Diversity in first year courses: Potential solutions

By Steve Draper June 2013

On 13 June 2013 we gave a conference workshop on addressing educational diversity in first year courses. The workshop focussed on participant discussion to relate the questions and possible solutions to their own contexts. In this post-workshop document, I sketch some of the potential solutions as I see them.

The potential problems are:

A. Students come with widely different amounts of prior specific knowledge of topics.
B. Students come with widely different levels of core disciplinary skills e.g. how to write a History essay.
C. Students may have, now during the course, widely different amounts of effort they are willing to give to it (e.g. it is their intended major subject, or an extra they are forced to take).
D. How to usefully engage even quite low levels of effort when the student thinks they know it already. (The worry here is that a well-prepared student may do even less work than a low motivation unprepared student: surely they should learn something nevertheless.)

Here is a rough guide to which solutions might address which problems:

The potential problems of diversity	**Solutions which may apply**
Diverse levels of prior specific knowledge	1, 2, 3, 4, 5, 6, (7), (8)
Diverse levels of prior disciplinary skills	(1), 2, (5), 6
Diverse levels of current effort	1, 2, 7, 8
Ensuring at least reasonable effort	1, 2, 3, 4, 5

1. Jigsaw

Significant parts of the following text are taken from Honeychurch (2012), which describes a successful use of this approach in a diverse first year class.

Jigsaw is an important and strong form of student-generated teaching, invented by Aronson in 1971. The idea is that the teacher does not teach the subject matter content, but divides the class into teams, each of which researches a topic, and teaches it to the rest of the class. Just as in a jigsaw puzzle, each piece — each student's part — is essential for the completion and full understanding of the final product. If each student's part is essential, then each student is essential; and that is precisely what makes this strategy so effective. Here is how it works: The students in a history class, for example, are divided into small groups of five or six students each. Suppose their task is to learn about World War II. In one jigsaw group, Sara is responsible for researching Hitler's rise to power in pre-war Germany. Another member of the group, Steven, is assigned to cover concentration camps; Pedro is assigned Britain's role in the war; Melody is to research the contribution of the Soviet Union; Tyrone will handle Japan's entry into the war; Clara will read about the development of the atom bomb.

This technique forces all students to depend on other students in their group. It can therefore engage all students, regardless of their interest or ability, by creating an environment where the more motivated students take control of their own learning initially, then teach others what they have learned. The fundamental difference between this and conventional teaching is that only the learners, not the teacher, function as a subject matter expert and source of knowledge. The fundamental difference between this and other methods of group work is that each learner is a member of two different, cross-cutting, groups: a Jigsaw group for reciprocal teaching and an expert group for preparing the teaching they must do themselves.

Aronson's way (slightly adapted) of summarising the design is:

- Students are divided into a 5 or 6 person jigsaw group. The group should be diverse (e.g. in terms of prior knowledge and/or level of effort).
- The content is divided into 5-6 segments (one for each member)
- Each student is assigned one segment to learn. Each student should only have direct access to their own segment.
- Students should be given time to read over their segment at least twice to become familiar with it. Students do not need to memorize it.
- Temporary experts' groups should be formed in which one student from each jigsaw group joins other students assigned to the same segment. Students in this expert group should be given time to discuss the main points of their segment and rehearse the presentation they are going to make to their jigsaw group.
- Students come back to their jigsaw group.
- Students present their segment to the group. Other members are encouraged to ask questions for clarification. This is small group, dialogic teaching.
- A test on the material should be given at the end so students realize that the sessions are not just for fun and games, but that they really count.

As mentioned, Honeychurch (2012) describes a successful use of this approach in a diverse HE first year class. Ann Brown (1992, 1994) has applied it successfully for Biology in US high schools, and with a somewhat different theoretical emphasis.

