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Social science for the life science teaching programmes

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Alison Burrell[1]

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In 1999 the University of Michigan created a Life Sciences Institute and launched a new academic initiative called the Life Sciences Initiative. The University President, Lee Bollinger, described the impetus for this initiative as follows:

"There is an intellectual revolution afoot in the life sciences – one equivalent to the revolutions in chemistry in the 1800s and in physics in the 1900s. Advances in the life sciences are raising new questions about what it is to be human, how best to lead a human or humane existence, what it is to be a living organism on this planet, and other crucial questions of human values that will reverberate throughout the social sciences, the humanities, the arts and medicine.

"…The revolution in the life sciences presents us with an educational imperative to which we must respond in three ways. We must equip current and future scientists and healthcare practitioners to carry forward science, engineering and healthcare for the future. We must prepare students for careers in the growing biological and healthcare fields. And we must educate all our students to be knowledgeable citizens in a world where moral, social, political and practical questions related to biology will arise more and more frequently."

If we replace "healthcare" with "agriculture and food", this quote fits admirably with the motivation that lies behind this event here today and illustrates that it is a widespread phenomenon in the international scientific community. A huge wave of new knowledge has been unleashed within the life sciences – what was unimaginable a few decades ago has become possible, if not commonplace – and it is increasingly recognised that a strong contribution is needed from social scientists to understand the consequences of this knowledge revolution and make sure it works for the benefit of society.

I congratulate you on having successfully negotiated the marriage or marriages that have brought all your social scientists together in one university department. This parallels similar changes in my own institution. We began about 5 years ago by merging all social science university departments into one large department. As a direct result, the profile of social scientists as a group within the university was enhanced. Shortly afterwards, the university was merged with the DLO (the Agricultural Research Service of the Netherlands – a government funded network of institutes engaged in applied agriculture-related research including biosciences and

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economics). Like some marriages, this one was not without financial motivation – cost saving, reduction in overheads - but its goals were also to increase critical mass, achieve greater diversity and promote pluridisciplinarity within the one organisation. Within this enlarged organisation (called Wageningen University and Research Centre), all social scientists now belong to a single entity, known as an expertise unit. Within the social sciences expertise unit, the university Department of Social Sciences retains its separate identity as does the Agricultural Economics Institute (the LEI).

Ideally, the gains from pooling resources should spin off not only onto research but also onto teaching, especially when it leads to greater flexibility in responding to demand and when it helps to reduce wasteful duplication in the supply of courses. As well as creating new structures, however, it is also important to get the incentives right *within* the new structures. This means that *within* departments, and between departments of the same university, the mechanisms for allocating research money, funding personnel, paying for courses and recognising collective effort should offer appropriate incentives for realising the full benefits of the merger. Experience has shown that the incentives created to encourage research are not necessarily optimal for producing an efficient and demand-oriented supply of courses. In particular, incentives that reward individual researchers or small research teams may produce fragmentation and competition that work against collaborative and cross-disciplinary teaching packages.

Regarding the impact of the life sciences revolution on teaching programmes, we can begin by asking a few factual questions. What is the state of play in European universities? Is the desirability of a social science input in life science teaching programmes well recognised? Is there a common view about what form this social science input should take? Is this input increasing, and if so, is the increase demand driven or supply driven?

Unfortunately, without having done the necessary research on current trends, I cannot give a definitive answer to these questions. The best I can do is share my "impressions" of the way things are going, based on first-hand knowledge of my own university, and on the prospectuses of a relatively small sample of other universities selected more or less at random.

A striking new development is that some universities are now offering truly multidisciplinary Masters programmes that span the life science/social science divide. For example, the University of Cambridge launched a new one-year Masters in BioScience Enterprise in 2002. It is an international programme for students who intend to follow a career at the interface of bioscience and business.[2] According to the prospectus: "It covers the latest advances in biological and medical science, together with business management and the ethical, legal and regulatory issues associated with bringing scientific advances to market. Case study analysis of UK and US

[2] The programme has been developed by the Graduate School of Biological, Medical and Veterinary Sciences of the University of Cambridge, in association with the Harvard-MIT Division of Health Sciences and Technology and the MIT Sloan School of Management, both in Massachusetts.

biotech firms are also used to illustrate the factors governing the successful exploitation and marketing of scientific discoveries."

