Teaching Methods: Inquiry based learning with Professor Simone Reinhold

AUDIO

Jo Earp (/authors/jo-earp) 05 October 2017

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Jo Earp: In this episode of Teaching Methods we'll be exploring inquiry based learning. I’m here with Simone Reinhold, Professor for Primary Mathematics Education at Leipzig University, Germany. She’s in Melbourne working with Dr Ann Downton and Dr Sharyn Livy at the Faculty of Education at Monash University and has just delivered a Dean’s Lecture on the topic of inquiry based learning in a primary school context.

JE: Professor Simone Reinhold, welcome to Teacher. Now, at the end of that lecture that we mentioned you asked teachers to ‘stay curious’ and we’ll come back to that a little later. But can you start by explaining what’s meant by inquiry based learning, and I’m thinking particularly in a mathematics context in primary schools?

Simone Reinhold: Inquiry based learning should always start with a challenging task. This means that the teacher should not just choose any exercise, and it’s not only about doing exercises to become faster in calculating, or to get quicker at delivering automatic responses … it means that in the start you have a problem and you’re challenging somehow, a new situation that the children are not familiar with. So, there should be something special about this situation, something new. Most often the teacher will just expose this problem to the children – not even commenting on details or giving little hints for a strategy, just expose it.

The children, as a first step they should explore what’s [been set]. They should try to think about “what’s the mathematics in it?”, and “can I try to find some examples in it?” … just go for a first exploration. Then try to discover patterns, for example, that
you can find in a special task or features of a specific setting. So, for example, you could think of even and odd numbers – a great one. If you want to display those even and odd numbers you could maybe choose little cubes. You’re forming rows of cubes and bringing together those two rows of cubes would show you that, in the end, when you add two even or even two odd numbers, this will always turn out to be a rectangular prism – so something even, in a way. And if you add an even number to an odd number that would be something different, that would be something not looking like a rectangular prism for example. So, this could be a discovery by just doing something, by just exploring this material and finding out new knowledge. You find new things that you’re not taught, but you discover by yourself.

The next step then would be to justify your findings. For example, to answer “does this always happen?”. Take any even, take any odd number, what happens and how can you justify that this does always happen?

Another step would maybe then be to argue by means of finding ways to display this – for example, with the material, or do a drawing, or set up a number of equations, or something like that to prove what you’ve found.

JE: So, build an argument then however you choose to do that?

SR: Yes, to do that. Not on the level that a mathematician would do that, of course not, but on an appropriate level that kids may reach.

JE: So we’ve gone through a series [of steps] … first the exploration, then the discovery, the reasoning and justification of those findings. There’s a documentation of that as well isn’t there. Again, that’s really open isn’t it, it depends how the students want to do it.

SR: Yes, and it always depends on the task of course, and it depends on the material that you provide. It could also be that you use totally different materials. Another option for this task of finding out that if you add two odd numbers there will always be an even number, you could also find out by writing down lots and lots and lots of equations, for example, and having a closer look at those. So, there could be different ways of finding out using this material, that material, that way of documenting your findings, and your way of exploring this idea.

JE: You’ve been a teacher in Germany and you’re now a Professor at Leipzig University. How common is inquiry based learning in German classrooms?

SR: I’d say the idea that children are, in a way, responsible for their own learning has a very long tradition [in Germany], going back to the reform pedagogy in the 1920s.
This inquiry based learning also stems back to the theory of Discovery Learning introduced by Jerome Bruner in the 1960s.

When I was a young teacher in 1990s I was strongly influenced by the work of Heinrich Winter, Erich Christian Wittmann and Gerhard Müller – colleagues that I mentioned in my Dean’s Lecture as well. They used to be professors and researchers at universities in North Rhine-Westphalia, which is a state of Germany. Especially the *Handbook of Productive Exercises* that they launched [in 1991-1992], that was something that struck me back then. It was full of those wonderful exercises that they introduced for us as young teachers and lots of material that provided us with some of these challenging tasks that I just mentioned. Lots of beautiful arithmetic and also geometric ideas that they spread over the country in a way. From then on, this has strongly developed throughout Germany, maybe not in every little school wherever you go. But, since 2004 we’ve had new German standards for mathematics education in primary and in every federal state there is a curriculum that relies on these standards. And actually teachers, they should try to find ways of implementing inquiry based teaching in their classroom, because those standards want us teachers to teach that way, they say it explicitly …

**JE:** We know that student achievement levels in any one class vary wildly, the most advanced students in any year of school are typically about five to six years ahead of the least advanced students in that year. In your Monash lecture you talked about the benefits of IBL (inquiry based learning) in terms of differentiation. Can you expand a little on that?