2. Judy Wilkinson's course design for Maths for Engineers

Judy Wilkinson (2001) designed and implemented a course of Maths for Engineers: a first year course. It is unusual in being designed to address both breadth and depth aims in a single course design: both achieving minimum competence for every student for every concept or topic, and going beyond that for deeper learning whenever possible. The course ran throughout the academic year, and was divided into blocks of 6 weeks each. Each block began by mainly lecture expositions and skills exercises, and there was then a competence test at 3.5 weeks. If students did not reach the required level of 70% correct, then they had the remainder of the block for addressing their shortfall, and retook the test. If they had passed, then they could focus on the mini-projects (weeks 5-6) which addressed deep learning by applying the same material in other ways in small groups, supported by a tutor. The projects either began with a physical experiment which was then modeled mathematically, or with a given math. model and used software to solve the equations and graph them.

Weeks within each block (of four)	**Hours**				
	1	**2**	**3**	**4**	**5**
1-3	Lecture	Lecture	Lecture	CAL	Tutorial
4	Lecture	Lecture	**Test**	CAL	Tutorial
5	Project	Project	Project	Project	Tutorial
6	Project	Project	Project	**Resit** / Project	Tutorial

(N.B. this is clearly a relative of Bloom's Mastery Learning design (Bloom, 1968), which at school level divided courses into blocks of 1 or 2 weeks; did a formative test; followed by personalised self-remediation based on the diagnostic information from the test; and retaking the test.)

This approach can achieve essential competence over a wide range of students' prior knowledge and skill, and current effort: and so it addresses problems A,B,C. It also gives competent and interested students access to advanced learning, and so addresses D.

3. "Magazine" courses

One approach is to design the course based on topical interest or relevance. This may help student interest, "authenticity" (connecting current learning to utility outside the university), and the appearance of novelty, which makes every topic look new (avoiding a problem with students who have "done" a topic at school with the same title and therefore assume they know it already).

The best lecturers change their jokes and cases (examples) every year, in order to keep it fresh and relevant. The difference here is to move the novelty / application into the title and learning objectives of each topic. The disadvantage could be that students will have learned a topic without realising its normal name and generality because their notes will be indexed by the case or application i.e. by the novelty not by what is general.

4. The physics approach

University physics typically requires school physics as an entry requirement. However there is so much physics knowledge available to be taught, that there may be no overlap: topics will be selected for school study mainly on the basis of requiring simpler maths, so overlap can be automatically avoided. There will be some other disciplines where this also applies (History? English?). However this is unlikely to work in, say, psychology where courses are often required to cover core areas at every level.

This effortlessly achieves novelty without the disadvantages of the "magazine" approach, and so addresses diverse levels of prior specific knowledge on this subject. But it does not address different levels of current motivation.

5. The core disciplinary criteria view

One perspective on learning and teaching in a discipline could imply a solution. If your discipline is essay-based, then most of the real aim of a degree programme is learning how to write an essay in that discipline. What really matters is being able to do that type of writing (to show that you think like a psychologist, or historian, or cultural theorist), regardless of specific topic. The marking criteria will stay essentially the same throughout (e.g. display critical thinking, show extra reading beyond the lectures, ….). In calculation-based disciplines, instead of essay writing skill it will be mathematical problem-solving skill: again a largely topic-independent skill.

If you take this view seriously then you could/should let go of the idea that the curriculum should be a list of facts (or a canon of core books) to learn which every student must know. In that case, you could select the actual specific material for its appeal on other grounds, since your real learning aims are to train them in the writing and thinking style. You could then go for a "magazine" type course, or pick topics that are definitely not on any school syllabus, and so avoid disinterest from students who think they have seen the material before. This wouldn't avoid some students being more pre-enculturated in the disciplinary attitudes and skills than others, but perhaps it would reduce differences in prior knowledge to within the range where peer interaction (cross-teaching) can work. Thus this approach could address differences in factual knowledge, but not in skills. On the other hand, an explicit focus on the programme skill (rather than on particular facts) could be good for all the students, and be helpful in addressing different levels of prior skill by focussing attention on skill rather than facts. Thus it might address problems A and B, and perhaps D; but not C: different levels of current motivation.

