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Findings: ICT interactions and their effect on teachers' ability to innovate

6.1   Introduction

The previous two chapters answered the questions of how organisational interactions and how collegial and professional interactions influence teachers' ability to innovate. Against the background provided in these two chapters, this chapter will explore how the presence of ICTs affects teachers' ability to innovate. The chapter will analyse and describe teacher responses to the following question:

> *How do ICTs influence teachers' ability to innovate and to sustain innovation in practice?*

6.2   Innovation and ICTs

The literature review has shown the complex connectedness of interactions between ICTs and innovation. For teachers to be able to innovate with ICTs requires a focus on curricular goals, compatibility with assessment, teacher collaboration, and ongoing pedagogical and technical support. The provision of ICTs alone will not ensure that pedagogic innovation occurs if implementation is confined to adaptation of traditional teaching methods (Cuban 2001 p.134; Peck, Cuban & Kirkpatrick 2002, p.51) or because the ICTs are confined to inaccessible laboratories (Cuban 2001 p.163; Means *et al.* 1993, Ch.VIa para.2; Peck, Cuban & Kirkpatrick 2002, p.59). Time constraints, workload factors and competing educational priorities limit teachers' ability to innovate and need to be addressed (Peck, Cuban & Kirkpatrick 2002, p.53). Financial resources need to

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be balanced between the provision of ICTs and technical support on the one hand and pedagogical support on the other (Anderson & Becker 2001, p.3).

A common problem is that the ICTs in themselves are seen as the innovation i.e. they are seen as a product innovation. The innovation needs to be the process innovation that comes with their use, i.e. they need to be perceived for their innovative potential. While teachers believe in the transformational potential of ICTs, their beliefs are tempered by caution arising from their need to focus on enhancing the learning process and support student understanding (Hennessy *et al. 2005*, p.181; Baggott la Velle *et al.* 2003, p.187; Rodrigo 2003, p.120). ICTs need to become an element of the curriculum (Huffman & Rickman 2004, p.282) and the innovation needs to take place in the pedagogical practice. However, as argued by Beetham and Sharpe (2007, p.2-3), the notion of pedagogy itself needs to be reconsidered in order to link technology and transformation.

Innovative pedagogical practices promote active and independent learning; encourage collaborative and project-based learning in real-world contexts; heighten sensitivity to individual needs and diversity; redefine traditional space and time learning configurations; and increase parent and community connections with the school (Mioduser et al 2003, p.26). ICTs therefore have the potential to play their part in teacher innovation in a number of ways:

- as the medium for generative learning experiences (Hokanson & Hooper 2000, p.533) and inquiry-based learning
- as the basis for collaborative interaction between teachers and between teachers and students
- by providing access to real-world contexts
- through supporting asynchronous time and space configurations as opposed to traditional school structures
- for communicating with the wider community

In order to realise the potential of ICTs, the planning and professional development for pedagogical change as well as the provision and maintenance of the ICT infrastructure are required (Venezky & Davis 2002, p.14; Staples, Pugach & Himes 2005, p.307). As argued by Venezky and Davis (2002, p.42-43) ICTs should be seen as part of a strategy for solving an important problem rather than as an end in itself.

Considerable time has lapsed since Fullan (1993, p.vii) called for an understanding of the totality of change brought about by innovation rather than studying the innovations themselves. However, as shown in the literature review aspects of change brought about by innovation with ICTs in schools are still not fully understood (see Ch.2, Section 2.4.4, pp.68).

In order to assist in understanding how teachers innovate with ICTs at Wilding College they were asked questions in the interviews regarding their interactions with ICTs. Their responses are described and analysed in the following section which is preceded by a brief outline of the ICT infrastructure and the climate for innovation that the ICTs present.

6.3 ICTs and innovation at Wilding College

Wilding College, as described in Chapter 1 (Ch.1 Section 1.2.4, p.7-8), has an excellent ICT infrastructure that, on the whole, is well maintained, is upgraded according to a technology plan and operates optimally other than when subject to outside problems such as power failures or connectivity failures from service providers. The group of partner schools operates from a central server site. Wilding College has some 200 PCs for academic use of which 120 are configured in class-size groups in the three labs and the library, another group is in a smaller hub and each of the 30 classrooms has between one and four PCs (2009 figures). Day-to-day support in application use is available in both the labs

and the library or remotely from the IT department. Learning design support is also provided by the teacher-librarian.

Standardisation in the provision of ICTs across the partnership had a limiting effect for a considerable period of time. The school shifted to one-size-fits-all solution for ease of management and control that, in reality, did not accommodate the variety in day-to-day classroom practice at the College. However, in 2008, specialised need was acknowledged and the trend started moving towards provision of ICTs according to specific subject department needs.

Some classrooms have multi-media projectors which at the time the data was collected (2007) had to be purchased from departmental operating budgets, but which now (2009) are provided by the IT Department according to need. Security is a major concern and an added expense that has to be factored in. All PCs are connected to the Internet and each teacher and student has their own email account and allocated space on the server as well as public space on the intranet. Standard Microsoft Office software applications as well as specialised applications are accessible including Google Earth, Multi-media Science School (MMSS) and a fourth generation web-based library OPAC. Over the past two years (2007-2009) the *Moodle*[1] learning management system has been piloted and its implementation is currently being accelerated.

The *Intel Teach to the Future*[2] ICT course was significant in developing Wilding teachers' ICTs skills within the context of an outcomes-based curriculum. Unlike the Assessors course which is mandatory for all teachers, the *Intel* course was offered on a voluntary basis in 2003. The course addressed classroom practice and used an underlying format that incorporated OBE methodology, resource-

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[1] See http://moodle.org/
[2] See http://www.intel.com/education/teach/

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based learning and ICT skills and was thus able to draw different changes together. The *Intel* format has subsequently been used successfully by teachers in different departments (e.g. History), including teachers who had not done the course, but who have gone on to develop their own units of work on the same basis. For *Intel*-trained teachers, the course was their first experience of outcome-based learning design. The course had a significant influence on the approach to ICTs of those who completed it. However, most of those teachers have left the school and the few that remain are among those that integrate ICTs comfortably into their classroom practices.

In terms of infrastructure, the potential (Hargreaves 2000, p.52) for innovation using ICTs at Wilding College is therefore significant. The pressures towards innovation exist through mandated changes and in particular the effects of the new curriculum and the change to an inclusive paradigm, as well as through the demands of the students and the workplace. The teachers' predispositions towards innovation vary as has been shown in the findings of the two previous chapters. In order to establish the effect of contextual factors on their ability to innovate in practice, their predisposition towards ICTs needs to be understood.

Some schools have managed to succeed in integrating ICTs into the curriculum, whilst others have failed despite the presence of enabling factors (Tearle 2003, p.267). In the case of Wilding College, the infrastructure alone is a highly enabling factor. The next section will therefore describe the responses of teachers in answer to questions regarding innovation and ICTs in order to ascertain how ICTs as an integral part of the context have affected teachers' ability to innovate.

6.4   ICTs and innovation: introduction to the cases

In order to establish the interactions between ICTs and innovation, teachers were asked similar questions regarding innovations with ICTs specifically as they were

asked regarding innovation in general (see Appendix 3.1, Teacher Questionnaire).

Not all questions were put to each teacher in this format as sometimes teachers might have already provided much of the answer in their response to another question. In other cases additional questions were asked to assist in understanding their responses. Evidence of patterns of convergence, mutuality and extensiveness were sought in the data provided. The interviews will therefore be described in sequence highlighting these emergent factors.

Teachers were asked what innovations in their departments involving ICTs had been significant to them and why. They provide evidence of either process innovation or product innovation or the interaction of both (Ch.2 Section 2.4, p.56). Positive influences on teachers' ability to innovate, constraints that limit them as well as the information literacy aspect of ICT integration were themes common to most interviewees.

6.4.1 ICTs and innovation: the case of Bronwyn and Ineke

Process innovation in response to the new curriculum was evident from the interview with the Life Sciences teachers. Bronwyn and Ineke also integrate information literacy into their learning design process. They are enabled by the provision of relevant resources, but constrained by limited access to facilities and unexpectedly biased towards alternative technologies.

6.4.1.1 Process innovation

Bronwyn provided the example of a project which had been significant to her. Her description of the learning processes indicates her understanding of generative use of ICTs. At the same time she describes using a blended learning technique in order for the students to be able to demonstrate their understanding.

In this instance, the research project culminates in writing by hand which has a number of purposes. Firstly, students have access to and research up-to-date information which is essential to the study of Life Sciences. Secondly, they have to interpret information into a conceptual mind map to show their understanding of the relatedness of the concepts. Thirdly, they use the mind-map as a basis of the write-up which is written under open-book classroom test conditions. This means they have to apply and evaluate information in order to understand the concepts. Lastly, the technique forces students away from copy-and-paste plagiarism. Bronwyn and Ineke describe how the project unfolded:

> **BK145:** *I think that Cancer project … puts everything into perspective. Where we've gone … where the children have been taught to go away from copy-&-paste, where they have to mind-map the information they get off the Internet and then be able to understand that before answering the questions. Because, you know what the first thing is they ask me? 'Why aren't they answering their questions on the computer?'*

> **IG146:** *Yes, we made them write them out …*

> **BK147:** *That was <u>so</u> powerful.*

> **IG149:** *It helps in terms of their planning and their organising their brains and their train of thought.*

> **IG151:** *And then they … and summarising and getting key points that they're going to talk about in their write-up.*

> **BK153:** *Yes, because they can't answer the questions …*

> **IG154:** *… until they understand …*

> **BK155:** *… without understanding, because you can't regurgitate. There's no regurgitation anymore.*

BK157: … and [then we take them to the classroom where] they have to write it up under test conditions.

IG58: We marked their mind-maps, […], gave them feedback and they could bring their mind-maps to class, as well as their research and under test conditions they could sit with their information and we gave them a handout where they had to write up the information that they'd found under the headings we'd given them – by hand.