Another example is the 2-year Masters degree in the Agrofood Chain that will begin in September 2004 in Toulouse, mounted by INRA in collaboration with the University of Toulouse. The

programme includes life sciences courses such as cell and developmental biology, molecular biology, microbial engineering and genetics as well as courses in communication skills, quantitative economics, experimental methodology, ecology, agricultural systems management, agricultural policy and industrial organisation of the food industry.

In these new, targeted programmes, life sciences, management and other socio-economic components are all seen as important. The programmes are designed to provide well-qualified individuals for particular niches in the job market – such as commercial biotechnology or the food industry. The specific content of the programme is more or less determined by the job market orientation.

These market-oriented programmes are intended to produce a certain type of life science graduate – one that is in increasing demand. However, society has other demands from life science schools, for teachers, practitioners in the farm, food and health sectors, administrators and regulators with a life science background and - by no means least important - for the next generation of researchers who will carry on expanding the frontiers of knowledge.

We can expect that these career profiles will still be catered for by the traditional discipline-based programmes, with names like biology, biomedical sciences, plant science, nutrition and health, and so on. However, our working hypothesis here today is that, compared with the traditional programmes of the past, these programmes will include a greater socio-economic content in order to cater for the increasing demand for life science graduates who are aware of the social, economic and ethical implications of modern science.

This hypothesis leads to the following questions:

- Are the traditional life science degrees in fact acquiring more social science content?
- If they are, at what level (Bachelors or Masters) do these social science components appear?
- Specifically, what kind of social science courses are now appearing in life science programmes?

To try and answer these questions, I've looked at the Web pages of some relevant universities in various countries. My conclusion from this survey, which was neither comprehensive nor scientific, is that the compulsory social science content in life science programmes is still rather small, and where it occurs, it does so within the Bachelors programme rather than at Masters level.

This observation leaves out of account the fact that, in certain programmes, life science students may have some completely free choices and could well opt for a social science course on an individual basis. If this *is* happening, it would not show up in the advertised programme descriptions.

Some of these impressions are supported by a more detailed analysis of the courses provided in Wageningen. As background information, Wageningen has 16 Bachelors programmes, of which 2 are in the social sciences, and at Masters level there are 27 programmes (some with a number of specialisations within them) of which 3 are social science programmes. Most of the others can be unambiguously classified in the life sciences or applied life sciences category. It is also useful to know that most courses in Wageningen earn 4 study points (one study point represents one week of full-time study, and translates into 1.43 European credits).

Table 1: Social sciences courses in life science programmes Wageningen University, 2003/4

Social science area	Bachelor		Master		Econ specialist	Total courses
	Comp	r. opt	Comp	r. opt		
Business management	1		3	3	1	4
Communication	3	6		4	3	7
Consumer behaviour & marketing	4	1	1	3	6	6
Economics	4			1	1	3
Environmental policy	3			3	2	5
Law	1		1			2
Philosophy	4		1		1	2
Sociology	6			1	1	5
Total	26	7	6	15	15	34

comp = compulsory course
r. opt = restricted option

Table 1 shows the courses offered from within the Department of Social Sciences and taken up in life science programmes. It is based on our new Bachelors/Masters programmes, which have been running for just a few years.

The last column of the table shows the total number of different courses per discipline given by the social sciences department that appear as a compulsory course or restricted option in life science programmes. In total, 34 courses offered by the social sciences department are taken up in life science programmes. The second last column shows how many of these courses (less than half) also appear in a specialist social science programme.

To interpret the other columns, let's take the row for communication studies. The table shows that, at Bachelors level, a communication studies course appears 3 times as a compulsory course amongst the life science programmes, and 6 times as a restricted option. There is no

compulsory communication studies course at Masters level in any life science programme, but a communication course appears 3 times as a restricted option at this level. Compulsory social science courses appear 26 times in the life science Bachelor's programmes (about 2 courses per programme – or 8 study weeks) but as we'll see later the distribution over programmes is very uneven.

