
- Integrative – understanding a threshold concept often involves appreciating the relatedness of what may have been thought of as disparate phenomenon.
- Bounded – learning a threshold concept will allow a student to understand a typically finite conceptual space with other threshold concepts at its boundaries.
- Troublesome – a threshold concept is likely to appear counter-intuitive, alien or incoherent.

As for the mechanism through which one learns a threshold concept, Meyer and Land introduced the idea of a liminal space. This is a problematic space in which a learner holds both old and new conceptual understandings and through which a student must pass before a threshold concept can be understood.

In my view, the aim of a problem set (the role of which I see as completely formative) is then to push the student into exploring liminal spaces. In my experience, it is far too often the case that while an understanding of a threshold concept may help in answering a problem, the problem can also be answered satisfactorily while sidestepping the concept completely. In other instances, instead of sidestepping they may be able to use a simplified version of the threshold concept, the learning of which induces few transformative features. Meyer and Shanahan (2003) [15] noticed this last point when they stated:

> "Efforts to make threshold concepts 'easier' by simplifying their initial expression and application may, in fact, set students onto a path of 'ritualised' knowledge that actually creates a barrier that results in some students being prevented from crossing the 'threshold' of a concept."

It strikes me, then, that an effective strategy is to write questions that deliberately probe the applicability, scope and correctness of the simplified expression of a threshold concept. This is reminiscent of how to promote expert thinking, for example, Wieman and Perkins wrote that [9]:

> "To move a student toward expert competence, the instructor must focus on the development of the student's mental organizational structure by addressing the 'why' and not just the 'what' of the subject. These mental structures are a new element of a student's thinking. As such, they must be constructed on the foundation of students' prior thinking and experience."

In particular this quote highlights the similarly transformative nature of achieving expert thinking and learning a threshold concept, and underlines that the key to acquiring these transformations is to lead the student to analyse basic assumptions. Perhaps an outcome of battling with and learning any threshold concept is to move the learner slightly further along the path from novice to expert.

Several precautions must be taken to guard against students becoming despondent when coming up against threshold concepts, or resorting to mimicking true understanding. Schwartzman argues that "taking on the challenge of uncertainty" is instrumental in the transformative learning of a threshold concept [16]. With regards to this, Cousin [17] advises that students are made aware, before starting out, that specific threshold concepts are difficult to learn, thus giving the learner the confidence to step into the confusing and contradictory liminal state. Another approach to ensure that students do not sidestep threshold concepts is to provide model solutions to questions, showing that a student is required to explain his thinking clearly and focus on the 'why', since this is usually where the difference between superficial and full approaches to threshold concepts lie. In fact, the difference could be made even clearer by dividing a problem set into 'exercises' and 'questions'. The former would have solutions that are easily found in books (ritualised knowledge or the 'what'), while the latter would focus on deeper connections and understanding (threshold concepts or the 'why'). This would make it difficult for students to avoid addressing the latter. Thinking selfishly, it also might make problem sets easier to mark. Moreover, it could allow the 'exercises' to be self-assessed, something that has been linked to improved performance [18] and could promote the self-reflective qualities desired in students.

7. CONCLUSION

The task of reflecting on and developing teaching is not one that should ever be concluded. In this portfolio I have discussed examples of approaches I have taken. The whole process has involved engaging with educational literature, seeing the learning process from several perspectives and discovering new methods and approaches to teaching. As such, I'm sure next term's teaching will barely resemble my initial attempt. I only hope that this development continues in the future.

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APPENDIX: QUESTIONNAIRE AND RESPONSES

Oxford physics undergraduates: Comparing aspects of learning Exit this survey

Introduction

This questionnaire shouldn't take more than 2 minutes.

It will ask you about different factors that make up your learning of physics, e.g. tutorials, lectures, and other resources.

Rather than rating your tutors, the lecturers or the books, the aim is to compare how relatively important each of the factors is to your motivation, enjoyment and understanding, and also how much time you spend on each.

We won't ask for your name and all information will be treated confidentially.

