# School C Teacher 2 – 17 Jan 2017

Interviewer: At the time of the famine and all that kind of stuff, so not easy circumstances at all. I think that for them to understand the personalities of people involved. The problem with all these kids, is that they just see the gadgets in their hands, and think that's computer science in their hands with no sense really of all the personalities, never mind the fantastic ideas and everything, but these as individuals, they're captivating for some people in a way that the dry ideas won't be, you know?

Teacher: Well, the stories of some of the computer scientists are ... The story of Ada Lovelace is another good one, is that ... And the idea that she was taught mathematics and an antidote to poetry is just ...

Interviewer: Just awesome, isn't it, really?

Teacher: It's brilliant.

Interviewer: The other one who's really interesting, who I like, is Claude Shannon.

Teacher: Oh, yeah, yeah yeah, yeah.

Interviewer: Don't read about Claude Shannon when you're doing a masters degree because you'll just feel depressed.

Teacher: Because he's so smart.

Interviewer: Well because his masters degree was the paper that proposed how to make digital computers.

Teacher: Yeah, yeah.

Interviewer: Then you think, "No one will ever have that much influence with ... change the entire world."

Teacher: I think one of the cool things to get over the idea to the kids with that kind of stuff is that just what game changers they are. The degree of, never mind that it's just computer science, but it's just disruptive thinking isn't it? People who have the balls to go out and think different, and Shannon ... There's a whole lot of people at that time, that late '40's early '50's, with just astonishing people. And for kids now to understand actually, in terms of the core ideas between 1947, '48, '49, and now, it's the same ideas.

Interviewer: Yeah.

Teacher: Which in it's way is rather depressing. But I mean, when did [inaudible 00:01:46] paper, what was it, '47 or something like that? The idea that what was the most formative decade for the development of digital computers, the 1940's, is just insane.

Interviewer: But there's a few inventions like that. The combustion engine, cars and aeroplanes are still using, essentially the same technology they've been using for 50, 75 years.

Teacher: So for them to understand that actually, ideas have a shelf life, which not just about whatever Samsung have come out with this month. These ideas have been kicked around for decades, and different people have contributed in small ways to them. You show them that first integrated circuit, [inaudible 00:02:30] or somebody, and you look at how it shrunk and developed over the years, and just the intellectual effort that's going ... Whatever these kids go off and do, the sense that they could be involved in projects which are just as dynamic and changeable, and these weren't box thinkers, and all that kind of stuff. So I think that computer is a really good ... Role model is not quite the ... But it's a really good lab rat isn't it, in terms of how ideas develop over time.

Interviewer: It's also a good area where you can really see how rejecting current thinking can have a huge influence. And it might not be computing where that will be the influence. But in some other field, whatever field ...

Teacher: And you might not even know then. It might take quite a long time for it to come to fruition, the idea that we have this timeline on the wall, that's probably one of the reasons why they get the history a little bit more. But the idea that MIT, they had this [inaudible 00:03:27] idea, at the end of '60's and so on, and it looks kind of like an Ipad does now. And to go over the idea, what Apple did, they're not just a bunch of geniuses from a corporate point of view, they buy people early enough to be able to make their IP and turn it into something celibate.

Interviewer: I think one of the interesting stories about Apple as well is that what Apple does brilliantly, or has done - and I think they've hit a peak - is they take an idea, and they find ways of packaging it that people who won't ... They'll make it comfortable and reassuring. And then they shift that over time, but the design concepts of making things that are digital look like things that are physical, and those sorts of stuff that they really pioneered. So that when you held an Ipad early on, it didn't feel like this weird thing that nobody had seen before.

Teacher: Yeah, they are amazing, aren't they? I don't think that anybody ... It's a shame really, lots of specifications and stuff like that. We do lots or really quite dull stuff to with ... Boring shit to do with legislation, or disposable electronic waste. And none of that kind of stuff is covered, which I think will be much valuable to kids who are really, anywhere who would do ...

Interviewer: It's all interesting. I'm Interviewer, I'm Lancaster University, all that stuff. I'm doing research, I'm working on my PhD, which is broadly on digital economy but specifically on the computing curriculum and the connexion between how kids at key stage three are learning about computing, and how that affects their life choices and views of the future. Do you have any questions for me?

Teacher: Are you particularly focused on their career choices then, at the end of the a school, or their degree choices, or ...

Interviewer: It's more just how it's changing them and their choices.

Teacher: Them as individuals?

Interviewer: As individuals. But also, what I'm finding, and what I've found doing this research is there's some bigger questions about the computing curriculum and where its [inaudible 00:05:29] are. That in some ways, I can't ask some of those questions I started out asking because this area's too young.

Teacher: Yeah.

Interviewer: And so there's bigger questions about what's being covered and what's not being covered, and how that prepares them. And in some ways it's not about them changing their choices, it's just them wanting, or not having, certain skills.

Teacher: Yeah.

Interviewer: I'm gonna skip a whole bunch of questions that I've asked some people about ... How long have you been a teacher, and did you do anything before you were a teacher?

Teacher: Back in the '80's I did integrating computing.

Interviewer: Okay.

Teacher: Then I went to work on the trade magazine, the journalism type thing. And then I became a teacher in 1999, and I've worked here ever since. Just teaching IT, computers.

Interviewer: What was your name again, by the way?

Teacher: Teacher. M– [inaudible 00:06:27], 51 years old, male.

