Physics students in the secondary school classroom - a win-win-win situation?

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Overview

The Undergraduate Ambassador Scheme (UAS) is now a well-established project across many UK universities[1,2]. In this scheme undergraduate students in science, engineering, and mathematics can go into local schools to learn from and to assist teachers as part of credit-bearing studies for their degree. UAS has a central office that can provide significant help to universities to set up and run such a scheme, though each university is responsible for its own implementation.
www.uas.ac.uk

We describe and reflect upon the implementation in physics and astronomy at St Andrews in sessions 2007-8 and 2008-9. Our module is titled 'Communicating and Teaching in Science', and has final and penultimate year students going in to local secondary schools first to observe teaching and then to take part in the teaching[3].

Win, Win, Win?

Students win benefits from work-based-learning, developing their communication skills, starting to think about the learning process, and deepening their understanding of basic physics.

School pupils and teachers win from the benefit of an enthusiastic classroom assistant, with a good knowledge of physics and a developing skill set in teaching.

University-School Relationships win from the promotion of contact between universities and schools, perhaps also making university seem less remote for some of those in front of our students.

Module Structure

Second Semester, previous session. Students apply to join the module and get interviewed. Successful students each get linked with a "mentor" school teacher and go through child protection clearance.

Summer Vacation

Start of New Academic Session

Introductory session in orientation week.

Students visit schools, initially observing classes, filling in log book.

Occasional tutorial at University, and reflection on experiences, formative assessment of log book entries.

Students begin to take an active part in the classroom under supervision.

The placement is the equivalent of a morning a week for ten weeks.

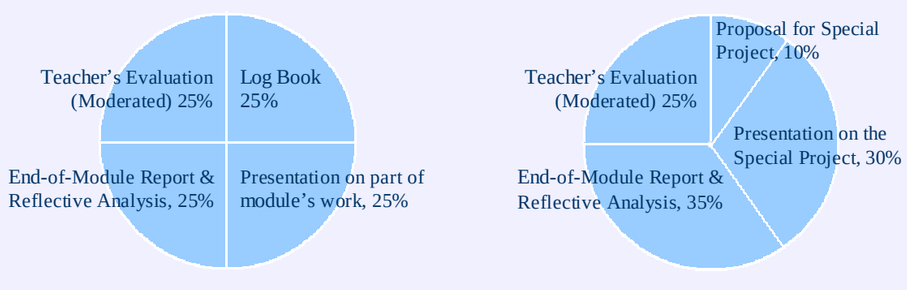
Students submit a "proposal" document for their "Special Project" with a school class; which is assessed.

Students work up towards their special project, where they take the lead (under direct supervision of their mentor teacher) delivering a lesson, leading a science club, visiting a science centre, etc.

Students submit to the University a report on their school experience, assessed.

Students present a talk to staff and fellow-students on their special project, assessed.

Summative Assessment



In the first year of operation we used the UAS suggestions for summative assessment items. Student feedback and discussions amongst staff suggested that in our situation we may benefit from providing formative assessment on the log book items early on in the module, and not using this student diary as a summative assessment item. This logbook was important to students as they reflected on their experience and in preparation of the end-of-module report and presentation. We wished to see the student input to the suggestion for their special project, and to ensure University staff had the opportunity to give formative feedback before the special project took place, hence the proposal requirement in 2008-9. In the second year of running we were also more prescriptive on what should be the subject of the end-of-module report and the presentation.

Student Feedback

Logbook summative assessment was removed in part due to feedback from 2007-8 students.
All five of 2008-9 class from physics and astronomy agreed that this change was appropriate.

The 2008-9 physics & astronomy class members gave the following answers to questions about the module:-

Had you been considering a career in school teaching?	Y Y ? N N
Had you been considering a career in other education?	Y Y Y Y N
Had you been considering a career in science communication?	Y Y Y ? N
Was this module useful to you in this (above) direction?	Y Y Y Y Y
Are you now more or less likely to steer your career in that direction?	M M M M M

In addition, the 2008-9 physics and astronomy students on average reported a similar workload to lecture-based modules, good communication with their mentor school teacher, and good communication with University staff. All felt well supported in their schools.

