# The Seedling: STUDENTS' PERCEPTIONS OF SCIENCE EDUCATION

DR SIMON TAYLOR writes about close encounters with student learning in Year 9 and 10 science classrooms.

What is learning like in Years 9 and 10 science from a student's viewpoint? What is really going on? Let's take the opportunity to get up close to their learning world.

My current research examines the perceptions of secondary students – how they see learning in their science lessons. This article centres on what we as teachers can learn from student voice, how personally relevant learning contexts used in lessons were particularly significant for Māori and Pacifica students, and how established collaborative practices influenced student engagement.

A key feature of *The New Zealand Curriculum* places emphasis on teacher actions promoting student learning in the 'Effective Pedagogy' section (Ministry of Education, 2007). It's been in the spotlight in the professional learning and development initiatives over recent years where there is importance on creating a supportive learning environment, encouraging reflective thought, and enhancing the relevance of new learning for students.

Year 9 students at Te Waha o Rerekohu Area School.

However, what kind of learning do we want to promote for our students in our science classes (as well as for ourselves as science teachers)? How should we go about making changes to the way we teach science that embrace effective pedagogy described in the curriculum? One major factor that emerged from an extensive study in New Zealand directed by Graham Nuthall was that the power of peer relationships and teacher interactions directly shaped student learning experiences (Nuthall, 2007). Furthermore, Science Capabilities (Ministry of Education, 2014) have been identified from the Nature of Science strand in the *The New Zealand Curriculum* to promote the concept of science citizenship. Students are urged to bring a scientific perspective to decisions and actions.

They are encouraged to:

- work collaboratively both with their peers and their teacher
- reflect on why they are learning about a topic
- challenge views using evidence
- ponder the validity of experiments
- share their developing ideas with their classmates
- use their scientific understandings to make decisions
- take actions in social and cultural contexts.

These are challenging propositions for science teachers of 21st century teenagers. Importantly, these descriptions imply that learning is inextricably linked with the social encounters of science activities in the classroom. For example, if students are required to share their developing ideas with their peers, then what matters is how they do that and what the students extract from the experience. Their experience of the activity shapes their learning (Nuthall, 2007), and if they have the opportunity to evaluate and reflect, these can be helpful levers to go on and ask further questions. To find out how students experience science in the immediate learning environment and measure what actually happens in science classrooms through their eyes could help teachers further unpack the Nature of Science strand. Perhaps there is a danger to rush to list strategies and construct methods with these specific capabilities in mind, so let's take a breath to ponder the world of the teenager in science lessons.

## The research

This research predominantly focused on gathering student voice at the junior years of secondary school, collecting descriptions from a wide range of classes and using a quantitative student survey, learning drawings and student interviews to measure this. About 950 Year 9 and 10 secondary students in 41 science classes attending schools situated in the central North Island were invited over a period of three years to share their perceptions of what science learning was like in their lessons. The following comments are a brief and introductory interpretation of four themes (student perceptions) that were highlighted:

*Shared Control* titled as 'Learning to learn'. This is the extent to which students are being invited to share with the teacher;

take control of the learning environment, including the articulation of learning goals; and design and manage learning activities – this included practical experiments, and the determination and application of assessment criteria.

As teachers we can empathise with the metaphor 'learners in the driving seat' highlighting the significance of students taking control of the learning, but how does this happen in Year 9 and 10 science classes? Sharing control with students is a practice by teachers that could be considered challenging (Watkins, Carnell & Lodge, 2007) because of time and curriculum content coverage constraints, particularly in secondary schools where tight timetables can reduce science to three hours per week.

Using both *actual* and *preferred* student forms of a learning environment survey, results show students preferred a far greater collaborative and participatory classroom than what was measured of the actual environment. The shared control theme revealed the lowest score (44 per cent) compared with the other three themes. See the table below for comparisons.

From results of the survey with respect to an individual item "I help the teacher to plan what I'm going to learn", on average, 39 per cent of the participants signalled that they almost never did this with their science teacher and 68 per cent of the students indicated that they either never did this or they seldom did. Thus we see an emerging pattern about attitudes in sharing control with the teacher with a large percentage of students perceiving a limited capacity in co-constructing their learning with the teacher. Preferred data also indicated a yearning from the students to work more closely with the teacher in decision-making in science lessons.

Lesley's drawing of learning in science at Year 9.

**"What is learning like in Years 9 and 10 science from a student's viewpoint? What is really going on? Let's take the opportunity to get up close to their learning world.**

### Learning about the world

*Personal Relevance*, or 'Learning about the world' was the second theme describing the extent to which school science and students' out-of-school experiences are connected, and how students make use of their everyday experiences as a meaningful context for the development of their scientific knowledge. With this in mind, students' views of learning as drawings were collected to help the research take on more of a qualitative measure, with emphasis on personal relevance.