Interviewer: And where do live? Then I can write it like a journalist. My BA is in journalism so I can write Teacher, of [inaudible 00:06:39], 51, said ...

 And so you said you did computing ...

Teacher: As a degree.

Interviewer: As a degree.

Teacher: [inaudible 00:06:50]

Interviewer: And was that coding, and computer science, and that sort of stuff?

Teacher: Yup, yeah, all that, yeah.

Interviewer: Have you ever worked in the computing industry?

Teacher: I worked for a little while as a programmer.

Interviewer: Okay.

Teacher: For GEC. So we wrote C code, in Unix. But [inaudible 00:07:10]

Interviewer: And when was that?

Teacher: In the '80's.

Interviewer: Okay.

Teacher: Late '80's.

Interviewer: Just 'cause you say you wrote C code on Unix, and it could be anytime from the '70's to today. There's still people doing that.

Teacher: Yeah.

Interviewer: What do you think of the change of emphasis from ICT to computing for the curriculum?

Teacher: I think it's broadly been good. I think we've thrown the baby out of the bathwater as well, at the same time. So I think that glib comment that students find IT boring was utterly misinformed. I don't think there's evidential base really for this colossal shift from IT to computing. I think it was initially, my understanding, is that it was driven an awful lot by CAS, with a big influence from the universities. Which is kind of ironic, given that I think probably most schools will pass on maybe three students max to computer science classes. So I think it was led at the top end with a lot of university influence, which led to a bunch of changes that don't really enrich the life of a 12 year old very much, who would rather eat their left hand than go and do computer science at university.

Interviewer: Yeah. Do you think that CAS was misguided, or do you think it wasn't heard correctly, or where do you think that ...

Teacher: CAS is like a bunch of gorilla fight, who've been stuck in the jungle, fighting for years and years and years. When you come out of that kind of gorilla struggle, you're pretty pumped up aren't you? So they are gonna come out fighting, aren't they? And they were very effective and good advocacy group. And their heart was in the right place.

Interviewer: Do you feel like - and this isn't one of the questions, but something I found - The discussion around CAS tends to be too high level?

Teacher: Well that's what I meant about the university stuff. On the one hand, you've got the universities and CAS setting up and guiding a process which, in many ways ... And go say then that kids find IT boring, ICT boring. In my experience, of over a decade as a teacher, no, they didn't.

Interviewer: Yeah.

Teacher: They found elements of it, but those were the same elements that exam boards were put into, really stayed specifications. And we've got some of the boring stuff to do in a computing specification as well. I don't think they found an awful lot of the ...

 And I think it's gonna be really fascinating to see in five years time. We talk about these kids who are digital natives, and that word, that phrase, is often used in a defensive way, in terms of parenting, as well as teaching. These kids are experts in an area which, is somehow a line behind the stones that parents, teachers, have neither the inclination, nor the skills, to access. It's almost like we've been precluded from it, which is absolute bullshit.

Interviewer: Well and using something a lot and using it well are ...

Teacher: Totally different things. And so we get a lot of parents who come into parents evening, if their kid appears to be able to tap and swish in the right places, that makes them incompetent.

Interviewer: And then they ask why their isn't doing as well.

Teacher: Yeah, but I don't necessarily think that even ... In terms of, when you get a parent coming in, "Why should my kid do these subjects?" I'm still not sure that CAS has ever really countered the ... Aren't we trying to produce a generation of coders, or what? Is it really just about coding? I don't think that this ... Even though people talk about Wing, and the bloody definition of computational thinking and all that kind of stuff, I don't think we've got anything really, which is properly ... Without using bullshit words like abstraction, and patent recognition, and generalisation. Give me something which will immediately, within eight words, sell it to a 13-year-old. And reference Jeanette Wing, and computational thinking, abstraction.

Interviewer: Abstraction doesn't do that.

Teacher: It's bullshit. No, it doesn't mean anything to these kids. You try using big words like decomposition to a 13-year-old. You say right, so you want me to break different ideas down into small things. Yeah, well I do that all the time, and I've been intuitively doing that since I was four. Is that all you've got in your locker, really?

Interviewer: Or even longer.

Teacher: So what are we saying? We look for patterns, we hide things away, we break things down. Really? That's what we do all the time anyway, you know. It kind of is, isn't it? I don't think we've got a basic rationale for selling it to 13-year-olds.

Interviewer: Do you think that industry either had too much, or not enough, or about the right amount of influence over ...

Teacher: As a guy, I used to go [inaudible 00:12:29], quite a few times, and you look at the way the influence of ... What I'm just hesitating about is I'm not sure the question of how ... If it's a curriculum-based questions, then I would say probably no.

 But if it's a broader based question, which I think is relevant to do with the use of computers in a broad sense - networks, hardware - in schools then I think that they have sold a lot of unnecessary shit to schools. A lot of unnecessary hardware, software, monitoring software, management information software, VLE software, that schools didn't need, didn't know how to use, didn't have the capacity to run properly. So I think they've had too much of an influence. But it's the Teacheret place. If we accept the common ...

Interviewer: But you have too much ... My initial presumption when I started doing this research was that CAS had heavily influenced the curriculum, and CAS was ...

Teacher: Influences of Microsoft and Google.

Interviewer: But not just Microsoft ... But also BCS is driven by industry. So I thought, "Well, this is being driven by an industry initiative." What I've come to realise is that actually is far less, and it's been driven by well-meaning enthusiasts as much as anything.