BK159: They didn't like it. They were out of their comfort zone.

IG160 &162: Completely. They hated it […] because they can't write and they can't read and they can't spell.

BK163: But some of them are getting it … you know, the [names students] … I mean it was … I said to Ineke 'It's mind-blowing what they have extracted from that small exercise'.

BK165: And again, you know, with that testicular cancer … again that was Ineke. We have to do something that is relevant to them. Because I suggested prostrate cancer because that's part of the Grade 12 syllabus and Ineke said 'no, we have to do something for them …'

IG166: … because boys of their age can get testicular cancer. It's rare, but it can start from 15 years old. And the best way of finding it is to do self-diagnosis, self-examination and I wanted them to be familiar with that procedure.

IG168: Yep, we describe that … self examination procedure.

BK170 & 174: I just said to Ineke "it's the most powerful bit of" … because we weren't involved. We were the facilitators. We never stood up and talked a thing about cancer. These boys and their answers … I said to Ineke … I was blown away by some of their answers. […] But it gives your … you know, like your [names student] … they did <u>the</u> most amazing stuff … a chance to actually fly, because they went into the detail that your … the other boys didn't do. In the end they said they enjoyed it … they didn't like the writing.

Bronwyn and Ineke are clearly comfortable with integrating ICTs into their practice and have high expectations of the students' technical skills, assuming that their students are comfortable with standard application packages. They see ICTs first and foremost as student research tools. Whilst there has been some resistance from the students, their methods have succeeded and the overall standard of attainment is exceptional. Bronwyn and Ineke ensure that ICTs are used as powerful thinking tools (Prensky 2009, p.7): in their practice it is the guided interaction with information that enhances student understanding.

The factors that have converged to meet all the criteria for innovative integrated use of ICTs in this instance are as follows:

- Bronwyn is one of the few teachers who completed the initial *Intel Teach to the Future Course* and who still remains at the school, while Ineke has had considerable relevant private sector experience with ICTs and current resources.
- Bronwyn and Ineke have an openly collaborative relationship as indicated in the continual use of the first person plural 'we'. They agree that the bottom line is that they *'get on with each other'* (BK43: Ch.5 Section 5.5.1.1, p.216).
- They have high expectations of their students and design and facilitate the learning process.
- With the interests of the boys at heart, they personalise the learning to real-world student needs.
- Their methods support the notion of *"writing across the curriculum'"* (Smagorinsky 1995, p.160)
- Formative assessment occurred between completion of the mind-map and students writing the final report.
- Bronwyn makes regular use of the school library services and incorporates all forms of media in her classroom practice.

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Writing skills, whilst taught in the English (Primary Language) classroom, are also accepted as their joint responsibility as Life Sciences teachers. Not all students are able to write well in Grade 10. Each individual learner researches and writes to the level of detail that they are capable of. However, with the extension of their methods from Grade 9 upwards, practice is expected to improve student writing over time. The fact that students struggle with writing does not deter these teachers nor inhibit the extension of the innovation within their department. At the same time they have found a way to avoid copy-&-paste plagiarism.

At the time of the interview, Bronwyn and Ineke were implementing their methodology in Grade 10 and subsequently used it from Grade 9 to Grade 12. In a second example, following Internet research, students had to submit their working documents for formative assessment before proceeding to build their models of the HIV virus. The most important impact of ICTs in this case is that students and teachers alike are exposed to the very latest research information on the HIV pandemic in a multi-media format. The teacher facilitates and guides the access, scaffolding the learning process at the same time.

6.4.1.2   *Information literacy*

Bronwyn co-taught the Grade 8 information skills module for two years. From this experience she developed high information literacy expectations for students and considerable comfort in working with information resources. We have collaborated on many research-based projects incorporating electronic and printed media and designed and co-taught together on some units and appreciation is expressed for this type of help:

> **BK224:** *I think, Ineke, you've hit the nail on the head, because I know, when I say to people, "you know, Mary will help you with <u>anything</u>" "Oh no, rubbish" and I say "<u>What? Mary will help you and plan your lesson</u>". I mean … you know that Grade 9 one we had on indigenous plants. And, I mean the way you did it and then you kept it and the next week we pulled out the same flip chart. It was so … it was so helpful and I've spoken to*

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people and they don't <u>know</u> that they can use you! So I don't know if that's where you need to change a bit. I don't know if you need to change it too quickly because you need another librarian first. [Laughter]

BK228: *I know … it's critical … which is … you know that thing on [indigenous plants] I couldn't have done that without you saying 'let's do the Inspiration'[3] … showing them how to make the notes.*

BK219/221: *I think it's frustrating that when you like want to get into a computer or want to get to computers … and I know we've [to MR] spoken about that as well … you can't have, you don't have access to them … because I still think the Computer Studies should be completely separate: they should have their own lab so that we have more access. I don't know, that's just my ideal world. That's why I'm often in the Library … which I actually prefer – I prefer that. There's more help here.*

Similarly, from her personal ICT experience, Ineke understands Web 2.0 implications and particularly how unreliable wiki-based information can be. They discuss student information literacy limitations:

IG182: *And it's also taught them things like you can't just go to the first website you see and accept that it's gospel. A lot of them don't know that Wikipedia, for instance, can be edited, by anyone and if someone brings me something printed off Wikipedia I always take it with a big pinch of salt. And I say to them "Well, do you know that this can be edited? If you wanted to go change the definition you could do it". So I think I'm teaching them a lot … that you need to look for credible websites. You can't just go to any website.*

BK183: *In fact, I penalise my class if they only have Wikipedia as their main source because I don't mind them using it as their starting point … going out from there. Some of them … most of them understand that now. I think you also explained to a lot of them.*

IG184: *If you do a search, a Google search, it's invariably one of your first two websites … is Wikipedia. So that's the one they tend to go to first. And they need to know that*

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[3] *Inspiration* = visual thinking software www.inspiration.com

they must rather, in our case, maybe go to a medical website that's credible and that's … you know is from a credible source. That's quite important to me.

Ineke describes a Grade 10 peer evaluation session which I had observed at Bronwyn's recommendation:

IG187: *And they had to present and then they evaluated each other. Every child got a rubric for every child that was presenting and they had to evaluate each other and we took the average of all the evaluations as their final mark.*

BK188: *Mary saw some of those and I mean… that [names student] … I mean he didn't have a single note. Mary couldn't believe it. These were Grade 10 boys. Look, not all of them were that standard … a lot of them … a couple of them read.*

IG190: *… what I did with mine as well then. A lot of them came in with cue cards that they'd written out. I said to them "Why are you writing cue cards? Why don't you just print out your slides?" And I actually showed them on my screen how to print out handouts or 3 slides per page or you can make a notes [print] or whatever and they just didn't think about that. So here they're sitting writing out cue cards and I said "What a waste of time!"*

BK194: *No, I still make them … you know … like that thing on candida … I made them make a table and then I mark that they've done the table correctly on the computer. So they have to be able to do a table. I don't mind if it's in Word or Excel.*

IG195: *Graphs … we usually make them draw a graph … because they've got to plot their points and there's a… there's a whole sort of practical skills thing. And their prac exams are done mainly … graphs are done by hand … they have to be practised at that.*

IG197: *I use it lots for my teaching. Because I teach off PowerPoint most of the time, I'm on the Internet all the time getting especially visuals, diagrams, pictures off the Internet all the time. So I use it a lot for that.*

> *BK198: And Ineke then … [to IG] that one with the antibiotics … And then Ineke did the extreme drug-resistant TB and Ineke lectured all the Grade 11's. So she doesn't just … didn't just keep it for herself.*
>
> *IG200: I worked on antibiotics so I've worked with [?????] presentation together and delivered it to all the Grade 11s.*
>
> *BK201: Ineke's the expert …*

The factors that have converged in this instance are:

- peer evaluation was used as the basis for summative assessment
- the students were required, *inter alia* to demonstrate interactive use of tools in their PowerPoint demonstrations consistent with core competencies (Ch. 2 Section 2.5.1, p.81)
- content was disseminated via peer presentation
- Social learning also occurred in that students demonstrated to one another what is possible with ICTs and the highly skilled influenced those with fewer skills.

As with the cancer project, Bronwyn and Ineke did not use ICTs for certain standard tasks that are generally accepted as ICT-based i.e. writing as explained above and graphing. Graphing is taught as a manual skill as students are required to draw graphs by hand in examinations. However, they do teach certain specific skills such as using table layouts. These are taught not only for the sake of the skill, but to scaffold, for example, the compare and contrast learning process. In each case, the decision to use ICTs or not is based on the most appropriate learning tool for the purpose or a blended approach to learning (Matheos, Daniel & McCalla c.2005, p.56; Singh 2003, p.52).

Their department is characterised by a co-operative common-purpose focus and this extends to their use of ICTs as both a teaching tool and as a professional

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resource. At the same time they note resources that will be of interest to individual students. However, there is one strange anomaly in that although the information is gleaned from the Internet, Bronwyn hands it out in paper form rather than distributing it electronically indicating that she has not fully realised the potential of electronic sharing:

> **IG208:** Very, absolutely … I'm on the Internet <u>all</u> the time … all the time.

> **BK209:** In fact I took an article for one of my Grade 12s […] about a new hormone because he was asking me about fat metabolism and why with one syndrome children have to have growth hormone. And I said "I've got just the article for you" and he said "that's just what I love". And I said "You will know about it because it's not part of the syllabus, but here's the article, read it, photostat it and so … I also do that for the boys.

> **IG210:** Bronwyn's always the one who goes through the newspapers, the magazines and collects stuff from there. I collect stuff off the Internet. And then we just share it all.