6. Test on day one

One approach is to start the course with a competence test. This both identifies who needs remedial work, and on what; and it shows the students what knowledge is required. It is unlikely that they will then think they already know a topic on the basis of its short title. To take a ludicrously exaggerated example, they may think they know "gravity" because they can state Newton's inverse square law of gravity; but if the test

requires them to use General Relativity they will know they are far from the required level. Conversely it could be used to help low-prior-knowledge students to identify their weakness at once, indicate how they can fix that, and provide support.

It would thus address A and B in the best grounded way possible (there would be no student self-deception about already knowing the material). However it would not satisfy students who really do have more knowledge and motivation than the course needs (C,D).

7. Presenting the university as a resource not a syllabus.

One approach could be that courses should be pitched at the minimum all students should attain, and that the best and brightest can go farther and deeper into the subject on their own, using the library and only a few indications from staff. For instance, at school my English teacher once gave us a long list of what he judged to be the most important / interesting contemporary English novels of the last 15 years. I kept that list for some years and eventually worked my way through about half of it. His judgement, or hints, on what was worth reading was certainly valuable for inexperienced boys, cost him little effort and no class time at all; yet took care of what to do with the surplus learning energy of the interested.

In completely other words, this seems to be the underlying argument in Snyder's "The hidden curriculum", a study of a top university course. His observation was that a pervasive disease of HE courses was ludicrously overloaded reading lists and curricula. Yet a positive spin on that observation, is that it is not hypocrisy nor lack of considered teaching, but addressing how different students want to learn different things, and supporting that diversity. It is a profoundly anti-constructivist view to say that teacher knows exactly what every learner should learn; that no learner differences should be countenanced, and everyone must learn the same. Snyder's interview data brings out how in a given class, different students decide to learn different things, with different consequences for their present and their future. And that that is much of the value of a university.

Applied to a first year course, this would mean simply providing some suggestions, perhaps only as a reading list, for what the more interested and energetic student might usefully do beyond the core minimum. This could be seen as an implicit, low profile version of the Judy Wilkinson course (where higher performing students go further with their project work). But it is NOT doing nothing. There is a great difference between a course where students feel or are told that there is nothing more for them to do, and one where interesting further investigations are indicated. One of the most important benefits which contact with an expert has, is getting their opinion on what is interesting or worthwhile to learn. Novices do not know this. But given that information, learners can do the rest given sufficient time and motivation.

This approach does not address differences in prior knowledge (except inasmuch as that leads to boredom and unemployed motivation in the better prepared). It addresses differences in current motivation levels (spare capacity) by suggesting voluntary, self-managed, solitary additional activities for the motivated student.

8. More structured voluntary approaches

There are a number of other, but more structured, approaches than the one in the previous section. Like that, they do not address differences in prior knowledge except insofar as these then lead to surplus motivation; they do address differences in current motivation level by offering essentially voluntary activities. They could be criticised for not requiring better prepared students to put in a standard amount of work: only for absorbing surplus available effort. They thus address A and B indirectly and C directly, but not problem D. This is in contrast to Wilkinson's design above which channels student effort into the advanced activity as soon as they have passed the competence test. Thus the approaches here could be said to lead to more able students gaining less from the course than the less prepared, unless the more able are also more motivated.

Corrigan & Campbell (2013) describe setting up a student-led professional development society, where members design and carry out activities related to the eventual vocational purpose of their degree programme.

Bell, Johnston & Woolmer (2013) describe "Vertically integrated projects". These are multi-disciplinary projects involving students across several years, and staff too. They won't address "diversity" but should address soaking up extra motivation in the most energetic students.

A proposal (not implemented) in my own department, is to have senior students adopt volunteers from earlier years to assist them in a research project: giving them earlier contact with research culture and what it means in practice.

All of these are good for drawing the motivated in, and are more social than the "reading list" idea above in [7].

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