Teacher: Yeah, I that's probably true. And I would say, I suppose really that the influence of Microsoft and Google, as far as I can recall, as being the big players, although you could also talk about your raspberry pie type people, couldn't you? Obviously not in behemas in the way that those other two are, but I wouldn't say that they've enforced any kind of commercial agenda on it. And I would suggest that actually, to look for a commercial agenda in terms of the corporate influence of CAS is to look into one place. I think, more interesting, is the commercialization of exam boards. And the influence that that's had in terms of the provision of teaching materials for schools.

Interviewer: Yeah.

Teacher: So what you've got now is CAS coming out of the hills as gorilla fighters, certainly getting legitimacy. Putting their combats away and wearing suits and ties and going to meet R–, our colleague here. He was the Fidel Castro, and remains the Fidel Castro in many ways. He's leading his own gorilla struggle here, as well.

Interviewer: He tries, he tries.

Teacher: That's just his personality, you know,.

Interviewer: I like the idea of pictures of R– on posters and undergraduates.

Teacher: He would as well. Freedom for KL The thing That bugs me more is the way that you will have ... CAS has come up with its own - they haven't got it on the wall anymore - but initially, they came up with some fantastic pathways, and all that kind of stuff. And they were kind of ... What we're looking for, teachers like me, and [inaudible 00:15:38] is we're looking for a clear guidance from them on what should teach.

 And I think their initial pathways document was really rather good. And they produced another document earlier on, which I think was called something like The Body of Knowledge, or something like that, one of the earliest documents that they produced, certainly from my experience of them. And that broke the curriculum up into certain topic areas, and was really rather good. And it would make broad statements like this - it would say that kids should have an understanding of how the internet works from the beginning, at their home, to the end, to the servers, like a beginning to end understanding. And it didn't nickel and dime you to death about exactly how you should do that. But as a generalised statement that we could all buy into and chop up and break down in our own ways. That was great.

 So then what happens is that you get them then coder-friendly into these pathways, hardware, network software, and all that kind of stuff. And it came at a really bad time, and I think this is kind of important, because it coincided with wide-spread curriculum changes in terms of national curriculum levels that many people had used. It started off as being a massive imposition. People had got used to using them, so it became habitual. And certainly we had to start turning the CAS stuff into this grid and doing something which nobody has ever nailed in IT or computing teachers, which is to tell us what is the difference between a level four learner, a level five learner, and a level six learner.

 Now in other subjects, with a longer [inaudible 00:17:13], a cannon, you might call it.

Interviewer: Yeah, yeah.

Teacher: They could do that. And we could never do that. And if you put ten people in a room to talk about IT levels, you'd get 25 different answers, and it's the same with computing. Now unfortunately, if CAS had happened five years later, all that shit would've been gone. And we would've had less anxiety about what is level 4, what is level 5, and so on, 'cause they're just red herrings really, and yet somehow we need progression, don't we?

Interviewer: Yeah.

Teacher: We need to do that. So, back to your original question, CAS has done a great job with that, and I think it was relatively free of the commercial influence of those people. And I think sometimes that comes down to individuals. If you look at Google guy on the CAS notice boards, Peter - I can't remember his name - but the Google guy anyway, his influence is always very good, and he's always very careful about declaring commercial interest and so on. So I think that was a very positive influence, actually.

Interviewer: Yeah.

Teacher: And it's also been backed up by Google putting their resources, like their computational thinking stuff that they do, which is often more broad based than CAS would do.

Interviewer: Yeah.

Teacher: So I think they've had a very Interviewerign and positive influence. But for my mind, the more corrosive side of influence is the exam boards. And that's because they will take a kind of a framework that CAS has done. And CAS is almost saying, "It's beautiful, it gave birth to these beautiful ideas, and these beautiful children." And they get fostered by the exam board and turned into little monsters.

 So we've now got these specifications which are kind of like the original ideas that you could see coming from CAS. But they then pin the butterfly out in lots of different ways and tell you you've got to do this, and you've got to do that. And then they sell you the books that go with it. So they are the ones that are making the money out of all this. Not us.

Interviewer: What I find interesting about that story, and I'd love to know specific examples, but it fits very much with other stuff. What I find interesting is that the fear with the Googles and Microsoft of the world isn't that they're trying to make money, but they're trying to shape their future workforce in a certain way. And I think from what you're saying, and also other things, I think that's probably less so.

Teacher: Yeah.

Interviewer: What's interesting is that the exam boards, it feels like they don't necessarily have the best interests of the pupils.

Teacher: No it's recruitment. And I think that within schools, generally, the commercialization of those awarding bodies, it's a really destructive influence, but very hidden influence that they've had in terms of shaping. And really what they're bothered about is recruitment. So they want to get the numbers taking their qualifications.

Interviewer: Taking their recruitment to their qualifications.

Teacher: Yeah. So why are you gonna do the OCR course, rather than the Apple course, or the Excel course, and so on. And the fees that they then charge, and the books that they then sell, and the training courses that they then offer, and so on.

Interviewer: Well, and that matches with two things that I've heard from other people. One is around pseudo code, and how pseudo code can be this really broad thing, and is loosely defined if you'd speak to people in industry. But as soon as you get into the exam boards, it has to be very specific.

Teacher: Yeah. Well personally I think that's a really terrific example. Because if you take that 13-year-old, if you go back to that 13-year-old who may or may not have ... The Jeannette Wing thing. So, if you go back to that ... And let's forget abstraction and generalisation and [inaudible 00:21:05] and all that kinda shit. What we're gonna help him do, the 13-year-old, is clarity of thinking. So pseudo code is the best possible tool you can have for pairing an idea right back to its basics, and get you to articulate something in a way that you just bish, bash, bosh.