6.4.1.3   Enablers and constraints

The Life Sciences curriculum is dependent on up-to-date resources to enable the teachers to contextualise student learning in real-world areas such as biotechnology and genetics. Access to print and electronic media is therefore critical. The teachers also need to maintain the currency of their own knowledge beyond the requirements of the curriculum. As HOD Bronwyn regularly requests materials to be purchased and responds positively to the library's SDI[4] service to teachers. Such access and the teachers' awareness of new developments beyond syllabus content stimulate the extension of student learning. The teachers are intermediaries between expert knowledge and student knowledge.

Bronwyn and Ineke agree that lack of access contributes to under-utilisation of ICTs, given that access to the labs is prioritised for computer studies. Ineke in

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[4] SDI = Selective Dissemination of Information. This service is provided to all Wilding's teachers who make their interests known to me.

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particular is constrained by this lack of access. Bronwyn speculates that even if she had the necessary computers in her classroom, support – or the lack of it – to keep the machines running optimally would be a constraint. The lab bottleneck occurs due to the simultaneous time-tabling of optional subjects such as IT[5], CAT, Life Sciences and Geography. Instead, these subjects compete for access in the remaining venue, the library which, on occasions, has to accommodate up to three classes at a time. The Science hub[6] lacks pedagogic support as well as on-hand technical support. Ineke describes the situation:

> *IG232/234: I think access is a <u>huge</u> problem because you can't get into the labs downstairs unless you book them out for the year at the beginning of the year, I think. Or unless you're lucky. I've tried to take my Grade 10s down there and every single time they are timetabled the same as [???]. That's it. […] You've got absolutely no chance of ever getting in there with them. So then, you use the Library, which is great or you can try the Science Computer hub which is not so great because the computers there aren't … well, the last time I used them they weren't up to scratch. I don't know if they've been changed now to XP or if they're working faster or whatever, but I don't go there anymore.*

> *BK236: You know, I was thinking if … even putting computers in the classroom won't solve the problem because we'll never have 25. I mean I've got 25 [boys] in my Grade 10 class. We'll never have 25 computers. I mean, it's just the logistics: who's going to look after them like you do? You phone, you have them repaired. I mean, we just wouldn't be able to have that. We won't have the time.*

Despite their familiarity with ICTs and their willingness to use it, they are unwilling to consider mobile technology as a solution to the access problem. Ineke believes that if mobile technologies were incorporated, teachers' lack of familiarity with the tools would be a constraint, while Bronwyn is influenced by student experiences in other countries:

> *MR237: And mobile technology? Do you think that that would that help at all?*

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[5] Information Technology (IT) and Computer Applications & Technology (CAT)
[6] A small hub of 14 computers

> **BK238:** *Ag … I don't think so. [to IG] Do you think so? The laptop?*

> **BK240:** *I would be wary of that.*

> **IG241:** *I think they can help, but the problem there would be teachers not being as comfortable or as familiar with them as the kids. So we would be almost back to where we were when we started introducing PCs and things like that ...*

> **IG242:** *… and you'd have hesitance.*

> **BK244:** *It was interesting … [a student] … he went [on exchange] to a school where it was all laptops. And he liked it of course because he loves his computers. But he said that as soon as the teacher's back was turned they were onto all sorts of things. That's why I like this. I like this set-up, where you can stand up and you can see what's going on. But we definitely need more, more of this facility [nods in direction of Library].*

Their reliance on technology requires that both teachers have a 'plan B' as the school and more recently, the whole country have been subject to lengthy power outages. They describe the effect of such beyond-control factors:

> **IG250:** *Well, I print out can-slides so I can do chalk and talk if I have to. So I do always have to have a plan B. There's no doubt. And I've got everything on my flash disk and on my home computer as a back-up. So you have to have backup. That's the one thing when you are using technology and you have to have Plan B.*

> **BK251:** *Those two days[7] [sighing] … 'cause that's when they were doing the Cancer assignment and the research … [shrugs] it was the most helpless feeling. Ag … it was absolutely awful. And they were 'Ma'am, why are you teaching us something that we …' I had to go through the practicals before the pracs had been set up. I said, 'I'm sorry, but this is Plan B'. [laughter] So they even noticed! This is not the right order! [laughter]*

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[7] BK refers here to the first major national power failure in 2006 when the school was without power for two days.

6.4.1.4 Summary & preliminary findings: Bronwyn & Ineke

The pattern of convergent and disconvergent factors that affect Bronwyn's and Ineke's use of ICTs are illustrated in Figure 6.1.

Figure 6.1: ICT factors: Bronwyn and Ineke
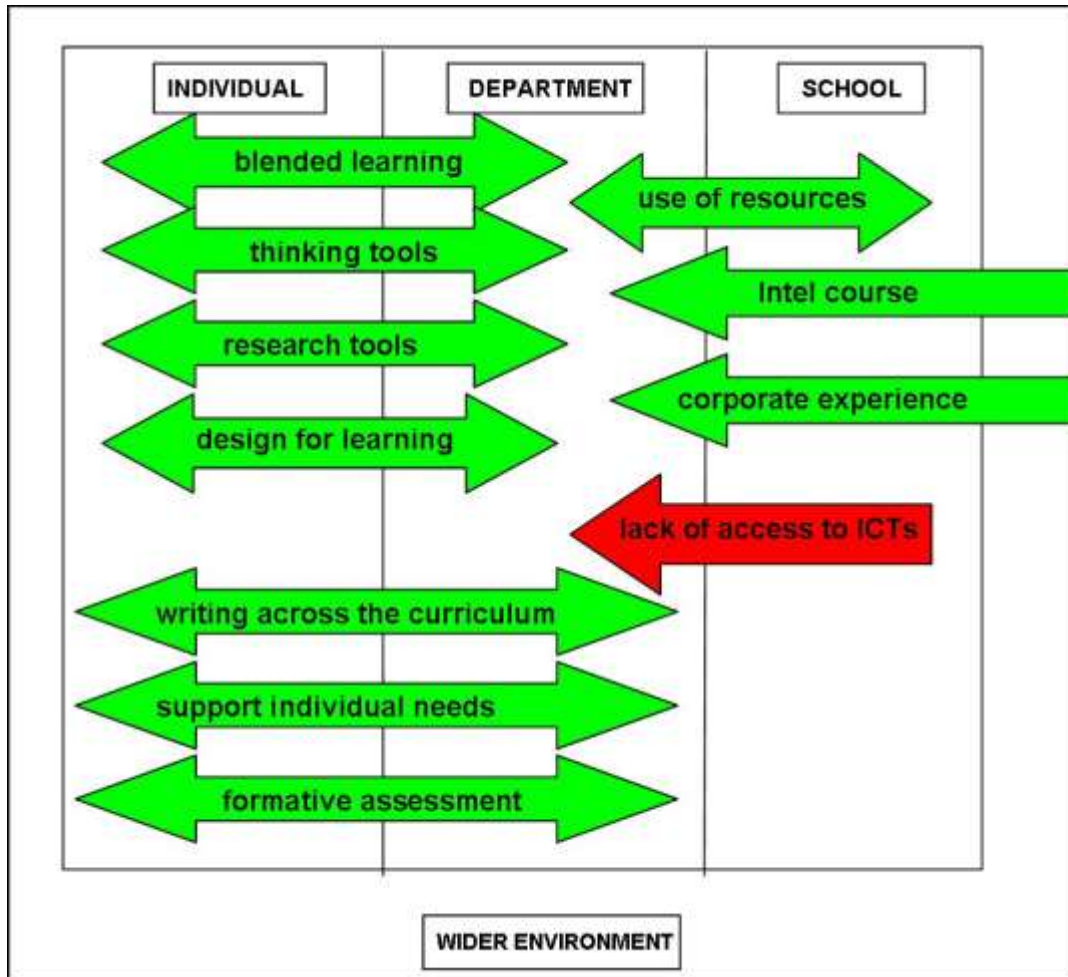
ICTs are integral to Bronwyn and Ineke's practice and from their entire description collaboration is essential to this process: they describe their common experiences rather than individual experiences. As the researcher, I got the sense that if I had interviewed them individually, I would have had identical stories. Their affinity for community-of-practice approaches is not limited to their partnership but extends beyond the department. Their focus is on student use of

ICTs rather than their own use of ICTs in that they continually refer to student learning examples rather than their own skills and use of ICTs.

Excellent collegial relationships; their common-purpose focus; teacher and student needs; available resources; and access to ICTs converge to sustain innovative momentum. Student competencies are addressed overtly through their methods which encourage active, research-based learning. Access to ICTs is critical and the teachers rely on the library for collaborative support in designing and co-teaching information skills as well as the provision of information resources. Bronwyn and Ineke serve as intermediaries and facilitators, avoiding plagiarism through detailed learning design, developing writing skills across the curriculum and ensuring that they focus on content that is of interest and appropriate to boys. Although they rely on ICTs, they prefer a blended approach. However, they are constrained by systemic issues: access to computers and a shortage of on-hand pedagogical support.

Despite their ability and willingness to use ICTs, they also show a surprising lack of willingness to consider mobile technology as an alternative form of access. The erratic electricity supply is a constraining factor beyond the power of the school. They have high expectations of students' ICT skills.

6.4.2 ICTs and innovation: the case of Arthur, Hennie, Magriet and Thabo

In this department, two pairs of teachers were interviewed. Unlike the differences between these pairs of teachers regarding organisational interactions, both pairs concur in the majority of their views concerning the impact of ICTs and how they have influenced innovation in their practice. There is a greater focus on product rather than process innovation, student information literacy levels are limiting and access is particularly constraining.

