

## Case Study CP802: Street Luge

### Abstract

**Reference:** Case Study CPM 802

**Classroom Practice:** Year 11 Materials Technology

**Title:** Street Luge

**Duration:** Whole year

**Teachers:** Steve Andrew, Lawrence Manders, Michael Johansen

### Overview

Street luge is an extreme sport that involves riding a wheeled sledge or 'luge' down a paved road or course in a lying position – speeds of up to 115km/h are often reached. St John's College-Hamilton Technology teachers, Steve Andrew and Lawrence Manders, and Morrinsville College Technology teacher Michael Johansen jointly developed a luge unit, which involved their Year 11 Materials Technology students each designing, building, and race-testing a street luge. The unit was successful in meeting all its objectives: students were drawn to the challenge and met it using good technological practice; teachers enjoyed the obvious pleasure the unit gave students and the way it resulted in good learning outcomes.



### Focus Points

- Collaborative planning and delivery
- Careful choice of context
- Student engagement and motivation
- High-quality outcomes

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### Background

[St John's College-Hamilton](#) is a decile 7 state integrated secondary school for Catholic boys with a roll of about 670 pupils.

[Morrinsville College](#) is a co-educational decile 6 secondary school with a roll of about 680.

Technology teacher Steve Andrew originally qualified as a motor mechanic and, after working in the automotive industry for a number of years, moved into teaching in 1989. He started teaching Workshop Technology, and felt comfortable making the transition into Design Technology courses because of the freedom it gave teachers and the ownership it gave to students. With the advent of the new Technology curriculum, Steve focused on giving all boys at St John's College access to programmes suited to their own particular needs and aspirations.



Michael Johansen also has a background in automotive mechanics. He completed his apprenticeship in Hamilton and worked as a mechanic in the city before shifting to Australia to work on heavy machinery in the mines. After completing his teacher training at the Waikato Teachers Training College in 1999, Michael joined the staff at Morrinsville College. Today he teaches Year 9-11 Technology, Year 11 and 12 Engineering Pathway.

At St John's, there are two Year 11 Technology classes of around 20 students doing similar programmes. Most of the students come to the course via a half-year compulsory course in Year 9 and an optional full-year Year 10 programme.

At Morrinsville there is one class of around 20 Year 11 students. Students start Year 9 with a half-year option with a full-year option by Year 10.

Steve and Michael had collaborated over four or five years and shared a number of junior programmes. One of these involved having Year 10 students design and build a snakeboard (a kind of skateboard). They had both run the unit over the past four years.

At the end of 2006 one of Steve's pupils suggested that building a street luge would make a good school activities project. The idea stuck in Steve's mind, and he mentioned it to Michael and Lawrence, who agreed that it would make a tremendous basis for a teaching unit. "We had a look at some of the material on the internet and we decided 'that's us!'"

The attractions of the project were obvious – the project was hands-on, would interest the boys, grab their imagination and give them a thrill. Michael liked it, and, as he tries to get his students to do projects that he finds interesting himself, the idea was a winner.



Nothing the teachers saw on the internet suggested producing a street luge would be beyond the capabilities of their students. Furthermore, a safe (but exciting) venue to test the students' creations was close to hand. About 20 years ago, Hamilton City Council had built a luge track for a local team keen to compete at the Winter Olympics. The track had been used by a club for a while, but now lay almost forgotten. Steve describes the venue as looking like "a footpath that started nowhere and ended nowhere".

"So we had a track to race on, and an environment that we would have to consider in our technological practice."

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### Pre-planning

Over the Christmas break Steve drafted the unit, and when school went back, met with the other teachers for their input. They agreed to keep things simple, and as safe and fun as possible. A race date was set towards the end of the year, on which all the students would get together and test their luges in one massive drive-off. Race day provided an event horizon for everybody, students and teachers alike.

Some stipulations were set for the students. "We wanted to make it safe, so the best way to do that was to make them go feet first, which is in the world governing rules anyway, and we decided to limit wheel size. That also made it more achievable for the students because they could go and buy a set of skateboard wheels and didn't have to spend a whole lot of money. There were lots of second hand skateboards around."

Furthermore, the luges had to be built in the school workshops without any specialist help. Seeking advice was encouraged but hands-on help was off-limits.