 And there should be no emotional overhead or stress about the particular semantics or syntax of you ... 'Cause the basic idea is, "Tell me your idea as simple as possible." That's it. Now that's something that we, as computer scientists, if we take our mission in life, and if our mission in life is to strip it down, strip it down, strip it down, until we get to the core. And then the beauty of that is you can do it in lots and lots of different ways. And we're after durable, plastic ideas, aren't we really?

 Now that's why I think the idea that the exam board should be prescriptive about that is utter bullshit. If you're a teacher who's interested in trying to foster, develop creative thinkers, free thinkers, divergent thinkers, then one of your basic tools has got to be speak it. Just speak your idea. And if you're saying to them, "What does every teenager want to do? Say as few words as possible." Pseudo code, isn't it.

Interviewer: So the other place I feel like - and you can agree or disagree with this - you can see that influence of exam boards is the influence on what languages are taught.

Teacher: Yeah, yeah.

Interviewer: They don't necessarily prescribe what languages you have to teach, but they set problems that can be solved in specific languages.

Teacher: I will say though, in defence of OCR, in terms of its qualification, the first version of it had 80% coursework, didn't it? No sorry, 60% - let me get this right - 60% controlled assessment. And they split that between, what they called an investigation and something which was a classic programing-type test. So the first one, the investigation, that was, I think, a really laudable effort to have like an open prairie or a problem. And some of them were quite specific, but some of them were quite broad-based. And some of them were a little bit off-pieced as well.

 And that was the basic idea of this investigation, was that you could go off-piece, and you wanted to encourage kids to go and do something different. So there's something about eCommerce for example, and the idea of them setting up their own online shop, and all that kind of stuff. It was quite cool really, 'cause they have to go and find a package, and all that kind of stuff. And I think there's a lot to be said for that teaching, not in a kind of bullshit bingo way, but that independent thinking, and then being able to go out, like they do on Skywhim, go out into the world and actually do stuff. They're not used to it, they're just not used to it, bless them.

 So it's kind of, they [inaudible 00:24:13], come out the castle. And they'd never go more than a mile away, 'cause they always need to get back before nightfall. 'Cause they're just scared. I always felt a bit ... I mean I know that you and I both like doing that, but we came to kind of struggle with it, because the kids do not have that robustness. But good on them for trying to do ...

 And then the next controlled assessment was a programing one. As it happens now, we've gone from 60/40 to 80/20.

Interviewer: So 20% coursework and 80% exam.

Teacher: Can't take coursework. Controlled assessment being you can do it in your own time, coursework being, do it under the spotlight, you know, high control. Which is a shame. Pragmatically, from our point of view as teachers, it de-stresses your life. And I suspect that's why they have done it.

Interviewer: They had pushback from that 80%.

Teacher: Well, yeah, we know that they did. But as a teaching model, the idea of that investigation-type thing is something that we would want to bring in the key stage 3.

Interviewer: I was saying not only earlier about the kids, having interviewed them, the things that they're coming up, as far as what will you remember in five years, which is one of the questions, it's the things that they drive themselves. It's the game, fat stuff, it's the stuff that they feel really invested in, that they immediately say ...

Teacher: I think the problem we've got with that is that there's a certain amount of ... If you're a scientist for example, and you want kids to do investigative type of work, they still need to know a certain amount of just practical stuff, how to use equipment and so on. And then they need certain feel or framework to be able to spot the data and do something useful and imaginative with the data. So we're not quite at that stage where they've got enough stuff that they know about, that they can then use that as jet fuel to go and do something else. We still don't ever seem to get quite to that sort of level where ...

 And I think, just going back to that, let me a specific example. With Google, for example, they have really cute little learning units, and so on, where they might talk about photography. And how do they do image recognition, how do they make that work? How can you give an AI, you want to say, an image, and they tell you it's a beach, or mountains, or they can do facial recognitions. Now, that would be the kind of cool things that would get lots of kids just, "Tell me how that works."

 But in order to be able to do that, they need to know a little bit about pixels, and they need to know about colour depth a little bit. So there's quite a bit to teach them before you get to the stage where they can ... So from our point of view it would be lovely if we could cram that stuff into year seven, with a bit more investigation in year eight, and a bit more in year eight, and more investigation still in year nine. But we never quite feel that we filled the bucket enough, we're still trying to fill the bucket.

 One other thing that CAS haven't done - I was talking about this at lunch the other day - have you ever come across the computer study field study guide, the one that was written by the New Zealanders.

Interviewer: No, I haven't.

Teacher: This stuff that comes out in New Zealand is absolutely awesome. I'll send you a link to this field guide. And you don't have that field guide do ya? I just printed it off, I've got my copy at home. You know the field guide, the computer science field guide, the one that's in red.

 So ,that is just the work of genius.

Interviewer: Yeah.

Teacher: Absolute work of genius for people like us who are aware that ... Like that specific example I've given you, you do want to literally, as well as metaphorically, zoom into pixels, and colour depth, and all that kind of stuff. But you also want to zoom out and ask the question how does facial recognition work? And you also want to, at the same time, ask the question do you give a stuff? Do you care? So all those questions. But the kind of from our point of view, they're dependent on them knowing a bit about the core technology. They don't need to, but we think it's rather cool the idea just how an image is stored, basically isn't it? Because you can't really understand how .... It's all black magic and weird shit isn't it, until you understand it, it's a bunch of numbers. IGB, and all that.