6.4.2.1   Process innovation

For Arthur and Hennie there are clear advantages to using ICTs as learning and as teaching tools. However, they prefer a blended learning approach, using ICTs when it is the most appropriate medium. The nature of the subject and its sub-disciplines determines the extent and manner in which they make use of ICTs. The four teachers share some of these uses:

> **AS131/132:** *I think that Chemistry has been really aided by strong <u>visual</u> aids. Um, we've used simple visual aids like [???] molecules which they really enjoyed. [???] But then, the problem with all of those visual aids, even the fancy expensive ones, is that they are very stationary, and that's not the way molecules behave. And some of the animations [???] for example we've used PHJ [?] which is a [???] website a fair bit, a similar sort of thing … and we've also done quite a few virtual experiments. Like we did some in Chemistry which is quite nice. What happens is [???] are really reactive [???] and you can do it virtually [???] not available [???]. So, those have been very nice. […] I use a projector and screen – <u>generally</u>. Sometimes the kids will work individually or in pairs on a desktop. Um … that's been very nice. We've also made a lot of use of some of the sections of … of Excel for their own lab reports. There have been times when we've spent quite a bit of time getting them to manipulate their data to get a straight line and it's very fast in Excel. "Try it – seven different ways".*

> *******
>
> **MD149a:** *Like I said, the multi-media. I mean, the pracs that are too dangerous for me in class they can see on the computer. The body, for example, for Natural Science, which I can't show them, unless it's a skeleton which doesn't have the same effect. They can see on the computer this heart pumping and where that molecule of blood goes. That helps amazingly.*

> *******
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> **MR224/226:** *And if we look at each learning area requiring a different range of classroom strategies, do you think your specialist area as Science teachers has influenced your approach to ICTs, and if so, in what way?.*

TL228: Ja, I think it has, because, I mean, as Magriet said earlier on, there are some of the experiments which we do not … we cannot do in class. They're too dangerous to do in class. So what we do is we go to the multi-media and then we do them there.

MD230: And then that stimulates every type of learner – the one that listens, the one that sees, the one that needs to write down, because they've got the worksheet with them. The one that needs to talk about it, because they work in groups of two people. So it works …

MR231: So that Multi-media Science really is the key to what you're doing?

MD232/234: Oh ja. That's the biggest, that's the biggest. That's our computer crunch … […] That's our computer crunch. That's what we use computers for. Multimedia.

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AS148b: The other factor though is sometimes the electronic gadgetry can actually get in the way and I've avoided some of it, so …

HJ149: Because its boys. They like the sort-of hands-on doing … getting the wow big stuff, doing it themselves in the old-fashioned way. There's lovely stuff on the market […] you know you get these [???] micro-kits with these tiny test tubes … and all these fancy … they're so <u>cute</u> … but its, you know, <u>boys</u> [resignedly] … so…

AS150: It doesn't go bang! [laughter]

HJ151: It doesn't go bang! … So they can't break these test tubes [chuckles]. So, for us, in that sense, we really make an effort to … to keep it hands-on, dirty, if you like.

AS154/156: But something like a photo gauge which is just a beam and … and it will time wherever you break that beam, is not a good thing to use in an introductory prac because the boys don't understand how it works. And it's an <u>abstract</u> measuring device. It's much better to get them a metre stick and a stop watch and design a prac on a big scale with toys … big and large toys […] rather than sophisticated air tracks and photo gauges and everything else which are much more precise but it's more abstract.

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AS222b/230: *But video technology I want to introduce. We do a lot of measurements. We could make very good use of that way of measuring, which is very intelligent. There <u>is</u> no better way. You can measure the volume … the maximum volume of [???] because you just keep on videoing it … and scale. […] And that's not something you can do in real life. […] And so they've done some … they've made some very good use of it for research.*

MD236: *We have actually. [I was] there actually when Ian made the water … one of the boys video-taped[8] it for us and um we were able to get the whole explosion. We stopped it and we got this amazing photo. […] Now the kids often miss the flash of light because it's so quick. And because it was on video we could stop it exactly where we wanted and we got this amazing … the kids actually caught on to what we were talking about. But I don't use it that often.*

TL239 & 242: *Ja, that experiment doesn't always work, so once we've got it like now, then we've got it to show the boys, ja. […] There's a lot of energy which gets released there.*

From the above extracts it can be seen that the main uses that these four teachers make of ICTs are for the multi-media features which help to:

- demonstrate practical experiments that are dangerous (MD149a)
- demonstrate reactions that can be slowed down in order for students to better observe them (AS222b)
- demonstrate live action effectively such as the pumping heart (MD149a)
- to stimulate students with different types of learning styles (MD230-234)

There are clues that indicate that some of the methods they describe are still relatively traditional such as relying on worksheets (MD230-234) or the use of a projector and screen (AS131-132) which is a teacher-centred approach, but, as Arthur explains, it is only used for a short period at a time. Arthur and Hennie

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[8] In this instance the student used his mobile phone to video the experiment.

are responsive to boys' affinity for hands-on as opposed to virtual experiments, which they have the resources to support.

The teaching of ICT skills is integrated into the units of work and relies in part on peer teaching:

> **AS134:** *About half of [the students] need to be taught [skills]. Certainly something like … um … plotting a straight line graph. Excel calls that a <u>scatter</u> graph. What they call an XY plot is not what we call an XY plot. It's two … its two sets of plots. So Excel's … the words they use are quite funny, especially in plotting graphs and [???], but …*

> **HJ135:** *But what I've found, Arthur, is that's not time consuming. The boys are so computer literate that you just actually show them once and tshweeee [gestures speed on keyboard] they teach each other and it's gone and then off they go.*

> **MR136:** *Oh, so you do find that. So they do have the competence. At what level are we talking here?*

> **HJ137:** *Grade 10, 11.*

> **AS139:** *That's about where it starts. Once you've shown them that it's not a big issue. And … and they show each other stuff and … someone will ask "how do I put a trend line in this" and you show the one then within 15 minutes the whole class will do it. [...] Well, its peer teaching.*

Application skills are conveyed through natural socio-constructivist methods: Hennie teaches the use of spreadsheets on a one-on-one need-to-know basis, which carries across the class through student-instigated peer-teaching. However, students' information literacy skills present problems, particularly to Magriet and Thabo.

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6.4.2.2   Product innovation

Custom-purpose ICT hardware also influences teachers' ability to innovate. Here, the innovations are the ICTs themselves.   By applying the tools, the teachers are able to change their practice or believe their practice will change if they were to acquire the tool.   The *Mimeo* or *e-Beam* and the school administrative system are amongst the tools mentioned:

> **MD 149b:** *[…]   And the other thing that I saw, which I desperately want, which was that thing in the staffroom there. They wrote on the board … and it gets immediately logged into the computer.*

> **MD152:** *That's amazing. I would <u>die</u> for something like that, because I make so many exercises on the board which I don't have time to go print on the computer. And then just to be able to open that the next day. That would be amazing. It would save so much time. It would save so much time, save so much time.*

> *******

> **TL254:** *Ja, ja, ja. As you were saying, like that board … Mimeo or something like that. I think those are the things to go for.   What I like about that is that you can convert whatever you've written into Word and whoever has missed a lesson, you know, can actually catch up. You know, now when we were busy marking we find a learner has just written "I was not in when we were doing this and this or that". And we try to say, "Oh, Ok, the boy was not in" and you know ... And you try to explain maybe, but it will be so brief and short and you can just pull up that lesson and give it to the boy "This is what we've been doing and if you don't understand then I will show you".*

Magriet refers also to the administrative use of computers and how they have helped her and to the Internet as a teaching resource:

> **MD156/158:** *Because the computers make our work actually a lot less. I must say, that's the one part that I'm grateful for. It makes my work less, not more. [...] The mark book, the mark book. When I write everything in my mark book and my mark book gets stolen. There's all my marks … missing. Now, as I get them, I enter them in the computer. The*

computer works out my average, Pencil Box[9] work[s] out my class average, grade average, everything. It weights it differently for me, which would have taken me forever to do. [...] I use [a hand written mark book as well], because in the classroom, if I take marks, I don't have a computer next to me. So then I put it in my book. Tests, I immediately …

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MD245/247: *GCM! We can't live without it, I'm sorry. I can't. […] Without Pencil Box we'd be screwed. I mean, we can't, no way. […]*

TL248: *I think we have, sort of I don't know … if I were to go to another institution where these things are not there, what would I do. I'd have to now reinvent the wheel. But really I think …um … it sort of has become part of what I do.*

MD249: *Email. Every correspondence, every meeting is by email. If I don't read my emails for one day I'm out of the loop completely. Completely. So we can't. We cannot. I mean, we're a huge staff, so to get a message to every single person. We don't have intercoms so if someone looks for a boy, you're stuffed. Because they don't read the DRO[10]. That's why we have to use email. So [shrugs] it's … we can't. We can't do without email.*

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MD165b: *[…] And I mean, it's made my work less. Notes for example. I mean, stuff I can get off the Internet. It's so much better. If I had to go for books to find everything, it'd take me forever.*

In each of these cases it is the ICT tool that is the innovation, not the practice. The product innovation has a positive impact on the administrative process. The tools assist the teachers' practice but how they teach is not affected, although the *e-Beam* may in future prove to have evaluative potential. *Pencil Box*, the school administrative system, has helped save Magriet time in such tasks although lack of classroom access means that she needs to use a hand-written mark book as well. More recently (2009) the manual registration of students each day has

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[9] *Pencil Box* is the administrative system used by the school
[10] DRO: Daily Routine Order or the regular means of communicating daily messages to students.

been replaced by an automated one on *Pencil Box*. Teachers are expected to register attendance during class time, but lacking a classroom PC, timeous and consistent registration is hindered.