Next

Oxford physics undergraduates: Comparing aspects of learning Exit this survey

The questionnaire

1. How much do the following factors affect your learning of a topic?

	Not at all	Very little	A bit	A lot	N/A
Lectures	○	○	○	○	○
Lecture notes	○	○	○	○	○
Problem sets	○	○	○	○	○
Written feedback on your work	○	○	○	○	○
College tutorials/classes	○	○	○	○	○
Recommended textbooks	○	○	○	○	○
Other textbooks	○	○	○	○	○
Academic papers	○	○	○	○	○
Fellow undergraduates	○	○	○	○	○
College examinations	○	○	○	○	○
University examinations	○	○	○	○	○

2. How much do the following factors affect your enjoyment of a topic?

	Not at all	Very little	A bit	A lot	N/A
Lectures	○	○	○	○	○
Lecture notes	○	○	○	○	○
Problem sets	○	○	○	○	○
Written feedback on your work	○	○	○	○	○
College tutorials/classes	○	○	○	○	○
Recommended textbooks	○	○	○	○	○
Other textbooks	○	○	○	○	○
Academic papers	○	○	○	○	○
Fellow undergraduates	○	○	○	○	○
College examinations	○	○	○	○	○
University examinations	○	○	○	○	○

3. How much do the following factors affect your motivation to study a topic?

	Not at all	Very little	A bit	A lot	N/A
Lectures	○	○	○	○	○
Lecture notes	○	○	○	○	○
Problem sets	○	○	○	○	○
Written feedback on your work	○	○	○	○	○
College tutorials/classes	○	○	○	○	○
Recommended textbooks	○	○	○	○	○
Other textbooks	○	○	○	○	○
Academic papers	○	○	○	○	○
Fellow undergraduates	○	○	○	○	○
College examinations	○	○	○	○	○
University examinations	○	○	○	○	○

4. In this question, try and average over the whole year (excluding vacations). Approximately how many hours a week do you spend doing the following?

Attending lectures	☐
Reading lecture notes	☐
Answering problem sets	☐
Attending college tutorials/classes	☐
Reading recommended textbooks	☐
Reading other textbooks	☐
Reading academic papers	☐
Discussing physics with fellow undergraduates	☐
Preparing for college examinations	☐
Preparing for university examinations	☐

5. Do you have any comments relating to the issues discussed?

Prev Done

1. How much do the following factors affect your learning of a topic? Create Chart Download

	Not at all	Very little	A bit	A lot	N/A	Rating Average	Response Count
Lectures	0.0% (0)	0.0% (0)	42.9% (9)	**57.1% (12)**	0.0% (0)	2.57	21
Lecture notes	0.0% (0)	0.0% (0)	14.3% (3)	**85.7% (18)**	0.0% (0)	2.86	21
Problem sets	0.0% (0)	0.0% (0)	19.0% (4)	**81.0% (17)**	0.0% (0)	2.81	21
Written feedback on your work	0.0% (0)	19.0% (4)	**52.4% (11)**	28.6% (6)	0.0% (0)	2.10	21
College tutorials/classes	0.0% (0)	4.8% (1)	28.6% (6)	**66.7% (14)**	0.0% (0)	2.62	21
Recommended textbooks	0.0% (0)	9.5% (2)	**47.6% (10)**	42.9% (9)	0.0% (0)	2.33	21
Other textbooks	4.8% (1)	28.6% (6)	**52.4% (11)**	14.3% (3)	0.0% (0)	1.76	21
Academic papers	**47.6% (10)**	28.6% (6)	9.5% (2)	4.8% (1)	9.5% (2)	0.68	21
Fellow undergraduates	0.0% (0)	0.0% (0)	28.6% (6)	**71.4% (15)**	0.0% (0)	2.71	21
College examinations	0.0% (0)	33.3% (7)	**38.1% (8)**	4.8% (1)	23.8% (5)	1.63	21
University examinations	4.8% (1)	**28.6% (6)**	14.3% (3)	**28.6% (6)**	23.8% (5)	1.88	21
						answered question	21