Interviewer: S– had a great little soundbite where she said earlier, where they realise it's not magic, it's maths.

Teacher: Yeah, exactly, yeah. That's true, but then you lose half of them again, 'cause then they're going, "Oh shit, it's maths." So you need to bring them back again. No it's not actually, it's creative, it's creative maths. And you're not gonna be ...

Interviewer: It's art, really.

Teacher: Yeah. Well, but there is an awful lot of that kind of stuff. Even the arty kids who are using their Photoshop or their Fireworks or whatever, the idea that this stuff is happening and it looks free form as though there's some imaginative thinking when they get the idea. And also the difference between [inaudible 00:29:13]. It helps them to get their head around so much in the modern world.

Interviewer: And some of the CAS documents there, there's quite a big deal about it, is that part of computational thinking? Is knowing what computers are good at and knowing what the human mind is good at. And I think that's one of those things that those aspects of computational thinking that is often lost, and particularly with digital economy theorists, they say that those are the most important skills, to be able to recognise computers aren't good at creating certain kinds of creativity. And we as humans need to get better at it.

Teacher: Yeah, sure. But as an example, in terms of the ... It's Davos this week, isn't it? And Davos last week was so big on industrial revolution, wasn't it? And the digitally comments in terms of robotics and AI and all that kind of stuff.

 Now, to get kids engaged with that kind of stuff, and to get them properly thinking from a knowledge basis of what careers are probably going to disappear and so on. And getting them to understand actually what are the limits now of machine learning, and how will that evolve within their lifetime. I'll be dead and buried dudes, but you're gonna still be here, and you're right on the cusp of something, which is as exciting now as it would've felt in 1840 or something like that. It's that much of a magical time. We're the people that they will be laughing at soon for calling them driverless cars, which is a bit like calling them horseless carriages. But we laugh at them, and people will, right at that moment now.

Interviewer: Do you think kids appreciate that?

Teacher: No. Kids are reTeacherably conservative.

Interviewer: Yeah.

Teacher: ReTeacherably. In my experience, when I ask them who would jump in the car without the driver, it amazes me always how reluctant they would be to embrace these kinds of changes. You ask them if they want a new Iphone 10 or whatever, yes they do, but do they want to do that? No, they don't.

Interviewer: But what I've heard from a number of the folk at the group interviews I've had with kids - they're all year 9-ish - is several of them say, "Technology moves too fast, we can't keep up with this. I don't understand my new phone by the time the next one comes out."

Teacher: Yeah, but I think we need to make distinct between capitalism and sales moves, too, Teachereting moves.

Interviewer: I don't think they're making that decision.

Teacher: That's why we're wrong, as schools and as teachers, not to do that.

Interviewer: Yes.

Teacher: Teachereting moves at one pace, and why? And I think them as consumers, they need to be ... We need to weaponize them as consumers, and help them to understand that their technological choices are driven by quarterly sales figures more than what they actually need, and they have more of a pause button. But that's because their parents are also saying ...

Interviewer: But do you think that we, as technology people, make the mistake of conflating that and Moore's Law? There is a degree where ...

Teacher: It's really fascinating though, you see. 'Cause when you teach the old specification of computing, it wasn't terribly morbid about Moore's Law. In fairness to OCR again, they had a bunch of teachers like us, we'd never really taken the top off our CPU anyway, just having a control unit ALU type knowledge was good enough for us.

 With this new one, we're having to do a little bit more, and learn a little bit more like that. On the one hand, that's cool, because the kids do actually enjoy it, and they like learning about it. But on the other hand, we're teaching them about, again, it's not that Water shedding technology isn't it. But to get them to see that graph, and without explaining to them shit, it's coming down, what'll happen then? And to say, "Well, when you use your phone for ages, what does it feel like?" And they go, "Well, it gets really hot, doesn't it." So you start thinking about what has that feeling got to do with this chart here?

 And if you can connect these classic ideas with their ordinary lived experience, then you get kaboom-type moments. Because they're coming in with their own solutions in their heads for why do things have to go a lot slower. Do you sweat when you run around, do you feel hot? That kind of stuff. And I think that it's finding those moments, when it's not just the gamers in the room who want to tell you about their war cool PCs, when you get the ordinary kids who think, "Do you know what, that makes a lot of sense, 'cause I don't want a phone to get that hot." We have an advantage at this school that we actually show the kids their hardware at the beginning, and I think one of the things computing people often forget to do is to show them [crosstalk 00:33:53] hold storage, and hold memory in your hand, and that can be quite a different moment where ...

 But we're still stick with exam boards. It will lack certain things about these architectures, as though there is this cannon again, established norms out there, and there simply isn't. If you try and tell these kids about ROM and RAM and all that kind of stuff, and their favourite computer just didn't use this stuff. Their favourite computer's this big and doesn't use that stuff in the way that your classical ... So why are we teaching this dinosaur stuff to a bunch of kids, you know? It's mad really.

Interviewer: It's funny too, speaking of exam boards, because the exam boards would struggle, I think, to include any hardware on any physical computer in the exam. And yet, those seem so fundamental to how things are progressing, but also engaging a wider range of kids. There are kids who handle the hardware and they light up, because it now makes more sense to them.