The *Mimeo* or *e-Beam* has been demonstrated but not purchased, and Magriet envisages it as a panacea to her lack of time, while Thabo recognises its potential for supporting students who have missed lessons due to extra-curricular opportunities (sports matches, tours, community service, exchanges etc) that form part of the complex wider curriculum of the school. Used together with a webcam or microphone the *e-Beam* device had been evaluated and discussed as a means of caching lessons that are centred on the whiteboard. Apart from supporting absentees, the device is also envisaged as a means of recording and reviewing teaching practice or for broadcast of a lesson to classrooms elsewhere. Arthur has referred to the *e-Beam* as follows:

> *"It will take a while, but I believe that this could become an invaluable tool in teaching. I do not do power points* [sic]*, but I use my data projector for all sorts of things. This doubles the power of the data projector."*[11]

While it is hoped that the *e-Beam*, will enhance the teaching practice that derives from it, the anticipated time-saving may also be significant given the overload that teachers describe. Certain teachers had expressed interest in the device for these purposes when first investigated five years ago, but the decision was taken by the IT Director to reject it due to technical performance limitations relating to the quality of the whiteboard surface it projected onto. With this problem overcome by technological improvements, the *e-Beam* has been demonstrated again more recently and teachers are keen to purchase it, but restrictions on access to Web 2.0 resources such as *Flickr* to enhance its use are currently being debated. The real value of the device is that it may address systemic problems such as finding time to support absentees.

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[11] Arthur (2009) Email to MR re *e-Beam*, 2nd April 2009

A further example of the impact of ICTs on her personally is Magriet's use of the Internet to find extracts that she can use as notes (MD165b, p.287). Her comparison of printed resources and electronic resources indicates her consideration of their time-related capacity and not their intrinsic value.

6.4.2.3   Information literacy

Magriet and Thabo describe the problems:

> **TL167/169:** *I think there are. You know lately, I when I bring my boys, I've been so disappointed about the quality of work which … which they submit. […] There's a lot of cut-and-pasting. A <u>lot</u>. And what the boys will do, immediately, one person will do something – cut-and-paste – whatever it is, and then quickly email a friend and they'll just change the names there and then they'll hand in the work. You know, if … OK. I would like them to research using Internet, whatever, but then at the end maybe I can ask them to write with their own hand, maybe it would be better. But, I find that a lot, <u>a lot</u> of my boys they just copy and paste.*

> **MD170:** *They just don't understand what we mean with 'your own words'. They think that if they change one word in the whole sentence it's their own work. They really don't … they think if they use this paragraph from this site and this paragraph, put them together and it's their own work. [shakes head]*

> **MD173:** *I mean if a kid that's on inclusion programme uses certain words that's quite a give-away. I mean, words <u>I</u> don't understand, so it's a give-away.*

> **MD178/180:** *I don't let my kids do assignments on the computer, from the Internet, unless it's like Multi-Media. But they don't … they never type stuff, like lab reports for me, from the Internet. We're not into lab reports as much in the senior phase. So, it's mostly juniors. […] It's hard for the seniors to copy and paste because it's … they can't just go into a site and find it. It's their own work, it has to be their own sums and their own … it has to be. But the juniors … ayyy!*

From these descriptions, three issues arise:

- although boys arrive in Grade 8 with technical competence, they lacking information literacy skills and therefore dependent on cut-and-paste techniques in research-based assignments
- secondly, the teachers appear to lack the methodology skills to address the problem, although the anti-plagiarism policy (Appendix 6.1) requires learning design intended to avoid such problems
- thirdly, research based assignments are avoided as a solution to the copy-and-paste problem

6.4.2.4   *Enablers and constraints*

There are a number of constraints common to all Physical Science teachers that impinge on their ability to integrate ICTs in the curriculum. These include access to the computer labs, maintenance of classroom PCs and a lack of sufficient funding for specialised equipment. The teachers describe their problems:

AS144: The [partner school] ha[s] got some quite nice data probes and we've looked at pricing them. And we've just … we've run out of budget. There's lots of very nice stuff out there that we'd like to buy.

HJ145: Ja. [to Arthur] There's one thing that we must invest in, really, and that's quite a lot of money. There's a huge emphasis on … on … on energy in chemical reactions and the way we measure that is by temperature. And sometimes it's very difficult just with a thermometer. So I think those electronic probes and that device … it can't be that expensive … just two or three and I think that's something we must look at. […]

AS148a: Budget factors are huge in terms of [???] what we plan to do. [A local] high school has a bigger slice of budget than we do. Let's get … its true. […]

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AS170: […] The fact that we have only one data projector in the department is a crying shame because for 6 times R10 … R60,000 every lab could have one and then the access could be much, much better.

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HJ209: *Money! [chuckles]*

ASF210: *Ja!*

HJ211: *Budget! [laughter] Did I say money! [laughter]*

AS212: *Yes!   Resources.   Um … with the amount of stuff that's out there … because sometimes you can search really hard and not find what you want, but you know it's there … you know it's there. Um … and finding stuff that's only 50% … you know … not there … [indicates wavering]*

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MD62: *Yes, I do [have a computer in the classroom] but it's broken [chuckles].*

TL63: *Basically, you don't have a computer in the classroom!*

MD165a: *It's the 4th [request for maintenance], but […]*

Arthur and Henry are frustrated by budgetary limitations that constrain their ability to use ICTs in the classroom. They draw comparisons with both the partner school, which has equipment that they lack and with a local publicly funded secondary school which they expect to have less resources. At the time of the interview only one Physical Science classroom had a projector. Part of the difficulty is the size of the department as the subject, although no longer compulsory, is a popular option taken by most boys. Given the number of classes per grade it is difficult to provide equitable access to classroom resources simultaneously. A partner school has such tools, but their department is not as extensive. A further constraint raised by Arthur is the sheer volume of resources that makes it difficult to source items that he knows exist but cannot locate. Although theoretically every classroom has at least one functioning computer, when interviewed, Thabo had no classroom computer and Magriet had

a malfunctioning one for which her requests for maintenance had apparently gone unheeded.

 Access to the computer labs and inequitable provision of projectors are serious inhibitors to integrating ICTs into the curriculum over which Magriet and Thabo despair. They describe their frustrations:

> *TL181: And at times, like for example, I've got two Grade 9 classes, I'll come to book and find [the labs] fully booked for one. For the other I can book. And when you try to book the following week you find that, you know … [sigh] … things are just difficult to comprehend. OK. You've done this with this other group; you have to do this with the other group. I think we definitely need another … computer lab.*
> *MR182: So access is the problem?*
>
> *MD183: Mmm.*
>
> *MR184: Does that lack of access actually prevent you … ?*
>
> *TL & MD185: Yes, <u>yes,</u> definitely.*
>
> *MR186: … from doing what you want to? So it's a huge constraint on you?*
>
> *MD187: No, it definitely is.*
>
> *TL188: Ja.   We either need another computer lab for the Computer Studies[12] and whatever …*
>
> *MD189: I think Computer Studies needs their own thing.*
>
> *TL190: … and then we can then use these ones which are here.*
>
> *MD191: That's a huge problem, because so many times I wanted to put them on Multi-media and …*

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[12] Computer Studies is the former name of IT (Information Technology) and CAT (Computer Applications Technology), still commonly used to refer collectively to these two related subjects.

TL192: *… and they're blocked.*

MD193/195: *… there's no time. […] There's no solution.*

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MD199: *[…] And then he shows them the projector and then he works with the Multi-media with the whole class. So it's not you sitting on that computer, you there. It's a <u>class</u> thing. That helps a lot. And I know [a colleague], for example, uses PowerPoint; every lesson of hers is in PowerPoint. And I know the kids absolutely love it. They absolutely love it. But we don't have projectors [shrugs].*

TL200: *Why don't you have a projector?*
MD201: *In the classroom?*

TL205: *Ahhh! We ordered three years ago.*

MD206: *Three years ago? I don't remember when it was.*

MR207: *OK. So what you are saying to me then is there are things you want to do and things that you see some of your colleagues are doing …*

MD208: *… which I can't do [what my colleagues are doing even though I want to] …*

MR209: *… which you can't do. Where does that leave you?*

MD210: *Frustrated! I … after … I feel I can pull my hair out, because there's so much stuff I want to show them, but I can't, because either I can't get in to the computers and I can't do it in my classroom … so it's just not done. So everything is me teaching and then doing exercises, because I've got no computers.*

TL212/214/216: *Ja, it doesn't really frustrate me because I feel if I really wanted to use it, I would like swap with [the HOD]. But, I … I don't know … because these boys are … they learn differently, so that's why I try to book them, that each one has his own computer. I like projecting stuff and teaching from there, but I don't become frustrated when I don't have that. But I <u>do</u> when I come to book down here and find that there's no space … […] Yes, I can't get a booking. And in our department we … we work with time.*

> *If we say with this module you're taking two weeks and you're not done and the boys have to go to another class. You know, you feel frustrated, don't know what to do and there's nothing, just nothing you can do. You just come up with some other ways of teaching the boys. Ja, it's … the time frames are too closely packed. I remember when we started with those tests and pracs, you find that the date is set but you haven't covered half the work. […] Ja, it is, it is [a serious problem]. Some of them we have to cancel them. […]*

It is in this last extract that the wider implications of lack of access are revealed. Lab bookings are dependent on systemic factors which produce time-tabling clashes for optional subjects, resulting in inequitable access between subjects and within the same grade in the same subject. Thabo and Magriet are willing to change their practice to incorporate ICT based methodologies and desire to do so, but access limits them to traditional means. Thabo recognises that the students learn differently with ICTs and wants to use them to comply with the requirements of the modules as designed. However, the outcome of the lack of access is inconsistency or incompleteness of curriculum delivery.

For Arthur, money spent on digital projectors would be a good investment. As HOD, he is frustrated by the lack of equitable access to projectors for his whole department. The intention is that all Physical Science classrooms be equipped with four PCs for learner use and a multi-media PC, projector and screen for teacher use, but into the third year of the plan (2009) less than half the classrooms have this facility. So far, only one classroom has a projector, resulting in lack of equity in the teaching methods used between different classes. This situation comes about for three reasons. Firstly, digital projectors are costly and secondly a department has to justify to the IT Department that ICTs will be used before they are provided, which is difficult to do when the tools are unavailable. A third factor is the security of ICTs in the classrooms with a number of projectors having been stolen, despite their being fixed to the ceilings.

The security risk has become so acute that a moratorium[13] on the roll out of all technology was called until security could be further improved.