The students also had to visit the luge site in Hamilton before they could start their project. "That was part of the deal. There were problems with some students who lived out of town. But, hey, these parents take them to rugby on a Saturday morning without any hassles. We gave them a couple of weeks to go and look at the track and take photos for their folders, which they used to help base their decisions on."



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### Delivery

Having established a time-frame for the unit and a few ground rules, the boys were given essentially a free reign to get on with things. With the enormous amount of information available on the internet, none of the teachers felt the need to develop much supporting documentation for the unit. On the internet students could find information on street lugging, its history, its rules, and how luges are put together – more than enough material to create their initial, revised and final briefs.

Luge design incorporates a number of consistent design elements, notably skateboard type lean-activated steering and an absence of brakes. The rules set by the sport's governing bodies (no one official body is recognised) reinforce this uniformity of approach, so the boys quickly found themselves working along the same lines. Despite this, there was still plenty of room for individual design choices.

"It was an interesting project, because luges can be made out of a range of materials. You can go for aluminium, steel, or laminated timber – they all work really well. It was important to me that students worked within the rules, but that they had the freedom to design what they wanted."

Steve accompanied his students through the development process step by step, helping out with ideas and suggesting alternative materials and processes. And because the choice of materials was critical to the development process, Steve asked a specialist from a local metal supply company to talk to the class about the performance characteristics of materials in different forms, such as their strength-to-weight ratio, profile, and thicknesses.

"The mentor from Industrial Tubing had worked with my seniors as a mentor the previous year and was really keen to be involved because he'd seen street luges on the internet. When I talked to him about what we were doing, he jumped at the chance to come in and talk about materials."

On the basis of this teaching, students completed a material selection sheet, detailing what they intended to use and justifying their choices.

As development continued, Steve made some "constructions" which got the boys thinking about things they could do to extend the performance of their luges.

"One of the things that I did was to make some examples of things and, without actually saying 'this is what you have to do', left them around to stimulate their thinking. For example, I made up a laminated timber luge frame, just the spine, and I left that in the workshop. The guys that were making the timber-framed luges looked at the laminated timber frames and they thought about how they could use that in their project.

"Then I made up some joints and talked about welding processes we might use. Then I put a gusset in, just as an example for them to look at. If you'd said to some of the boys 'put a gusset in' they wouldn't have a clue what a gusset was, but if they saw one in front of them then they could say 'I know where I could put that!'"

Steve also made up a set of extended trucks and left them in the workshop. Five of his students followed his lead and used extended trucks to improve the steerability of their luges.

One of the beauties of the project, Steve says, was that in allowing students to work in a range of materials, it gave them the opportunity to capitalise on the skills they had developed in Year 9 and Year 10 as well as develop new ones. "About half a dozen or more of the boys did their Years 9 and 10 in the wood-work room and had never been in this environment before. They didn't have many of the skills that we teach here, such as welding, or lathe-work. But that didn't really worry me because on the website I saw laminated timber luges that fitted in well with what they'd been doing. So I knew that these students would feel confident that they could have a good go at the project."



Many of the students at St John's had done Year 10 Technology, which involved building a skateboard. This had introduced them to many of the skills useful in their Year 11 project where they now had the opportunity to combine materials, thereby expand their skill/knowledge base. For example, the boys working in wood saw that by learning a little MIG welding (or whatever they needed to do) they could use steel to make things like footrests and combine them with a wooden body.

At Morrinsville, senior Technology is taught as an integrated package, a continuum of lessons and projects students progress through, accumulating practical skills and theory as they go. Year 9 students spend two terms designing and building a land yacht out of aluminium plate; the following year, students build a 'snakeboard' (a type of skateboard). The skills the students gain in these two projects prepares them to take on the more demanding Year 11 project, Michael says. "When they get to Year 11 they can use all the tools in the workshop."

Although the internet provided a lot of very useful design information and leads, the boys were required to model their designs and test them before starting in on the full-scale product so they knew that they would work. Wheel-bearing and steering assemblies were modelled and tested. Ergonomic testing showed some students that they would be uncomfortably close to the ground when riding. "One of the things we really focused on was keeping things simple, because everything we saw on the internet was simple – it didn't have to be complex. I think they've learned that lesson – the simpler the better."

Steve had one of the school's science teachers talk to his class about the physics of the project, outlining what friction, gravity, and momentum were and how they would influence the performance of the luges.