Teacher: Yeah, but you'd be surprised you see. I think that if you were to build a collection of phones that could crack open and hand around in the way that we used to hand around desktops and things like that. Because even kids who you wouldn't necessarily think ... They're just interested in what is inside this thing. There's a natural curiosity for physical objects really. And I think it's that magic thing again, that does help.

 Downstairs where I teach, in terms of the CAS things ... The classrooms are in my corridor, and they'll tell you about the physical world, and then the next door to it is the RE and they're gonna tell you about the spiritual world, and in this room here, you're gonna learn about how your digital world works. So whether it's the physical world, the spiritual world, or the digital world, they do like the idea when you are showing them. And again, it's about [inaudible 00:35:55]. What's that place called in Sweden where they have all the Facebook servers, [inaudible 00:35:59].

Interviewer: This is why we don't pronounce it.

Teacher: When you're showing them on a map, not just some theoretical idea. When you say, "Let's Google pictures of data centres, and let's fix this on a map here." So tonight, when you do your photos, that is gonna go over the sea somehow to Sweden, and it's gonna stay there. And you start engaging kids about the same isS– to do with Moore's Law and temperature. How come it's that, is it up there? And then telling them where the electricity comes from, and then suddenly up pop a bunch of green kids who are suddenly interested in that type of stuff. So it's not just your nerds, there are multiple reasons for engaging these kind of things, none of which are currently on that computing curriculum in terms of that wider, digital world. We're gonna help you understand your digital world.

Interviewer: I've sometimes occasionally used the term digics, which is instead of physics ... So we teach physics so people understand why things fall, and we teach digital stuff, digics, to teach people about the digital world, but remembering that that's not just Facebook. But the digital is also the physical aspect of life.

Teacher: Also, what you're talking about in terms of the intellectual tool kit that we bring to it as well. What the physicians did, and it becomes such a common place. You know [inaudible 00:37:24], that scientist guy who's often on the tele and on the radio, he has that programme on the radio called The Infinite Monkey Cage. And she was talking - just a throwaway comment, I heard it driving on the way home - and she was talking about electricity. And she was saying, "The thing about electricity is how cool and astonishing it is, and it still runs the modern world. But we've got so good at it, it's hidden away."

 And it was a very striking point, because the computing stuff, it's got so ubiquitous, it's also kind of hidden away. But you mustn't allow it to be thought of as something which, when these parents come and then they go, "Oh, he or she can do that." We have responsibility to tap into their curiosity, to file up their curiosity.

 It does work better than that. You mustn't do that.

Speaker 3: She bought me this, and she said, 'cause she keeps the good one in her room, and she gives me this one.

Speaker 4: It's too late love. What did you just do?

Speaker 3: [inaudible 00:38:27]

Teacher: So we mustn't give it up, but we must package it better. Of course, it's the hardware, and the software and all that kind of stuff. But really, it's about your understanding how your world works. And if we can package that right, then we'll definitely get more light bulbs back on in a classroom.

Interviewer: Well one of the things that I thought of when I was talking to S–, is that one of the differences between a computer and say a clock, is that a clock you can take apart, and you might not be able to get it back together again, but you can actually see how it works, you can see the cogs put together and understand that. In a computer you get down to the chip. And actually, the chip is where all the action happens, and it doesn't matter if you break the chip open, it won't be any clearer once it's open, because it doesn't reveal itself in that way.

Teacher: No. But I think that idea is interesting, that if you're trying to get over the idea to kids, like what is computer memory, and you can blabber away all you like, but you start using something like this, and they need to see something like this. And they start understanding what we mean by a name, memory location, and the idea that how many boxes told you need to store this stuff in. And you make it as practical and concrete as possible. Then you are making this untouchable, microscopic thing, incomprehensible to them. But people don't have the mental ...

Speaker 4: I will come back. I have to do a duty. I used the good one.

Teacher: No!

Speaker 3: He's gonna show you how to do it.

Teacher: You need to pop it in properly. And then you mustn't do it ever so fast. It's got to be really quite slowly.

Speaker 4: Oh.

Speaker 3: Just in too much of a hurry.

Teacher: Yeah, you are in too much of a hurry. Shall I do it sideways now? See, what you mustn't lose is the IRT.

Speaker 4: They only had that one.

Teacher: That's all right. It does work fine.

Speaker 4: They only had this one. I would've liked to buy the one we had.

Teacher: I must say, I've ripped shit load out of things like you.

Speaker 4: The recent technique.

Teacher: [inaudible 00:40:38]

Speaker 4: All right, so I'm doing bus duty. So I will be back in 25 to ...

Speaker 3: That's fine, no problem.

Interviewer: I've managed to con you into talking for 45 minutes.

Teacher: [inaudible 00:40:56]

Speaker 4: Don't get him started.

Speaker 3: Yeah, don't get him started.

Interviewer: I can tell.

Speaker 3: I'm the same way, I get going.

Interviewer: And I haven't asked you any of the questions that are actually on the sheet, 'cause we went in a totally different direction, which is fine.

Teacher: If you have to, send me some questions.

Interviewer: Well I said to S– I would send her three of the questions as well. Now that I think about it, because she did the same thing, she said, "Oh, I can only speak for three minutes."