6.4.2.5   Factors influencing ICT use

Exposure to ICT developments, the nature of the subject and teacher beliefs all have a significant influence on these teachers use of ICTs. Whilst Magriet states directly that there is a single influence on her ICT development and that is myself as she has no time to discover new things beyond school, Arthur and Hennie pause for a considerable time before responding to the question on how their ICT-based innovations have come about.

> **MD253:** *The only influences I get from ICT are the ones that you bring into the staffroom. Seriously, I don't know people in the ICT world.*

In her comment (MD253) Magriet raises the question of how teachers are exposed to ICTs. While HODs might be exposed to ideas at conferences they attend, ordinary teachers are reliant on HODs or other colleagues. There does not appear to be any systematic exposure to ICT-related ideas, only ad hoc exposure.

> *******
>
> **HJ159, 162:** *Well, I think … it's available! [chuckles] And it's another type of <u>resource</u>. For me certainly is this MMSS, it's certainly something I cannot recreate in the classroom, something I can't in my wildest dreams actually have the boys design. Its just so <u>wow</u> for me to see visually! I think the fact that it's available and that specific programme is incredible. […] It requires very little from me, and I'm not just saying that I'm lazy and not doing anything. It's wonderful that it's something that's so brilliant that works and I don't have to do anything. I have to know <u>how</u> it works and know the content to explain, but it's just so wonderfully designed that it's … and every student can go about it at his <u>own</u> pace.*

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[13] The moratorium ran from January to May 2009. The security operation at the school is massive, but it is still possible for undesirable elements to access the property. ICTs at schools across the province have been targeted by thieves.

AS164: Ja … and there are some … there are other websites. We've used quite a few websites, but there are <u>too</u> many. So it's sometimes a bit of a trouble [???] [to HJ] you know that Doppler effect which is very nice pictures of the object [???] speed [???] breaking the sound barrier and so on.

AS168: Some people tend to dump a lot of stuff rather than [???] on the Internet [???] which has been a bit of a weakness because it's not always aligned with what should be taught. [Indicates levels] It's a higher rather than the low level [???] … um … and some people use it very, very well.

AS175: Yes, I think there is a difference in the way that we approach it as chemists and as physicists and those are the two areas in our own subject. In chemistry we need it a lot more because molecules are so small and what do molecules do? We constantly have to go back to the sub-microscopic world whereas the physics is very hands-on, interactive. So we don't need it that much because we've already got a very good route in [???].

The nature of the subject is a contributing factor in this instance, with the two sub-disciplines requiring different approaches to ICTs based on scale. Arthur and Hennie concede that it is probably the availability of the ICT hardware as well as the quality of the multi-media software that has sparked their use of ICTs to recreate virtual experiences otherwise not possible in the classroom. In this case, it is the convergence of the hardware and software together with the teachers' understanding of the consequent learning potential that sparks the change in practice. Apart from multi-media, there are specific websites that are valued resources. However, Arthur believes that the glut of websites encourages certain teachers to dump inappropriate information onto the students.

Hennie holds distinct views on the significance of ICTs and Arthur concurs that ICTs are but one of a range of tools available to teachers. Although they both refer to student learning, they describe ICTs as teaching tools over which they have control, rather than as learner-controlled tools:

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HJ196: It's difficult because it's got its place, but I don't want it to … to over-rule my teaching and what I do in the classroom. But it's a very, very fundamental useful tool. But it's actually … but I tend to use it when I feel that "this tool will help me with this", but not as the only means. Having a data projector and that projector and this is how we do it, or computers or cameras or whatever … [shakes head negatively] … for me I'd like to use it and I'd like our department to do that [turns to AS] just to … when the message … when learning is required, what's the best tool to accomplish that learning and if it's ICTs, fantastic, but its not the only tool.

AS197: I think Hennie's right. Another very useful piece … another weapon in the armoury. I have a very strong aversion to lessons by PowerPoint, because I think that … [nods] almost always, it's just another way of putting sage centre stage.

AS201: You see, whiteboards or Smart Boards – Smart Boards – they've got their use but I've got a data projector and I use the data projector every single day, but very seldom will it be on for more than a few minutes in a lesson, because its there to make a point and when the point's made then you move on and you do whatever else. Ja, so Smart Boards are useful, but um … a conventional Smart Board is far too expensive. I don't think its resources well-spent and it's got the danger of being a new tool and you want to play with it while you do this. I think overheads[14] did exactly the same 25 years ago or whenever they were introduced. Um … I can remember teachers who sat down at the overhead and wrote on them. It wasn't good teaching. So, I think …

HJ202: [to AS] If you say it's 'not good teaching' … I mean, if that's the only thing you do …
AS203: … then … that would be better …

HJ204: … But if there's this one lesson and you've got this … you want to plot this graph and you know that this is fantastic and there's this machine can do it for you …

AS205: … by all means. Absolutely perfect. So, it's another resource to use when you need it, when it's the best …

HJ206: Don't you think – it's just occurred to me that … it's very individual. Because I … I can think of some members of staff who would love doing it because the [???] next year

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[14] Overheads = OHPs or overhead projectors

the lesson plan is done and it's OK and its fine and I've done this. But <u>my</u> teaching style is every year … I never do the same thing. Maybe I'm just stupid and wasting a lot of time that I complain I don't have, but I <u>hardly</u> ever [...] there's never the same lesson done in the same way. Does that make sense? I would know that this prac works very well, but even then I would change the chemicals or write something different, "let's try it". But I think where the interactive whiteboard has got this <u>advantage</u> is that you don't have to re-plan lessons, but the disadvantage is that <u>you</u> don't grow as a teacher, I think. Well, you might use it, sorry, to actually add stuff, because I know you can do that, but it's … I don't know …

AS207: *But if it's a different class and you've got a different relationship you probably need a slightly different style.*

In this interaction between Arthur and Hennie, they both reveal the extent of the influence of their beliefs about ICTs and their potential in the classroom. Arthur is averse to what he perceives to be pre-prepared lessons delivered through PowerPoint, implying the presence of projectors and multi-media PCs for teacher-centred delivery. This is an oblique reference to a colleague who bases her lessons on PowerPoint presentations. A spirited discussion ensues in which each stand their ground. Hennie chuckles as electronic whiteboards are mentioned as part of this teaching method, implying reservations that he has about this technology and how his colleague uses it. He challenges Arthur on the point of good teaching, to which Arthur responds by reiterating his point on ICTs as just another tool in the teacher's armoury, again focusing on teacher-centred use. Hennie at first reveals a naïve understanding of a PowerPoint as a means of locking in a lesson for perpetuity. However, he then admits his lack of logic. It would appear that he has a bias that he cannot explain or justify fully. Arthur concludes the discussion on this point, attributing choice of strategy to the complexities brought about by the inter-relationships between a teacher and each different class. This interchange reveals that although the teachers are comfortable with certain technologies, they take time to rationalise those that they are not familiar or comfortable with themselves.

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Use of ICTs as a communication device and link to real-world contexts has been limited to project work[15]. It has not been used at all for curricular purposes (e.g. for online collaborative projects), except in individual project work in which, even if suggestions have been given, students have not always made use of expert contacts:

> ***AS218:*** *I've suggested that and I've found the boys very reticent. I've given them a name. The Grade 10 projects …*

> ***HJ219:*** *[…] The Grade 10 project … […] yes, we do that a lot. I've given them names and other peoples' telephone numbers and they do contact them by email, by phone. Yes. Not as the syllabus, but as the wow stuff, additional things.*

> ***HJ221:*** *Yes, [projects are] not prescribed. It's a free market. They can do whatever they like. We encourage anything as long as it's new to them. Even if it's something I've seen before but it's new to this boy and he's designed his telephone or a camera. It's new to him and whatever technology he's used.*

Project-based work is used, inter-alia, to encourage innovation amongst the students. Hennie's use of the expression *'the wow stuff'* (HJ219) in referring to project-based work implies that the Physical Science curriculum (or syllabus content as he calls it) is less interesting to the students than self-directed project-based work. The Grade 10 projects were introduced more than 20 years ago, but are still successfully sustained and over the years some of the school's students have achieved recognition nationally and internationally at science fairs. The question arises of whether the formal curriculum offers less than what the students are able to learn by themselves if such independent learning is indeed *'the wow stuff'* (HJ 219) that interests boys.

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[15] Each grade 10 student has to complete a major investigative project either individually or in a group.

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6.4.2.6   Discontinuation of innovation

One discontinued innovation[16] was an integrated cross-curricular module developed together with the Geography department at the inception of the new Natural Science curriculum.

> **AS183:** We've actually developed a very nice module that involved looking at rocks using microscopes as well etc. which was very nicely integrated, [???] but I think we've kind of lost some integration [in the Natural Sciences] as other people have taken the module over.

> **AS185:** […] … in that particular module, just because the next person took it over.

> **HJ186:** [to AS] But, I think what Mary was saying was working with the Geography … a bit of Geography in and …

> **AS187:** Which there should be, you see, in the department of Natural Science. […]

> **HJ189:** There's a lot of common ground. There's a water module that we created and I think [the Geographers are] doing it in Grade 10 as well, the whole cycle, the whole water cycle. And in Grade 10 we do the water cycle now again. So, there's lots of scope.

> **AS191:** We did, for one year, have the Geography department in the Natural Science department. That was very … um … [long pause].

> **AS193:** [It did not continue …] it was time-table and [other factors] … mainly time-table. The person involved was very keen to continue. Also, we were slightly over-resourced in Natural Science, so that was the main reason. So that was a real thing.

In this instance the innovation involved the cross-curricular collaboration, co-teaching in each others territory as well as a new area of curriculum. However, the innovation was not institutionalised due partly to systemic factors, with staff changes resulting from the scrapping of Physical Science as a compulsory

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[16] This section is included here as the response was provided in relation to ICTs, although it is not only ICT related.