"What students see in classrooms has an influence on the way they understand learning and especially learning in school" (Watkins, Carnell & Lodge, 2007, p. 27) and one way to examine these comprehensions is to invite students to draw learning. However, learning is not an object but a process and this can pose a challenge to students when asked to draw the learning in their classroom. The test in drawing a process such as learning involves thinking about abstract concepts. Sarason (2004) notes the term 'learning' is not like the words 'boat' or 'water', or 'rocket', which have visible, concrete meaning. In making these pictures, students do not merely represent what they see, but they do consider aspects, like for example, their position, size and image of the teacher, the physical nature of the classroom including what is written on the board, the cultural images, scientific contexts, social interactions and sometimes they include speech bubbles with written words describing their thinking. It is understood that drawing is much more than a simple representation of what one sees. The act of drawing and the production of a visual summary of experience can be a powerful mechanism in making sense of the experience where Milne (2008) assures us that children use drawing to grapple with the meaning and purpose of their lives.

The following question was posed: "What does learning look like in your science class?".

Students were invited to compose their drawings of the science lesson on an A4-sized piece of white paper. All the drawings were unique – there no drawing was identical to another, and the majority (97 per cent) of all the students portrayed classmates in their pictures. This suggests that most students perceived their learning in conjunction with other classmates and most (74 per cent) had specific details of classmates and/or teacher (e.g. facial features, hairstyle, clothes). Most (71 per cent) of the drawings depicted a teacher somewhere in the picture and 14 per cent of the drawings presented the teacher as the central figure in the room. What was surprising was that only 37 per cent of the drawings had specific details indicating science was taught there (scientific apparatus, science terms on the whiteboard) and in terms of >>

### STUDENT LEARNING ENVIRONMENT SURVEY

**"WHAT HAPPENS IN MY SCIENCE CLASSROOM?"**

A summary of mean values across themes over three years, N=689.

| THEME | STUDENT PERCEPTIONS ACTUAL MEANS % |
|---|---|
| Shared Control | 44 |
| Personal Relevance | 63 |
| Critical Voice | 66 |
| Student Negotiation | 69 |

**Key:**

| | | | |
|---|---|---|---|
| 0-20% | Almost never happens | 41-60% | Sometimes happens |
| 21-40% | Seldom happens | 61-80% | Often happens |
| | | 81-100% | Almost always happens |

Year 10 students at Mount Maunganui College.

personal relevance, there were very few (7 per cent) drawings depicting learning about science outside of school, such as current events or personal interests that were linked with science. In addition to the learning drawings, there was high statistical significance in the quantitative results with respect to personal relevance and ethnicity. In comparisons, the New Zealand European students showed higher perceptions of personal relevance in science lessons with a mean of 64 per cent, compared with New Zealand Māori (60 per cent) and Pacifika (55 per cent) students. One of the items in the survey, "My new learning starts with problems about the world outside of school", revealed a high proportion of Māori and Pacifika students signalling that rarely this happened. In the interviews that followed, some Māori students spoke candidly about the importance of personal relevance in their lessons, so that they could link their world outside of school to what was happening in their science lessons.

Personal relevance in science classroom activities has been seen as a significant link to positive student engagement (Bolstad & Hipkins, 2009) where students can begin to sense that their learning about science is inseparably connected with their real world and this happens not just at school, but at home, when they are at the skate park, playing netball, having dinner, etc. However, what is not sometimes observable to students is that these connections between the science activity going on in the classroom and the real world context are not clearly demonstrated or deliberately emphasised. Authentic contexts such as these may be implied in science teaching but can often be lost in the everyday business of laboratory activities. Time for reflection and discussion on the purpose of the topic can also be easily forgotten because of time constraints. However, it is this very process of reflection with peers that could make the difference in drawing students further into their learning, so that they could feel greater personal involvement and commitment.

In the student interviews, a question was asked: What kind of topics would you like to study? Students spoke of a desire for out-of-school relevance in their lessons and with particular interest in their family and in sport. Here are some short excerpts from different Year 9 student responses.

*"I'd really like to learn about Egypt, pyramids and mummies. I like the science mysteries. Me and Mum have this scrap book and we've collected cuttings and information about mysteries, lost civilisations, ghosts..."*

*"Rugby and sports, touch rugby. I like to know about fitness, how to keep fit. My dad has a fitness coach that tells him all about the body, diet and how he can keep strong."*

Some students were keen to debate ideas with their peers and take the opportunity to look at both sides of current environmental issues, such as, for example, oil drilling, sand mining and protection of natural resources. Some female students spoke passionately about their delight in debating ideas with their peers and had strong opinions about animal ethics.

Here is an excerpt from an interview that highlights this

*"We speak our minds. I like this. I'm not embarrassed if I don't know the exact answer. I like teachers who ask us questions and want to find out our opinions."*

Some Māori students spoke about being frustrated in their science lessons; not engaging with them at all because they saw little chance in being able to talk about things that they were personally interested in as the topic at the time did not fit with their interests. They felt that, at most, science lessons were pre-determined and they did not want to embarrass themselves or others by attempting to make changes to the programme.