**SR:** This term ‘natural differentiation’ that I tried to translate from German to English [in my lecture] means that you have one task for all children, you have one framing for the whole lesson. Starting with this one task, you have a low-level entrance for all. So, all children in class should work on the same idea, yet working on different levels, which means that there might be some who find more elaborate ways of documenting, or they find various strategies to solve a problem. Whatever might be different it’s all okay in this one classroom situation. It’s the teacher’s job then, in a way, to find ways of encouraging the kids to maybe move on and find another variation and do some more work about it.

What is important for me is that … differentiation in this sense does not mean that every child is going for something totally different and you never know what your neighbour at the table does, or what your friend does, but it’s working on the same issue, it’s working on the same topic, it’s working on the same task.

**JE:** So, actually just choosing that level of task where they can all enter is
important. Coming up with the task, I know some teachers struggle with that. In terms of another approach then to do with differentiation, that would be to devise a different task for different groups of students and give them all something slightly different. But, what are the benefits of working on a common idea or task then?

SR: I think that we live in a society where we need to collaborate. I think that learning also is very strongly influenced by being forced to negotiate with others about your ideas. It’s clarifying concepts while you try to explain what you’ve understood, or if you haven’t understood anything (that might also be the case). This is something we always have to keep in mind when we’re teaching in general, I think, it’s not only about maths education. I think in all fields, in all domains, in all subjects we should think about this.

We go to school in classes of 25 or 30 children, or so, not only because this is a simpler way of organising it but because social learning is a very important issue in general. So, that’s why I think it’s very important that we keep this in mind for maths education, which is something that you could do in your own room at home, you could do most of the things at your own desk at home, but the benefit you have from this social setting is that you’re forced to, for example, justify your findings at the minute. It’s not that you calculate and do your things. Working with a partner, working in a group, forces you to tell explicitly what you’ve thought about this and this and that, and why you think this is true, or why you think this strategy doesn’t work.

JE: So, this social learning in the classroom and the exchange of ideas as you’ve mentioned there. What we’ve not talked about a lot actually is the role of the teacher in this. They shouldn’t really be sitting back and let students ‘discover’ everything for themselves should they? You’ve spoken about finding that balance, which is tricky, between explorative and informative learning. What would be an example of that?

SR: Exploring mathematics or discovering patterns in mathematical structures is a wonderful thing to do, but you can’t discover, or rediscover, or invent [everything] because that attitude might also hinder a good conversation you might have about something. Let’s think of geometrical shapes, for example. You could discover, for example, properties by comparing shapes or finding out that eight cubes can be assembled to a bigger cube, or to a rectangular prism. You can explore and discover all this but it doesn’t make sense to invent, for example, new terms to name a cube or a prism in another way. You could call it a brick, you could call it a box, or la-la-la-la-la, but that doesn’t make sense because in the end when you want to get to any
conversation about your findings you need a common language and you need not only vocabulary but maybe also phrases that you may use in special settings. That's the part of the teacher, to support this, to clarify, for example, vocabulary, the use of terms, or to introduce correct mathematical language. That's what I'm thinking of when I talk about there being an informative part. You couldn't just do anything without using any conventions, I think.

JE: Finally then, let's return to that message that I mentioned right at the beginning. At the end of your lecture, you invited teachers to 'stay curious'. As I mentioned earlier, you've worked as a teacher yourself, your role now is in the area of research and education of preservice teachers. You feel we need to be preparing them for inquiry based learning by sparking their own curiosity don't you?

SR: That's my mission. Actually that's the reason why I became a researcher, because I'm so curious about how children are learning, how they acquire knowledge, and how they develop throughout this special period of time in their life. This is so fascinating to see and I wish we could get young teachers to find this way of looking at children's learning so fascinating as well. ... You have to stay curious about what kids are doing, otherwise you will miss finding out where they have misconceptions or if they have improved in a special way, you will miss all this and just go for the assignment or the assessment at the end of class and say 'well, this went wrong' and 'that went wrong' but you'll never know why.

JE: It's been fascinating speaking with you today, Professor Simone Reinhold, thanks very much for sharing your expertise.


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Professor Simone Reinhold encourages teachers to 'stay curious'. Think about a recent lesson or unit of work you've taught:

What misconceptions did students have? Did you share and explore these in class?

If things didn't quite work out as you'd planned, why? How will this inform your future planning?

References