Several main features emerge from this table:

- More than half the social science courses provided to the life science programmes are available to non-social science students only. Moreover, it should be added that the courses that are also accessible to social science specialists tend to be options for them rather than core courses. This indicates a general view that social science content delivered to life science students needs to be structured and delivered in a different way from the core courses designed for social science specialists.
- However, even the courses designed specially for life science students remain identified with a particular discipline – sociology or law or business studies.[3] It is worrying that, since the social science courses offered remain bound to a particular discipline, students in a given life science programme with 2 compulsory courses may get a course on, say, philosophy and ethics, and another course on consumer psychology, but may well still miss a *broad* exposure to the way the social sciences conceptualise and analyse contemporary social issues.
- There are fewer social science courses appearing at Masters level. Where they do appear at Masters level, they are more likely to be restricted options and the emphasis (half of the courses) is on business management, and consumer and marketing.

Some features of this table are hard to explain without further information. For example, the greatest number of courses is offered in communication studies (with titles like communication and technology, communication and policy-making, environmental communication and so on). The philosophy group offers two courses – one on the philosophy of science and ethics, which is compulsory for 4 life sciences bachelors programmes (including plant sciences) but is not in the animal sciences programme, and one on food ethics that appears *only* in the food quality management masters programme. Agricultural policy appears only in the bachelor's programme in organic agriculture, and so on. I may be wrong, but the distribution of courses suggests that there is not (yet) an overall guiding philosophy or consistent vision in operation, but rather that the selection of social science topics has been made on a fairly *ad hoc* basis.

Table 2 shows how the social science courses taken up by life science programmes are distributed among the different programmes, and between the two study levels. The largest number of

social science courses is available within the organic agriculture Bachelors and Masters degrees – not surprising, as these degrees are relatively new, intrinsically applied and multidisciplinary, and commercially oriented. Environmental sciences also stand out as having a larger social science component at bachelor's level.

Otherwise, the picture is quite sparse. With just one course at bachelors level and none at masters level, we find biotechology, and soil science. Molecular science has just one course, a restricted option at masters level. This means that just four study weeks in a 3-year Bachelors or 2-year Masters programme are allocated to social science topics either compulsorily or as a restricted option.

Table 2: Social sciences courses in life science programmes Wageningen University, 2003/4

Life science programme	Bachelor		Master		Total courses
	comp	r. opt	Comp	r. opt	
Agricultural & bio-resource engineering	4	1	1		6
Animal sciences	2			1	3
Biology	1	1			2
Biotechnology	1				1
Environmental sciences	6			3	9
*Food quality management			2		2
*Food safety			1		1
*Food technology			2		2
Forest & nature conservation	1	1		2	4
International land & water management	1	1			2
Molecular sciences				1	1
Nutrition & health	1	3		1	5
Organic agriculture	6			7	13
Plant sciences	3				3
Soil water and atmosphere	1				3

* No Bachelor's programme is offered.
comp = compulsory course
r. opt = restricted option

Now, it is important to know that these tables only show courses that are formally incorporated into study programmes. *In addition*, Wageningen bachelor students can also choose up to 4 courses (about 40% of their third year) freely outside their programme, with the approval of their study advisor. Students following a 2-year Masters can choose their minor discipline (up to 25% of their study points) outside their main programme.

[3] Occasionally, the teaching of a social science course to non-specialists is shared with a life scientist. When this happens, students are likely to become more aware of the interaction and links between life and social sciences.

In theory, life science students could use these free study points to opt for social science courses. However, it is unrealistic to expect many third-year life science students to opt for social sciences from within those bachelors programmes where there has been little or no compulsory social science exposure in first and second years. After a few more years, when these new programmes have settled down, we'll have some hard evidence about how these free choices are being allocated.

Now, I come to the last – and most challenging - question, namely: what can the social sciences usefully offer to tomorrow's life science graduate?

Our starting point has to be the recognition that life science graduates will be called on to operate professionally in a world where, as our opening quote put it, "moral, social, political and practical questions related to science will arise more and more frequently". This means, of course, that within universities, academics from both life science and social science orientations should already be convinced of the desirability of exposing life science students to some social science, and *both* groups should have ideas about what a useful and challenging contribution from the social sciences might consist of.

Nevertheless, as social scientists we are the experts in our own core knowledge and teaching curricula, and we know what we have to offer. So it is particularly appropriate that we should try to develop some ideas of our own about what knowledge and skills we can impart to life science graduates to help them to perform, as professionals and citizens, in a world where science offers more benefits to humankind than ever before but where its potential for unexpected and problematic social consequences has also never been greater.