2. How much do the following factors affect your enjoyment of a topic?

Create Chart Download

	Not at all	Very little	A bit	A lot	N/A	Rating Average	Response Count
Lectures	0.0% (0)	9.5% (2)	19.0% (4)	**71.4% (15)**	0.0% (0)	2.62	21
Lecture notes	0.0% (0)	14.3% (3)	**47.6% (10)**	33.3% (7)	4.8% (1)	2.20	21
Problem sets	0.0% (0)	4.8% (1)	0.0% (0)	**90.5% (19)**	4.8% (1)	2.90	21
Written feedback on your work	9.5% (2)	**33.3% (7)**	**33.3% (7)**	14.3% (3)	9.5% (2)	1.58	21
College tutorials/classes	0.0% (0)	9.5% (2)	33.3% (7)	**57.1% (12)**	0.0% (0)	2.48	21
Recommended textbooks	9.5% (2)	14.3% (3)	**42.9% (9)**	28.6% (6)	4.8% (1)	1.95	21
Other textbooks	14.3% (3)	14.3% (3)	**52.4% (11)**	14.3% (3)	4.8% (1)	1.70	21
Academic papers	**42.9% (9)**	23.8% (5)	14.3% (3)	4.8% (1)	14.3% (3)	0.78	21
Fellow undergraduates	9.5% (2)	0.0% (0)	**57.1% (12)**	33.3% (7)	0.0% (0)	2.14	21
College examinations	23.8% (5)	**28.6% (6)**	23.8% (5)	0.0% (0)	23.8% (5)	1.00	21
University examinations	**28.6% (6)**	19.0% (4)	19.0% (4)	9.5% (2)	23.8% (5)	1.13	21
						answered question	21

3. How much do the following factors affect your motivation to study a topic?

Create Chart Download

	Not at all	Very little	A bit	A lot	N/A	Rating Average	Response Count
Lectures	4.8% (1)	0.0% (0)	23.8% (5)	**71.4% (15)**	0.0% (0)	2.62	21
Lecture notes	4.8% (1)	0.0% (0)	**52.4% (11)**	38.1% (8)	4.8% (1)	2.30	21
Problem sets	0.0% (0)	0.0% (0)	19.0% (4)	**81.0% (17)**	0.0% (0)	2.81	21
Written feedback on your work	4.8% (1)	**33.3% (7)**	**33.3% (7)**	28.6% (6)	0.0% (0)	1.86	21
College tutorials/classes	0.0% (0)	4.8% (1)	33.3% (7)	**61.9% (13)**	0.0% (0)	2.57	21
Recommended textbooks	14.3% (3)	14.3% (3)	**47.6% (10)**	23.8% (5)	0.0% (0)	1.81	21
Other textbooks	14.3% (3)	28.6% (6)	**52.4% (11)**	4.8% (1)	0.0% (0)	1.48	21
Academic papers	**38.1% (8)**	33.3% (7)	14.3% (3)	0.0% (0)	14.3% (3)	0.72	21
Fellow undergraduates	4.8% (1)	19.0% (4)	**42.9% (9)**	33.3% (7)	0.0% (0)	2.05	21
College examinations	9.5% (2)	9.5% (2)	**42.9% (9)**	28.6% (6)	9.5% (2)	2.00	21
University examinations	9.5% (2)	0.0% (0)	33.3% (7)	**47.6% (10)**	9.5% (2)	2.32	21
						answered question	21

4. In this question, try and average over the whole year (excluding vacations). Approximately how many hours a week do you spend doing the following?

Create Chart Download

	Response Average	Response Total	Response Count
Attending lectures Show Responses	10.05	201	20
Reading lecture notes Show Responses	4.50	90	20
Answering problem sets Show Responses	**22.40**	**448**	20
Attending college tutorials/classes Show Responses	4.30	86	20
Reading recommended textbooks Show Responses	2.80	56	20
Reading other textbooks Show Responses	1.30	26	20
Reading academic papers Show Responses	0.16	3	19
Discussing physics with fellow undergraduates Show Responses	6.40	128	20
Preparing for college examinations Show Responses	2.56	46	18
Preparing for university examinations Show Responses	11.29	192	17
		answered question	20

5. Do you have any comments relating to the issues discussed?

Download

	Response Count
Hide Responses	7

Responses (7) | Text Analysis | My Categories (0)

Showing 7 text responses — No responses selected

Most preparation for college exams done during vacations.
9/12/2011 19:31 View Responses

In question 4; preparation for college exams is done during vacations, and the preparation for university exams is only true for Trinity.
9/12/2011 0:26 View Responses

I don't have enough time to prepare for exams outside of tutorial work.
8/12/2011 22:40 View Responses

Arguably all of the time options are preparing for examinations.
8/12/2011 21:40 View Responses

Question 4 has lots of overlapping sections, eg reading textbooks with answering problem sets, and most of the previous fields with preparing for exams.
6/12/2011 14:38 View Responses

Preparation for college exams tends to be done over the vacation and not in term time.
5/12/2011 14:29 View Responses

last question of 4 seems irrelevant as revision takes place in trinity term only so averaging doesnt make sense...
5/12/2011 13:07 View Responses

answered question	7
skipped question	15