Extracts from Student Work

During the summer I worked at Sensation, the science centre in Dundee, and kept good links with the staff there. Subsequently I wanted to incorporate Sensation's influence on my outlook towards communicating science, into my special project for this module.

I went to visit the head of Sensation's education team to discuss the idea of bringing a group of students to the centre. The idea was to let them experience science education in a different way to in the classroom.

It was then mentioned that a new show called "Energy for the Future" was running for the general public through October. I knew through previous discussions with my link teacher that the first year class in *** are just about to study a topic on energy and this would tie in very well.

It was suggested that I adapt the show for a school audience linking in to what the class would be learning in the following weeks, as well as providing links to Scotland's new "Curriculum for Excellence". The links would be set out in a document and made available to future school groups.

Sensation

My project entails creating a compact package for *** that will allow pupils a brief insight into the steps that lead to present day technology. The project will be designed for a second year science class, but will have the flexibility to be given to more advanced abilities. I intend my project to access each pupil's objective reasoning skills and require them to cast their own opinion upon the lesson. I feel it's fundamental to my main aim, which is inspiring pupils to reach their full ability, that they are directly involved in aspects of my lesson. Besides inspiring, I aim to give the idea to pupils that they are having a break from learning and trying something new and fun.
…

To conclude I believe my project will inspire pupils to be the best that they can be, to appreciate human achievement, and to respect technology around them. I doubt many pupils will vote against any advancement, but to impart the notion that sometimes-grand benefits have consequences is an invaluable lesson. The project has been designed in such a way that it can be re-used for years to come.
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Extracts from students' proposals for their special projects.

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Questions are a very important part of teaching. Different types of questions can be used in a variety of ways to communicate the content of the lesson. Direct questions at confused students gets individual pupils listening and thinking for themselves but also enforces in other students that they do not want to be in the position of not knowing the answer. Open questions and more general questions, "*What do you reckon will happen*?" encouraged deeper thinking.

Obvious questions were used repetitively to drum in important facts that needed remembering and "*What's the difference between the way you've drawn it & the way I have*?" was a good way of making pupils think about the correct answer without highlighting the mistakes explicitly. Peer involvement was another good method of questioning "*Amy says it is a concave lens – do you agree*?" and having a vote made everyone commit to an opinion. Questions like, "*Which would you like to do first*?" included the class in what was going on and refresher questions, "*What did we do last time*?" were used to see what pupils remember from previous lessons.

Answering these questions well was also important in the learning process; being specific and expanding answers was encouraged; *time? -> what time? -> time taken to travel distance A to B.*
Praise was given for good additions, even sometimes if they were shouted out. The use of scientific words was also enforced from as early as first year, "*reaction time not reflexes*". Repeated wrong answers to questions often highlighted common misunderstandings and reflected how well the class is listening. .