The social sciences share with the life sciences the same underlying aims – that is, through scientific analysis to understand, explain, predict and – where there is social, political and ethical demand – to develop mechanisms to intervene and control.

This scientific agenda means that the various social sciences, as research disciplines, are becoming or have become as narrow and focussed as the different life sciences. But just as being an expert in aquaculture or in molecular biology does not necessarily equip someone for a broad understanding of the life sciences as a whole, the expertise of a particular social science discipline is not adequate for a real understanding of complex social issues as they emerge in today's world. To equip our students adequately needs a broader approach - a synthesis of valuable concepts and insights from across the board in the social sciences.

Moreover, although at one level the aims of the life sciences and the social sciences are the same, the focus of social scientific study is the individual and collective behaviour of human beings, which is driven by the ***choices and decisions*** of the very object of their study. This requires different ***concept***s for viewing the world, different ***techniques*** and ***skills*** for observing, formalising, measuring and analysing; and it means that the kinds of ***issues*** that show up as

"social science" issues can be extremely complex and multidimensional, requiring in fact the coordinated input of various disciplines from the life sciences as well as the social sciences.

I am going to talk about some of the social science concepts, techniques and issues that seem to me useful and potentially valuable for life science students. It is inevitable that my list will have an economist's bias. I would have benefited from sitting down with other social scientists to compose a truly representative and balanced list, but I did not do this. However, the list proposed here is not intended to be a definitive one. Rather, I want to use it to illustrate a way of responding to the challenge of how to deliver some useful socio-economics to life science students.

That is, starting from scratch, we could begin by asking what it is useful for life science students to know and be aware of, and ***then,*** having done that, we could compose new and imaginative courses out of these elements. This is in complete opposition to the disciplinary approach, which starts with existing courses where material from within a narrow disciplinary area (say, microeconomics or environmental law) has already been packaged for specialist social science students, and then adapts these courses to make them accessible to non-specialist students.

Let us start with concepts. The social sciences provide a set of concepts for conceptualising and analysing society and human behaviour. Box 1 gives some examples, which are discussed in the next paragraphs.

Box 1: Some useful concepts

- social & cultural context and its evolution
- non-neutrality of institutions
- economic value
- human, social, ethical values
- treatment of time
- role of information
- concept of risk
- scientific status of social science theory & knowledge

Generally, the social sciences recognise the importance of ***social and cultural environment***. Individuals do not act in a vacuum; their decisions, adjustment processes and reactions to their changing environment depend profoundly on their social and cultural context.

In particular, awareness of the ***non-neutrality of institutions*** helps to explain individual and collective behaviour. For example, the way assets are owned and by whom influence the way economies work, as does the way property rights for collective goods are defined and allocated. Procedures for defining and defending intellectual property rights and the regulatory system for new technologies are important for understanding the uptake and outcome of technological innovation.

The ***concept of economic value*** is crucial in a context where so many decisions depend on a "bottom line" that is expressed in money terms. The fact that economic value depends on the demand for something *relative* to the scarcity of its supply is often not intuitively acceptable to non-economists, but is the key to understanding the paradox of relative values (i.e., many ne-

cessities are relatively cheap, many luxuries are very expensive). Since both demand and supply for particular resources depend on social and cultural norms, *and* on institutional arrangements, *and* on the distribution of asset ownership, all these factors underlie the formation of economic values. These ideas emphasise to what extent current ***economic values are conditional*** on the social and institutional *status quo*.

At the same time, to understand many of today's most pressing issues, we have to recognise the ***limitations of the market*** – prices reflect society's marginal valuation of something only providing all economic goods are marketable and the conditions for a free and perfectly informed market exist. When these conditions are not met, market prices are misleading indicators of society's valuation of a particular good, even when we accept the social and institutional *status quo* underlying market behaviour. The fact that some markets are missing altogether does not mean that non-marketed items are without economic value

And what about ***human, social and ethical values***, as opposed to *economic* value? Can these values be expressed and recognised with the same "authority" as a "market value"? How can they be incorporated into a decision-making framework?