*Critical Voice* titled as 'Learning to speak out' was the third theme. This focused on the extent to which a social climate had been established in which students feel that it is legitimate and beneficial to debate ideas and voice their opinion in class. In the 67 interviews that took place, a pattern that prevailed in most was that students spoke of the general freedom and autonomy they had in speaking out in class. It was encouraging to hear most (but not all) of the students interviewed, responding positively to the way their teacher encouraged them to speak out in lessons. Apart from a few exceptions, overall their voice was valued and they felt comfortable asking questions of the teacher and calling the teacher for their attention. However, some students remained uncomfortable about challenging the teacher about the way they were taught. Some felt okay talking about operational tasks but in terms of explaining science ideas openly to others they were much more hesitant. Many students spoke enthusiastically about when their teachers used a range of learning strategies, because they were engaged for longer. They said that there was more opportunity to enjoy science and speak up in class if there was a mix of different tasks in a single lesson. Some students spoke of wanting a greater choice in *when* they would do the activities in the lessons. Some students said they were hesitant to discuss their personal scientific queries because they thought they were not associated with the topic they were studying at the time.

*Student Negotiation* titled 'Learning to communicate', examined the extent to which students have opportunities to explain and justify their ideas and to test the viability of their own and other students' ideas. This theme had the highest actual mean score (69 per cent) in the student survey, out of all four themes.

This theme was identified as being the most preferred and valued across all classes over the three years. Nevertheless, negotiating discussion with classmates can be a challenging task for teenagers, particularly when the conversations depend on their own confidence to speak up and negotiate the next

steps in an activity. As teachers, we are well aware that there can be much activity going on in science lessons in terms of practical manipulation, methods to follow and classmates in close proximity to one another. Hence there are demands for students to negotiate conversations and keep focused on the task. We asked the question in the student interviews. Tell us about the opportunities you get explaining ideas in a science lesson? Many of the responses described how students initiated discussions by actively seeking and forming a group where they could have more opportunities to talk about ideas than if they were on their own. Some students felt overwhelmed with a science lesson in terms of completing the written work if there were minimal co-operative strategies in place. Here is an excerpt from an interview that highlights this:

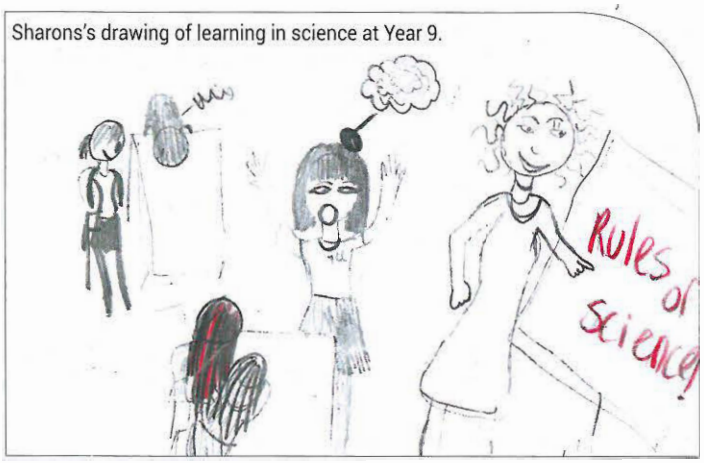
*"Most of my answers I write down from my head. Sometimes the teacher talks too fast and I don't understand. So I ask my friend about how to do it. She breaks it down for me."*

Many discussed how, if there were no groups set up by the teacher, they would purposely develop a collaborative structure with other classmates to help each other. Another feature of the student responses was that forming a group or being in a pair meant students could have the ability to shield distractions from other groups. Nearly all students in the interviews appreciated working on science activities in groups, saying they could share the load, bounce ideas around and that they had greater confidence in speaking within the group than in a whole class discussion.

The following excerpt highlights this:

*"When we are in groups working on something, we have more power over what we can do. I know the teacher thinks he's the boss but really we do what we want. We talk about it together and we do it a lot quicker. We kind of plan out the different things to do, while talking. We share the load."*

Year 9 students at Morrinsville College.




Sharons's drawing of learning in science at Year 9.

Many valued some time to talk about things other than science that were concerning them and this was the way they liked to work most of the time. Some (13 per cent) of the learning drawings portrayed the student directly interacting with the teacher. Half of the drawings portrayed student discussion, movement in the classroom or there was a sense of social negotiation going on in the picture. As stated, 97 per cent of all the students portrayed classmates in their pictures, indicating the importance of classmates in their science learning. There was little evidence from the pictures of the act of planning the learning between students or of the students operating together with the teacher in working/planning together. Fourteen per cent of the drawings presented the teacher as the central figure in the room and in larger proportions compared with the size of the student images. These pictures portrayed the teacher situated at a distance from the students.

## Conclusion

The world of the 13–15-year-old students in this research is dynamic and particularly responsive to social presence, personal relevance and sharing control with the teacher. The students preferred less dependence on their teacher and much greater shared control in the lesson. Activities where the students themselves could manage the work and make decisions about problems were considered fun and engaging. Much of what these students do in science was determined by their social relationships and the drawings highlighted the importance of social negotiations. There may be increasingly more emphasis for students to learn about real-world issues but these students were signalling that this rarely happened. How the choice of topics where personal interests were used as contexts did matter to these students. Collaboration in the groups transpired when the classmates had the opportunity to form groups, share ideas, and reflect on the reasons why they are studying a particular topic.

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