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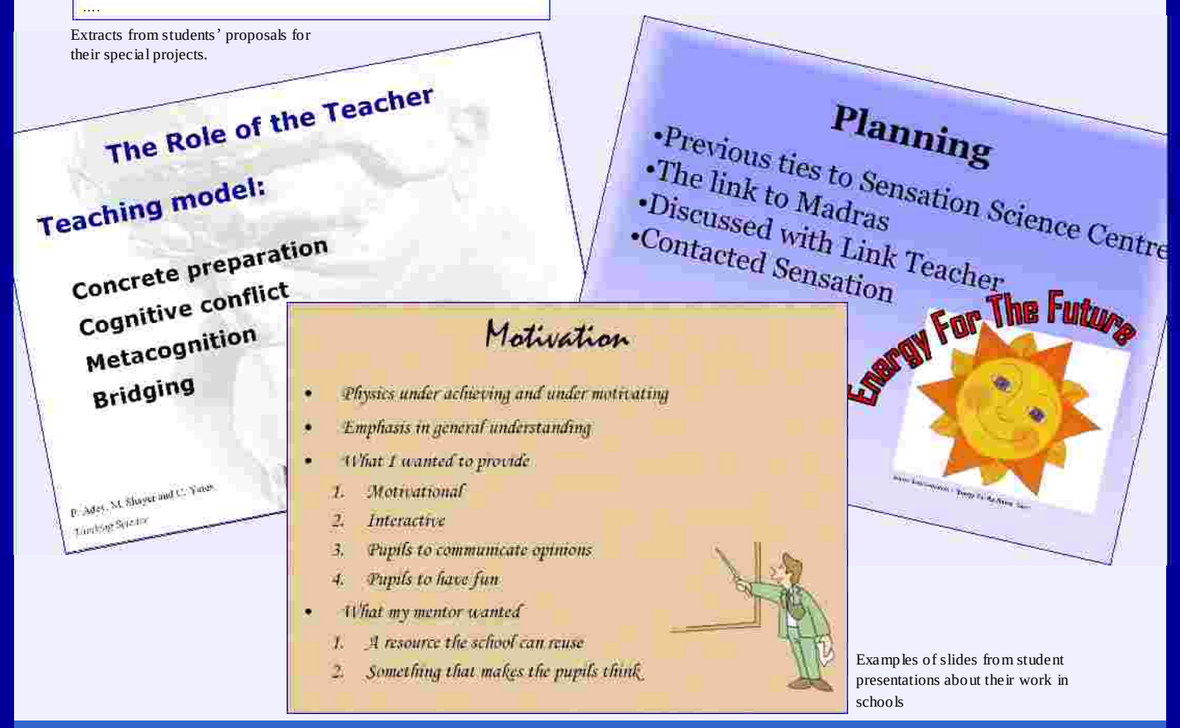
Extract from a student's report on what she had learnt from her placement



Examples of slides from student presentations about their work in schools

Student Comments

"This module has given me invaluable experience in science communication. It not only gave me an insight into teaching various age groups but also how to go about communicating ideas to them in a relevant way. As I was mostly teaching just one class I was able to build up a relationship with the pupils in said class and I hope that I may have inspired some of them to carry on studying physics at higher levels and made them realise that physics isn't boring but can also be extremely useful and fun. I think that this is an excellent scheme both for students like myself, for the experience it gives us in teaching, communication and interpersonal skills; and for the pupils in the schools, as it gave them someone to relate to that wasn't a teacher and was nearer their age so that they could find out what university was like."

"This module has developed my confidence and my communication skills. This makes it easier for me to consider different career paths and I now believe I have the skills to go into a career where communication plays a large role."

"I enjoyed this module. It was a nice change from the standard academic module and a really good opportunity to do something practical and get involved in the local community outside of the university. Many students live in a university bubble for four years while they are here and it is fun and rewarding to do something in the real world."

"I think this module has a unique draw for students, being an interdisciplinary module it allows many Schools to introduce their students to the idea of teaching and still give them credit for this. I also think that the module allows students to better understand their own core knowledge of science, by having to teach it to younger students and respond to their questions. To me there is no better revision than having to teach the subject."

Teacher Comments

"The main benefit for us was definitely the motivational power on our pupils of having a young person in the room who was clearly enthusiastic about Science/Physics. We also have materials developed by all three students who have been placed in our Physics department during the two years the course has been running, and these are valuable too."

"The scheme seems to have been well received here as well; I think it does well because it has a clear focus and end result as opposed to an ad hoc arrangement."

Acknowledgements

The Team at the central offices of the Undergraduate Ambassadors Scheme, including for financial assistance.
Our Module Leader, who is the current Dean of Science at St Andrews, Prof Alyson Tobin, and my colleagues working on this module in other Schools within the University.
All the local secondary school staff who have supported our students, and the pupils who have interacted with them.
All of our students who have put so much enthusiastic effort into this module and who have helped me in generating and gathering data for this paper. The extracts of student work above contain material from Tony Corcoran and Kirsty Scott, amongst others.

References

1. Undergraduate Ambassadors Scheme - www.uas.ac.uk
2. C Lacey, J Giles, and C Allerston, *How to get a taste for teaching*, Physics World, May 2005
3. Bruce Sinclair, *The Undergraduate Ambassador Scheme implemented at St Andrews*, New Directions in the Teaching of Physical Sciences, Physical Sciences Centre of the UK Higher Education Academy, December 2008