Teacher: D–'s the same ... Well actually, no, D–'s different to us in the sense that D– is younger, and he's not a computing specialist in that sense, and it's been really, really hard him to get grips with some of these things. Just in terms of, can we just get a grid, a compass bag in here, on where we're headed for. And just tell me what the destination is. So if you were to think about how we've talked about how the internet works in that sense, in the old days we had a major problem the idea with kids the difference between the internet and the web. But these days, there are more opportunities to make that distinction more real, and actually something which is not ... 'Cause there's all kind of shitty classic differentiate that we don't mean anything to the kids. But actually, the way do that now ... It's interesting that kid mentioned [inaudible 00:42:23], because I would've thought they might've mentioned [inaudible 00:42:26] more than that. 'Cause we tend to teach it more of a package-based thing now.

Interviewer: Yeah.

Teacher: And we found if we get over the idea that ... If you're saying to somebody, "How does the internet work?" They'll go, "It takes your stuff, splits it up, let']s it go random directions and then puts it together again at the other end." How mental is that? And if you're saying to them, you've just summed up the internet dead quickly, haven't you? This was, again, one of those disruptive ideas. They were driving around San Francisco bay in a converted ice cream lolly doing this stuff. And you show them to the kids, the kids say, "We'll just Google it." Look, that's what they were doing. And you show them before computers, and yada yada yada. They get it. From the internet point of view, it doesn't matter what the data is, it doesn't care, just splits it up sends it on its way, blah blah blah.

 So then when they're talking about your Xbox, and you're playing on your Xbox, or your console. Is that a web page? No it isn't. Well what carries the data. I don't know. Well, it's the internet that's carrying your data. Or the Snapchatting, or the Spotify music and all that kind of stuff. There's more, particularly with the internet, things coming around as well. There's much more of a sense for them to get that.

Interviewer: To finish off that point ...

Teacher: What you're looking for is clean ideas. I don't really want to be fighting this battle of, is it the internet, is it the web? 'Cause it's not about that. It's about this beautiful idea that you can split something up, let it go its own random way, and put it back together again. Now that, in terms of all those abstraction, all that kind of stuff, it's all there that you can unpack at different times. But that is just a radically disruptive and paradigm shifting thought. It's amazing for them to get their heads around.

Interviewer: You could use cool activities where you take ten kids, and you give them each a picture, and you chop it up into pieces.

Teacher: Yeah, exactly, yeah.

Interviewer: And you say, "Okay, you've got two teams, and we need to assemble the picture on the other side of the playing field."

Teacher: Yeah, definitely. And we do that, we text and all that kind of stuff. And the precision with which they will fail to label their packets and all that kind of stuff. And the beautiful thing is, the poor kid who's doing the TCP job of putting it together at the other end, they go mental. It's brilliant. They're the ones who're bothering these other kids, they're the ones who are saying, "I've got some things missing." Well what have we got missing? I've got a packet missing. And some other kid will say, "Well now, my Xbox, when it says package dropped, is that what it's talking about?" He said exactly, that is what he's talking about. So there, colouring in little bits of their own world, and it makes more sense to them. The A-level people, then they learn about UDP, rather than TCP. So that's packets, but it's more tolerant, so it doesn't matter if it misses a few. For gaming, or streaming, all that kind of stuff.

 Now that's one of those things again about how they need a certain amount of technical knowledge to build ... They've got to have a few bricks to click together before they can go off and do their own thing. But the internet is a great example to that type of stuff.

Interviewer: I'm going to jump back into the questions for a second, 'cause there's two or three that I think will be really interesting to have your take on. So the first one is, what do you think is the most important thing you guys teach through computing?

Teacher: How the world works. How the digital world works.

Interviewer: And it's not the problem solving, it's not the computation, it's how all the ...

Teacher: I'm much more pragmatic than that. 'Cause I think if you can hook into how the world works, you can only explain that through that problem solving, and I think all that stuff comes out of it. I don't start with that. If we're gonna teach problem solving, what problems are we ... ICT, you are always contriving problems to show techniques.

 The biggest problem that we've got, it's not a problem, but the biggest playground that we've got is how this world works. So in explaining how the internet works, for example, out tumbles all those other problems. We have a problem that we need to get data from here to there, it's like a big elephant type piece of data, and the kids will instinctively think send the elephant in one lump. And for them to think you're gonna split the ... Elmer. Elmer, so I always use it, that's why he's there. 'Cause he's my exclusion of packets. Your idea is to send the data all in one lump. That's like trying to send an elephant all in one lump, and this guy's idea was to split it up into packets, and send bit of the elephant. And I don't want to offend any of you vegetarian tree-huggers out there, but just as an illustration of ...

Interviewer: Send an elephant across the room through a garden hose.

Teacher: So I would say is how the world works. Because that hooks them, and then you can do all the problem solving.

Interviewer: And that hooks everybody.

Teacher: It does hook everybody, different people at different times.

Interviewer: Every single kid encounters ... The digital world is part of their world

Teacher: Totally. You've shown the picture. Last summer, there's a great new story with pigeons that have got these little backpacks on them. These little backpacks, literally little square backpacks. And they fly around to bigger cities these days to take air quality readings, different types of data. Now again, as the idea of how we're gonna do this, in the old days what did we do? Well we screw things into walls or something like that. But the idea that we can use all these little data gatherers in that kind of a way, 24 hours a day. We don't pay them, the data comes back for free.

 So you show them the picture of the pigeon with a backpack on it, and two thirds, they're immediately interested. So it's a case of picking good illustrations from the ... Bebrist. Bebrist is a really good example. The cool thing about Bebrist is they have these questions which are really quite intriguing to a lot ... But it doesn't actually close the loop with why this thinking is relevant to your world.