The way social scientists deal with ***time*** in analysing human behaviour can be helpful for understanding social issues. What is problematic – or what is optimal – for an individual or for a society depends on whether we take a short-term or a long-term perspective. The concepts of endogenous dynamics, time preference and irreversibility are crucially important here.

The ***role and value of information*** are highly relevant for decision-making on complex social issues. Information is a scarce good and hence of great value. Information asymmetry (the situation where not all parties involved in a transaction or a collective decision share the same information) is an illuminating concept for understanding many current outcomes.

Closely related to time and information are the concepts of ***risk and uncertainty***. Economists, psychologists and others have developed techniques for measuring risk, and concepts for analysing the attitudes of individuals and societies to risk. Different ways of dealing with risk in decision making, from purely actuarial approaches to the precautionary principle, are useful and relevant concepts.

Finally, users of the social sciences need to be aware that they are ***non-experimental sciences***, and that this has implications for the *status* of social science theory and knowledge. Not least important is the so-called ***Lucas critique*** – that is, the idea that when knowledge about patterns in human behaviour is used in an attempt to influence or control that behaviour, the intervention itself can alter the behaviour in question so that the knowledge is no longer valid. Of course, all living organisms evolve over time in more - or less - predictable ways. The difference with human behaviour is the speed and relative unpredictability of the adaptation. This can make much social science "knowledge" more ephemeral - more conditional – than the knowl-

edge gained in other scientific disciplines. The *way* in which the social sciences tackle social questions is as much a strength as the particular body of social science "knowledge" that exists at any point in time.

Box 2: Techniques and skills

- constrained optimisation
- marginal analysis
- survey techniques
- statistics for social scientists
- textual analysis
- costs-benefit analysis
- critical discussion

As for useful techniques and skills (see Box 2), as an economist I have to start with ***constrained optimisation*** and ***marginal analysis***, which underlie so much micro-economic theory, so much management advice and so many policy recommendations. When optimisation is the objective, the concept of "***the margin"*** is crucial. It is how things are balancing out at the margin that tells us where we want to be on the trade-off between benefits and costs, between alternative uses of scarce resources, and so on.

Survey design – in particular, how to construct a good questionnaire, choose a scientifically valid sample, make a good case study, techniques like CVM (contingent valuation methodology) – these information-gathering techniques are for social scientists the counterpart of the laboratory techniques of the life scientist. It is important to be able to recognise the classic pitfalls that can be encountered when collecting data non-experimentally, and for users of this kind of information to be able to judge whether or not it has been collected in a reliable way.

Some ***statistical methods*** have special importance in the social sciences – for example, multiple regression and the impressive array of econometric techniques that have been developed therefrom. Of particular importance is the principle of general-to-specific modelling, which is not relevant in the experimental sciences where experiments can be designed and controlled.

Textual analysis – the analysis of the content of written or verbal material, and the way the discourse has been constructed – increases awareness of how human responses to information can be influenced and manipulated, whether by advertisers or politicians.

Given the widespread use of ***cost-benefit analysis*** in current public decision-making for a whole range of applications involving life science issues, understanding the main principles and techniques involved (discounting, valuation of non-marketed items, decision rules, sensitivity analysis) is also highly useful for practical life scientists.

Finally, among the desirable skills to impart to life science students is that of ***critical discussion*** – critical discussion of theories, evidence, research results and interpretation of those results. This involves recognising the importance of stating one's assumptions and justifying all propositions with rational argument. This is a hallmark of social science discourse, where there may be a greater danger than in other branches of science that hidden biases and unstated assumptions distort arguments and lead to unfounded conclusions.

I am not suggesting that life science students should try to master all these techniques and skills to the point where they can perform them to a professional standard. Rather, the aim would be for them to acquire an understanding of how they are used in practice. For example, they should be aware of what kinds of assumptions underlie a typical cost benefit study or opinion survey, and to develop some instincts about how these techniques can be misused by practitioners or highjacked by end-users.

How can this be achieved? I would like to suggest that a good way of achieving this is through letting students see how social scientists analyse particular issues *in practice* rather than by studying concepts and techniques from a formal, theoretical starting point. Many of the most pressing ongoing or unresolved issues facing societies at the moment require collaboration between a life science and at least one, typically more than one, branch of the social sciences (see Box 3).