"I probably did a bit more science because I felt that was important. The other two teachers started the practical side before I did, but that didn't worry me too much. As a class we talked about friction and went outside and tested things, ran things down the hill, and the boys came up with their own conclusions. I didn't say 'this is the answer' and tell them to write it down. That's what I liked about this project: I was able to do a lot of teaching without giving them the answers."

The boys used material from the internet, their own notes, and digital photographs to document their projects. Steve set a series of deadlines to keep the boys on track.

"Most often I would not let students go onto the next stage unless they had completely finished something. For example, I said: 'If you haven't identified your safety equipment by next Wednesday you won't be coming out to the track to race' and that worked perfectly. There were a number of definite stages and for each I would set a deadline, and each time 99% of them would meet that deadline, because they were bursting to get onto the next part. I had it all documented on my laptop. I didn't mark their work at each stage, but I did record that they'd finished and met the deadline. And a copy of all the deadline dates was up on the wall to remind them and to get ticked off."



Michael formed his students into 'design groups' of three or four. While each student developed and built their own luge, Michael had them sometimes come together into groups to throw ideas around. This sharing of ideas allowed the more able students to 'drag' the less imaginative forward (or point out potential difficulties). "Some students came up with really off-the-wall ideas but their mates reigned them in. In a lot of ways, they were self-regulating."

To track progress, the three teachers met once a term and exchanged folders, which all turned out to be fairly similar in structure.

The inevitable pre-race day rush set in early, two terms out from the set date, and lunchtimes became very busy in the workshop.

"The students came in and I couldn't get rid of them, and Lawrence's class was just the same. The good thing about working together is that we could share the lunchtime supervision and that took the pressure off a bit. But of course you naturally want to be with your kids all the time in case a decision is made that you're not happy with."

On race day, the materials specialist who had spoken to the St John's students came along, with another engineer, and presented some trophies they had created. "They walked around and looked at all the carts and picked out a first, second and third, and we had a little presentation. They'd made up their own criteria such as finish, functional design and safety for the pilots."

An important design criterium was adjustability – making sure the luges could be used by other people besides their creators. On race day, students took turns riding each other's creations. As part of the evaluation process, the boys processed their race-day feedback.

The boys had three weeks after race-day to complete their project documentation on their developmental and workshop practice. They were also asked to comment on the knowledge they gained and used, analyse their specifications versus finished project and comment on how well the final outcome worked in practice

For the evaluation, the three teachers jointly developed a form. "We wanted them to go through some of the decision-making points – were the right decisions made?" says Steve. "They knew very well whether they were or not. We wanted them to comment on how good those decisions were. For example, the boys were asked to consider the wheels they chose for their luge: Were they appropriate? Was the driving position appropriate?"

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### Outcomes

At the end of the year, the three teachers jointly developed an evaluation of the project, which showed that all of the original teaching aims were achieved. "We felt the project was very successful," says Michael. "Students had a great day and went back to school pumped which had a very positive effect on the then Year 10's. We felt it was important to keep the fun aspect in the day. We couldn't see any reason for major changes and the students were definitely able to get merits and excellences in their NCEA assessment. At both schools, motivating students was not a problem."



Almost all students produced a successful end product. For example, only two out of Steve's class of 24 not completing (one left school and the other left Technology). The outcomes achieved were of generally very high quality. "There was real quality in the design. Students had thought hard about their projects – a lot more than we realised at the time. A lot of the luges were similar in some ways, but then they were very different in others."

The unit demanded students take ownership of what they were doing, and this engagement was the key to its success. Students were hooked from the outset, says Lawrence. "They looked at it, saw its potential, and that was it."

Michael concurs: "It wasn't hard to drive them on. They spent time debating the merits of their designs and weaknesses in other students designs."

"The essence of the brief was getting the luge onto the track and getting down safely – and having an enjoyable day, says Steve. "I was really worried they were all going to get 'dusted' after the first trip down the track, especially if they touched the concrete strip. But they didn't – they ground and skidded along, and made all sorts of noises, but most of them were still racing at the end of the day. By about 2 o'clock we might have had about six luges broken – six out of 40. There were a lot of repairs that went on in the pits all day – adjusting trucks to get lighter steering or heavier steering and changing wheels."

"And they did all that on their own all day, because we were doing the timing and taking photographs. From half-past nine when we arrived until half-past two when we left we didn't have to talk to one student – they were just up and down, up and down all day. They were totally engrossed in what they were doing and didn't have time to muck around. We thought that by noon they might have been sick of it, but even those who broke their luges were still involved, trading bits and pieces with others. I took a tool box with me, with lots of bits and pieces, and that was well used."