Interviewer: Well why is there such a disconnect between Bebrist which I hadn't heard of at all, and then have come for us a bunch in the last two days. Exam boards, for example.

Teacher: Yeah yeah, absolutely, yeah.

Interviewer: It seems like they're trying to achieve the same thing. Broadly, speaking. And one of them seems to do ...

Teacher: I don't think they are though, you see. I think the exam boards are trying to pump out qualifications, get numbers on it, get an income from it, and give you that traditional rubber stamped, gold standard qualification. Bebrists are truly to do with thinking. So I think that is much more ...

Interviewer: But in some ways as well, it seems that Bebrist is almost a recognition that the exam boards don't work, because the kids that ... I was talking to [inaudible 00:49:12]. She was saying how that's used to identify kids to keep an eye on.

Teacher: Yeah, because they're awesome.

Interviewer: Both in the schools, but also by the universities.

Teacher: Yeah, yeah.

Interviewer: It's almost like it's a recognition that the current exam boards system isn't identifying the right kids.

Teacher: Yeah, yeah. Well it's not even necessarily identifying the right kids 'cause again, that's kind of ... We're not looking for interesting things popping off the end of the conveyor belt, what we're interested in is those kids as they're on the conveyor belts, thinking, "I'm pretty good at this." Or, "This is cool." Or, "This is a different way of looking at the world."

 And for them, that's what we're looking to do is ... I'm not so much interested in what the rubber stamp is they get at the end. It's along the journey, can we make their intellectual lives more interesting? There's a load of drone bees at year 7 and year 8, which is a national ... It's just a tragedy, it's just ridiculous, and wicked really that the exam board system makes these kid's lives like that. It really shouldn't.

 But my problem with Bebrist is really, it can be ... You know like some people say Sodoku, I do it, I don't do it, I hate it, it's crap. It can be easily characterised or caricatured really, it's the sign of a geek, your thinking skill thing is a bit weird. And when you go through some of these problems with the kids, a lot of them are going, "Oh God, it's as simple as that, is it." That's the way into it, because it is a different way of looking at things a bit.

 But what I want them to do, the Bebrist people, is then to link that kind of way of thinking to problem solving in the real world. It does have some practical example, it's not just some circular academic exercise. These are little microcosms of ideas which, boom, they create this amazing thing, but it's to do with a mobile phone mess, and footprints of signals, and all that kind of stuff, transmission of radio waves, the kind of stuff that they do in science. And we need to do a lot more of that here, to link what we do, with what they do.

 Take images for example. The degree to which it comes up with a RGB type thing in the computing context, but you can also talk about colour when they're doing physics and stuff like that. We need to do a lot more of that kind of stuff.

Interviewer: Colours aren't as amazing once they think ... Where really, it doesn't fit in any discipline. But there is a whole discussion about seeing them CMYK and RGB. You've got your pixels, and you've got your ink, and you've got your light, and they all act slightly differently. And why is it they all act slightly differently, and what is it we actually look, and what is it we see. All of that stuff.

Teacher: Yeah, exactly. It's astonishing. When that picture of that dress came out, [inaudible 00:51:56], but when that little picture came out of that dress a while ago and the internet went mental, those kind of isS–s are ... They're just gold dust for us teaching this kind of stuff.

Interviewer: So, before bus duty, if you had a magic wand and could change the curriculum, could either change one thing or change all of it, what would you change?

Teacher: This is key stage four that you're thinking about now?

Interviewer: Mainly key stage three, but really any of it. If you could change one thing about the computing curriculum, or you could fix it, what would you fix?

Teacher: I think with that investigation thing really, that balance between being didactic, and then allowing them to investigate and learn for themselves. It's probably we need more DIY learning. Going back to what you said ages an ages ago, about if they ... It's not exactly teaching it for themselves, 'cause we need to take them to it. What I like the idea is that, you're in the wall garden, at stop, and we do a really good job in the wall garden, but they are absolutely busting to get out of the wall garden then, and they can genuinely explore for themselves, can they?

 It's that sense of breeding that curiosity and that independent thinking, and then they can go off and do their own work. I think they are curious, though, about how their world works. They genuinely are. Simple things, how come Netflix knows what you want to watch? How Amazon know what you want to buy. But the idea of helping them understand machine learning and AI and all that kind of stuff ...

 Let's go back to that field study guide, you should Google it. Computer science field study guide, written by these people, these guys. And the lovely thing about it, it covers all the areas that we want you to cover, and you look at the difference between that in terms of the tone, the type of language, the whole intellectual framework for it compared with an exam board textbook, and it is night and day. And the field guide pictures it just right, both for teachers, who are a little bit nervous about their subject knowledge, it helps them get their head around things. And the beautiful thing is it shows how things link together. I think every computer teacher should be given a copy of this field guide.

Interviewer: I was interested in what they do at New Zealand, 'cause they came up ... it was people in New Zealand that came up with the CS unplugged ...

Teacher: Yeah, exactly. It's the same people.

Interviewer: Is it the same people?

Teacher: Yeah, yeah, yeah. And we're very lucky in the sense that we're just always banging on about these guides. Banging on in a good way.

Speaker 3: Let the poor guy off.

Interviewer: No, no, no.

Speaker 3: He's an absolute legend in lots of ways. [inaudible 00:54:58]

Interviewer: I don't think I'll be able to get over the idea of R– as the Fidel Castro of CAS.

Speaker 3: Oh, absolutely. Actually, no, 'cause Fidel Castro then went on to lead an organisation in the kind of mainstream.