Box 3: Current issues requiring a multidisciplinary approach

- climate change
- globalisation
- animal welfare and animal rights
- loss of biodiversity
- genetic manipulation of plants
- human cloning
- future of farming and land use options
- access to water
- intellectual property rights and access to medicines
- responsibility for food safety

For example, globalisation raises all kinds of issues. One is that the rapid movement of people and goods around the globalised world has promoted the introduction of exotic species in new parts of the globe, where they threaten indigenous biodiversity. A special and unusual case of this phenomenon is the increased risk of animal disease epidemics among the vulnerable populations of farmed animals in western Europe and north America. Determining the optimal policy response to this threat involves obtaining many different kinds of information and balancing many priorities – animal health, production technology and economics, consumer preferences, biosecurity regulations that curtail producer rights, animal welfare, the ethics of trade protection and so on. A small team consisting of, say, a veterinarian or an epidemiologist, an economist, an ethicist, a jurist, could guide students through an analysis of the different aspects of this problem, so that they see different ideas, skills and arguments being applied in practice to a single issue, and how a multidisciplinary approach can lead to a better understanding of the various elements involved.

Any of these issues could serve as a vehicle for developing insight into how different concepts and analytical approaches from multiple disciplines are mobilised in order to try and understand a complex social phenomenon. An issues-based course, taught by a team coming from different disciplinary origins, and with an appropriately constructed curriculum, would ideally be a compulsory course at bachelors level in all life science programmes. The main aim of the course would be to create an awareness of the kind of input the social sciences make to studying these

questions, to see how social phenomena are conceptualised, to be exposed to the vocabulary and scientific approaches of the social sciences, and to see at first-hand the value-added of cross-disciplinary interaction. The choice of issues, and how much theoretical background to the concepts and techniques involved is included in the course, would depend among other things on the students for whom the course is designed, whether or not they have the option of taking further social science courses if they are motivated to do so.

In my own experience over many years of teaching economic principles and cost-benefit analysis to life science students - from a disciplinary starting point and within the boundaries of my discipline as an economist - I have repeatedly found that most students become interested and motivated only when techniques already expounded in a formal context are applied to issues close to their main interest. At this point, the economics becomes relevant to them and real understanding begins. At the same moment, however, the bombardment of questions about the social, ethical, or environmental implications also begins. Instinctively students (who are not just animal science, forestry or irrigation students, but also social beings) recognise that a multidisciplinary approach is required, and I am reminded yet again that a single social science discipline is quite unable to provide the full scientific framework needed for satisfying the questions that arise.

Summarising then, I am suggesting that our goals should be

- to enable life science graduates to understand and critically evaluate arguments and decisions regarding social and moral issues, especially those relating to the impact of science on society as well as those where society looks to the life sciences to provide solutions
- to impart to students a practical - and critical – basic knowledge of social science methodology and of how it differs from that of their own discipline, and
- to provide them with vocabulary, concepts and terms of reference for discussion and life-long interest in economic, political and ethical issues arising from the interaction of science and society.

The main question: "How best to deliver practical, usable social science content to life science students?" breaks down into some more specific questions:

- Should that content remain compartmentalised by discipline - as we do for social science specialists - or is it more useful to deliver it in a multidisciplinary context framed around an issue?
- *How much* discipline-based, theoretical content should we provide?
- Should we teach the theory first (followed by the application) as we still tend to do with our specialists, or begin with the issue, then explain, demonstrate, discuss how various disci-

plines are needed to get a proper grip on the issue, show this happening in a practical context, and finally – once interest has been aroused and an intuitive grasp of the arguments has been acquired – maybe follow up with a sketch of some of the relevant theory.

It's a challenge – but I am convinced that a creative approach targeted to these goals will involve a rather different approach from the one we use with our specialist students. It is impossible to be prescriptive about solutions, because they will vary according to the "learning climate" in a particular university, the personalities of the professors involved, the expectations of students, and so on.

Here are some keywords to act as guidelines: conceptually based; theory present but subordinated; issue-focused; multidisciplinary framework and context; student-responsive; encouragement of critical dialogue and discussion.

As social and life scientists who recognise the importance of the challenge, let us begin by encouraging critical and constructive discussion, amongst ourselves and with our students, about how we are going to respond.

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