Michael says he was amazed on race day to see how similar the luges were but, at the same time, how different they were as well. "The Morrinsville boys made their own steering units, while the St John's boys modified skateboard trucks."

Steve admits being surprised at just how well the luges worked on the track, especially since the fastest luge over the 250-metre course was clocked at 37km/h. "It goes right back to all the research that was done and how well they'd made their design decisions."

Students took a large measure of responsibility for race-day organisation. "We'd covered safety, so we were pretty well organised when we got there. Students had to identify the safety equipment they were going to wear and they brought all their own safety equipment with them."

The structure of the unit contributed a lot to its success. While allowing for a lot of individual creativity, it required students to work within well-defined parameters, and this allowed the unit to be controlled and managed with a very light touch.

Steve has always been a fan of students pursuing their own projects.



"That's the way to motivate students, because they love the freedom of owning their project. "But with growing class sizes at St John's, this freedom is a luxury that he can no longer afford. "We can't physically do that any more, with the amount of kids that we've now got and the number of classes."

The luge unit offers a happy compromise between freedom of choice and ease of management. Students have the freedom to operate within well-defined parameters. "Generally there were a lot of similarities between projects because of world governing rules, but there were lots of differences because of the individual input that was allowed. So it's a good example of a teacher setting up the development structure so that students have enough structure to know what was expected, but enough freedom to 'impose their own personality' on it."

The unit encouraged students to access knowledge essential to their development work. Steve was unconcerned that a lot of information in student folders came straight off the internet: "...that's fine if they show how they've used it."

The unit was structured so that it need not be demanding in money terms. Many of the boys cannibalised old skateboards for components. Others bought \$25 skateboards from the Warehouse.

Working with another teacher at another school was interesting and it worked out well, Steve says. Seeing how other teachers approached things had a positive impact on the individual teaching strategies used. "Sometimes you can be a bit narrow-minded operating on your own, but when you've got other teachers feeding into the same project that can really help develop your thinking. "

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### What next?

Both schools are repeating the unit with minor changes. Steve plans to simplify the unit a little and make it more efficient by streamlining the construction methods used: "Maybe instead of cutting and welding, we might use pipe benders a bit more – things like that."

He also may steer away from using aluminium, because of its expense, and make more use of laminated wood. "I think we could do a whole class of laminated timber luges. We ended up with three this year and they looked really nice and were a lot softer ride, which the boys really liked."



Steve is keen to push the functionality of the designs. Speed is an obvious measure to gauge progress.

He also plans use his first generation luge builders to mentor his next class. "We had material suppliers in to talk to us, but there are no local luge experts, although the boys did talk to people overseas on the internet. But next year I've now got a bank of local experts – and that's my Year 12s, who can come in and talk to my Year 11s. They're the closest I can get to local experts."

And he intends to pay more attention to how his students follow-up on their modelling and testing. "We need to make sure that we stick with the decisions that we make. Some students did all the wheel testing, but for their final product, they'd just put on the wheels they had at hand. The ones that won the race had used the wheels they had identified in the first place. That's where my 'excellences' came from – the ones that have stuck with the decisions that they've made."

While he was happy enough with the development work that was done, Steve says he intends to align next year's development work more closely with the NCEA evidence requirements. He's wary, though, of falling into the trap of teaching for qualifications rather than for learning. He's keen to keep the boys discovering things for themselves and making their own decisions rather than teaching by rote and providing all the answers.

Michael believes he has the materials/ construction side of the unit under control, but would like to fine-tune the process of documentation. He had to continually prompt some students to document their work with the workshop digital camera.

"I'm concentrating on getting the students to specify every bit of research they do and document any changes they make. They should record every single thing they do. My aim is to lift my 'merits' to 'excellences'."

Michael also plans on making good more of external experts in the unit.

"The unit is fairly open-ended," Michael says. "If it begins to pall, it could be easily freshened up by changing the focus slightly: instead of building luges to race on a prepared track, they could be designed and built to race over hillsides and farmtracks for example."

At present though, there doesn't seem to be much danger of students losing interest. Michael says the Year 10 students followed the progress of the Year 11 students very closely and started work on their own luges at the beginning of their Year 11, full of ideas and enthusiasm.