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subject in the school. This change impacted the ratio between student numbers and teachers and, where a Geography teacher had originally been drawn in to assist in teaching this module, the arrangement had to fall away. A further reason was intimated, but not fully or comfortably revealed. The interplay between staffing ratios and other factors might have been used to weigh each against the other in the decision to discontinue the module. In this case, the relationships between departments as well as between individuals within or across departments weighed more strongly than the advantages that the integration initiative might have offered to student learning. Relationship management thus emerges as a factor in sustainability.

6.4.2.7   Intra-departmental collaboration in ICT use

In answer to the question of how they work together as a department in integrating ICTs, unlike in the Life Sciences department which is characterised by a transparent commonality of being, in their department, according to Magriet, there is little perceived intra-departmental collaborative support beyond administrative tasks. Her evidence corroborates the point Arthur and Hennie raise (AS28/30: Ch.5 Section 5.6.1, p.224) regarding relationships in the development of modules. There is support for day-to-day administrative tasks but, it would appear, no curriculum support or professional learning support:

> **MD218:** *I don't know whether this is an example, but like Hennie knew for this one programme, we would all need it. So, he went and booked eight lessons. And then I just said "Fine. Eight lessons. I need Tuesday. You need Thursday, you need Wednesday and" … so he goes ahead and booked ten lessons, because there's no time and you just pick which one's you want. I think that's basically as much as it goes.*

> **TL219:** *Yes, as a department I think, we …*

> **MD220**: *… that's how far it goes.*

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6.4.2.8 Summary and preliminary findings: Arthur and Hennie, Thabo and Magriet

The patterns of convergent and disconvergent factors that affect Arthur's and Hennie's use of ICTs are illustrated in Figure 6.2 and those of Thabo and Magriet are illustrated in Figure 6.3.

Figure 6.2 ICTs and innovation: Arthur and Hennie
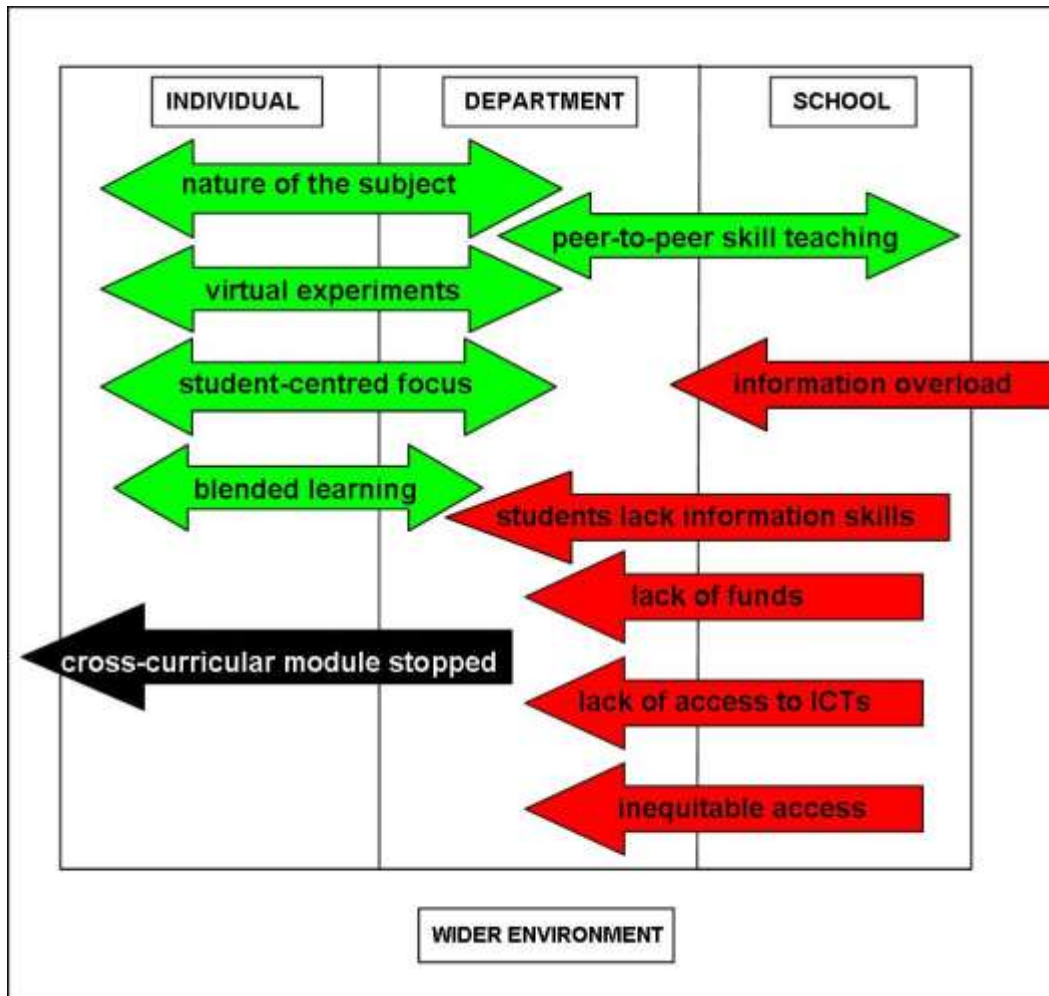
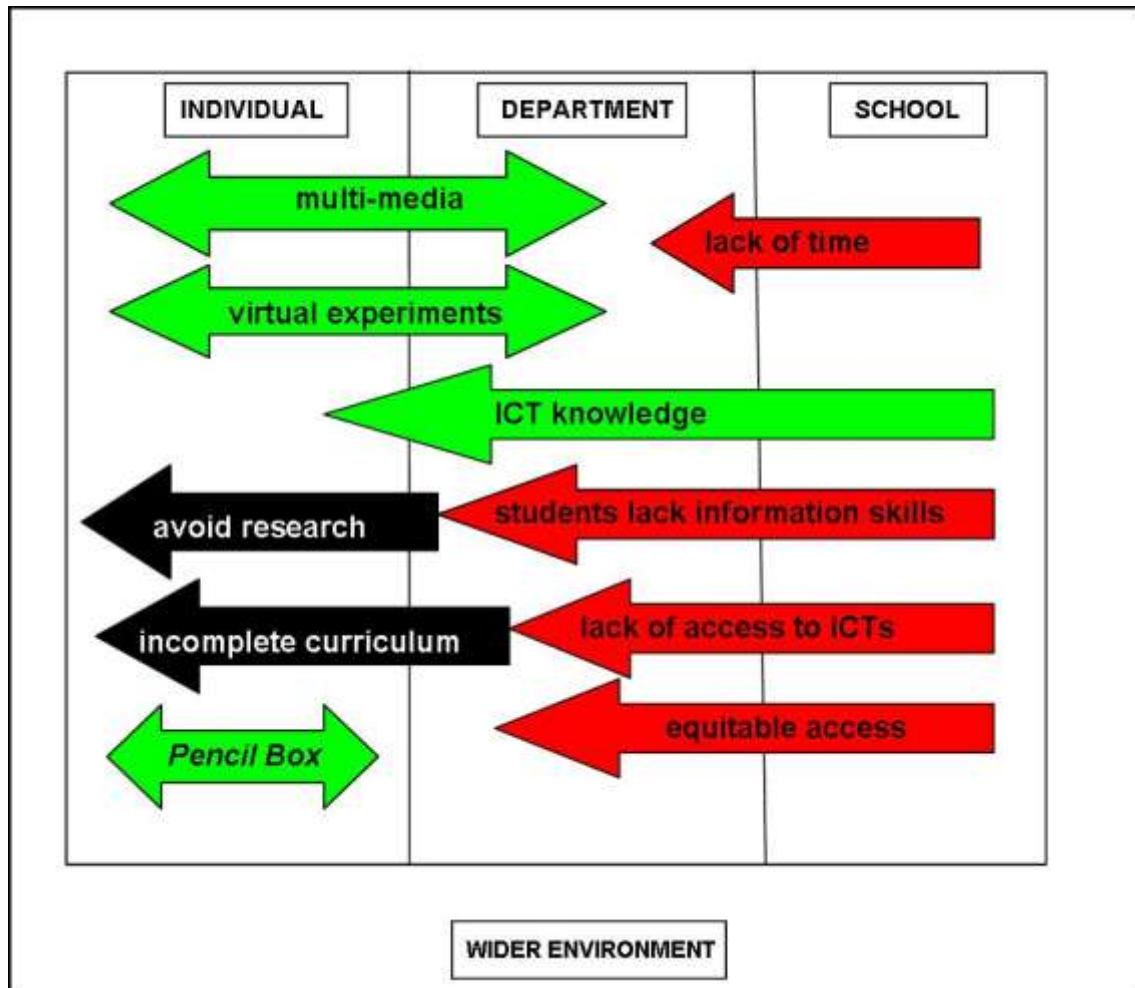Four perspectives are provided in this case in that two interviews were conducted, each with two participants involving ordinary teachers and HODs. While each teacher expressed dependence on ICTs as integral to their practice and they share common views on the impact of ICTs on their curriculum, there is variation in their views on the impact of ICTs on their practice.

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Figure 6.3: ICTs and innovation: Thabo and Magriet

Use of ICTs is influenced by the individual teacher's beliefs, their ICT proficiency compared to that of their students, and the grade-level and character of the specific class they are teaching. Multi-media provide a significant resource for Physical science in that it has capacities that are an improvement on real experiments, although the contradiction is that boys prefer the messy, hands-on approach. Whilst the boys have a natural affinity for technology, such as described in their peer teaching of Excel skills, they also have hands-on needs that are counter-intuitive to sophisticated technologies. All four teachers concur on the advantages of multi-media projection as well as the limitations of being without it. ICTs are perceived as classroom tools over which teachers have

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control or for student use in functional or reproductive learning tasks (Brackett 2000, p.3), but not transformative tasks. These uses contrast with Arthur's focus on student-centred learning (AS9/11: Ch.4, Section 4.5.2.2, p.167). There is inconsistency between the Life Sciences and Physical Sciences approach to graphing and the use of ICTs for the purpose.

However, disconvergent factors such as budget limitations; the security risk; information overload; serious access limitations; the provision, on-hand support for and maintenance of ICTs; and the decision making process for ICTs undermine integrated use of ICTs in the curriculum and, in some cases, limit the planned delivery of the curriculum.

Reliance on the administrative system, perceived by Magriet and Thabo as a significant ICT innovation and considerable time-saver, is undermined by the fact that neither has a functioning PC in the classroom and requests for maintenance are apparently not always met.

Students manifest a lack of information literacy which presents problems in research-based tasks, particularly for Thabo who uses ICTs regularly for resource-based learning. While Thabo is disappointed by what the students produce, Magriet ignores research-based tasks altogether. Both teachers are aware of what the boys are doing, but do not appear to have the pedagogical means to counter it. It is apparent from their interchange that scaffolding of the learning process is lacking when students are required to do research using the Internet. Although the school has developed an anti-plagiarism policy that specifies the need to design learning experiences that avoid cut-and-paste plagiarism, the mandate does not ensure that the actual change happens. Bronwyn and Ineke had pointed out that boys did not like their methodology, but by scaffolding the process they were able to ensure that the desired learning

outcomes were achieved. If Magriet and Thabo were exposed to their methodology they may be able to address these problems.

The discontinuation of a cross-curricular module leads to the question of where responsibility lies for relationship management and what resources are at an HODs disposal for ensuring that student learning interests prevail.

6.4.3 ICTs and innovation: the case of Henry

Few teachers raised the presence of ICTs in response to the question of how mandated changes had impacted their classroom practice as described in Chapter 4. However, Henry recognised the potential of ICTs to help achieve mandated change and stated that his classroom was well-equipped for the purposes, describing it as a *'fancy lab'*. He has access to not only ICT resources, but other resources too and is completely satisfied with what is provided. He is comfortable with the idea of experimentation and change, as well as with the ICTs themselves.

6.4.3.1   Process innovation

The greatest significance of ICTs to Henry is the real-time factor that access to the Internet allows. He provides examples that illustrate this point:

> **HN81:** Ja, the real live, real time, real time weather, real time volcanoes, earthquakes, that kind of stuff … so we used to say "Go and write us an assignment on Vesuvius or Etna or Mount St Helens or whatever". Now we say to them "I wonder where the greatest volcanic activity is this week?" They all look at you "No, there've been no volcanoes this week". "Go to the Internet and find out. There've actually been about 40 volcanic eruptions this week. Or earthquakes or whatever …" I explain to them … something like that tsunami was the most amazing real-time experience because you walked into class - and obviously that happened during the holidays – but … um … everyone wanted to talk about it and <u>everything</u> was still in real time mode although it was two weeks later that we walked into class.

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HN83a: … and imagine if it had been in real real-time. In fact, on the day it happened it was still possible to look at the Internet and see where it had hit already and where it was still going to hit … which is incredible. Now that kind of stuff … um, tracking Katrina … tracking Katrina was just the most amazing thing because you had George Bush standing up there saying this is, you know, not going to happen and we sitting in the classroom saying "George Bush, you're a bloody idiot because it quite clearly is going to happen" and all that kind of stuff. Katrina was the most amazing real-time stuff […]

HN83b: […] and what it allows you to do is that this is exciting 'cause you're now teaching thunderstorms to the kids. So you teach thunderstorms at the time of year i.e. now until February when there are going to be thunderstorms. So you teach in the classroom, you look at it on the weather radar and then you go outside and watch the same storm in real time. So the real real-time learning is a massive boost for Geography. Um … and obviously coupled then with things like Al Gore's movie[17] and that kind of thing. You watch Al Gore's movie and then you enrich that with saying "Well, what is the CO_2 value in the atmosphere now? You know Al Gore's movie is now two years old." "Gee, it's a 10% increase in two years. That's actually scary stuff." Or sea level change that you can see all the graphs ticking up. And the guys … you know, scientists who say this is … this is a slow process look like they're going to be wrong. I think everybody just about knows that global warming is real. But, they engage directly with it. It affects their lives. I always say to the Geography students: "Geography's about your lives, History is about dead people". And that's a serious point because the Internet allows us to engage directly with it. That's a huge [???]. And that … having a digital projector in the classroom to look at the stuff as it happens.

HN119: […] What … what is interesting is that more and more I'm getting asked, as the geographer, about things that affect [the school]: the lightning conductor, the general weather and that kind of thing. Now none of that would have happened without computers. I mean, people would ask me "Oh. You're the geographer. What will the weather be like?" and I would give them my amateur opinion, but now I can give them a pretty professional one. And say, for instance, lightning predictions … now that appears to have nothing to do with education, but integrate that with … with … we're going to do it by cell phones and so on and we have a system whereby if the alarm goes off the alarm will get to the alert level and then come to the Geography department for us to say if this is a real or not real or whatever. Now the kids are, I'm sure, going to tap into that. That's

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[17] Gore, A. (2006) *An Inconvenient Truth (*documentary on climate change)

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*going to have some strong educational spin-off. And there are all sorts of things of that
nature. There's a lot of integrated thinking going on informally because of those kinds of
things. But we've lost integrated thinking for various reasons.*

These examples of seismic and weather events illustrate the impact of real-time
access to ICTs. The new curriculum has the flexibility to incorporate global or
local events i.e. transformative learning is possible and happening through the
use of ICTs. Technological advances such as the school's lightning warning
system[18] enable real-time learning in the broader curriculum.

Having access to ICT resources in the classroom is a critical factor in Henry's
ability to respond to student needs, particularly in providing instant answers to
students questions. He is comfortable with admitting in conversations with
students that he does not know all the answers: student questions are valued.
Here, the presence of ICTs aligns with his thinking about his classroom practice.
ICTs also enable formative assessment of draft student work:

> **HN85a:** *Ja. The … the accessibility … mid … mid-lesson somebody will ask a question
> and I'll say "I dunno. Let's check the Internet". So you just put in a Google search, carry
> on with the lesson, then you check the answer and you tell the kids. So just having one
> computer in the classroom for Geography is a massive boost and I <u>suspect</u> that that's not
> happening a <u>lot</u> in the other Geography classrooms. And this is going … "there's the
> worksheet" [gestures]. Kids don't ask their own questions, they answer teacher's
> questions. Whereas in my class I take more and more and more liberty with the
> questions they ask. I just give the kids balls straight back at them. […]*

> **HN85b:** *Then also the manipulating of the kids work itself is important. They can email
> me stuff … first drafts … big gain you know if first drafts come through email. I comment
> on it [???] and email it back to them and the [???] draft comes in two days later. [???]
> That kind of stuff is very useful.*

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[18] The school is in one of the highest lightning incidence areas in the world, a fact established by Schonland
between 1955 and 1960. See: http://janus.lib.cam.ac.uk. Given the extent of the playing fields and numbers
of students involved in sports in the afternoons when summer storms are most likely to occur, protection
from such weather extremes are essential.

6.4.3.2 Product innovation

Henry has little interest in teacher-centred technology such as the *e-Beam* and electronic whiteboard (EWB[19]). He would prefer to have networked PCs in order for students to participate actively in lessons.   He shares his opinion on these technologies:

> *HN88: The classroom … an interesting thing about that is Smartboard technology doesn't excite me that much partly because of price so that that other thing which goes in the corner of the board … [e-Beam]*

> *HN90: … which can't do quite as much as a Smartboard but does about 99% of what a Smartboard does [and] is much more attractive. But that kind of technology enhances the management of teacher-centred learning. It doesn't do a lot for learner-centred learning and … um … that's why it doesn't excite me that much as a technology. When you're in teacher-centred learning it's nice to have but I don't see it as dramatically enhancing learning until that is networked and then you can say to the child "Don't come up … don't come write on the board" as we used to say, "but just sit on your computer and show the class what your thinking is. You know, just draw a diagram." So often you get a situation where a kid comes asks a question by drawing a diagram. Now that kind of thing you can improve dramatically with Smart Board technology. I mean it has to be there in a way that the kids can all contribute to that. So your little local … local area networks that talk to each other which the Apple had very easily … automatically like apples on a string …they all talk to [each] other. […]*

6.4.3.3 Information literacy

Henry, like Thabo and Magriet, is also concerned with how students interrogate the Internet, decrying their lack of information literacy:

> *HN27: Yes, that breaking down into smaller questions is to me … <u>so</u> fundamental to education. I don't know if you've seen the quotes I've got above my board. My first one is Piaget "Intelligence is what you use when you don't know what to do" and the second one is "Dare to be wrong". The third one is "You only learn by answering your own*

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[19] Although his preference would be for a less costly *e-Beam*, he accepted an EWB when it was offered. This situation came about as EWBs were passed as an approved technology, ordered and then homes had to be found for them i.e. decisions on purchase were not driven by need.

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questions or by teaching somebody else". And the fourth one is that "The best way to have good ideas is to have lots of ideas". And then I've also got Einstein's "The problems of today are not solved with the thinking that created them". So those quotes summarise the way I see things and we are not generally using our resources to match those ideals. […]

HN23b/25: […] [my approach] <u>manages</u> the question they ask of the Internet. And that's why, one of the reasons why, I think [it] works so well when it's working because they're not wasting time. But, um … when I invigilate other classes in here [...] walking around looking at what they're doing, it's still the shot-gun. This is the topic. Then they get 25,000 replies and they read the one at the top of the list and that's it [...] instead of asking a specific question which is very, very focused. So we can do a lot, lot better at managing [how students use the Internet].

HN27-31: […] By the time they get to Grade 10, that kind of approach they should fully understand, but they don't. If you give them a topic to research they don't automatically break it down. They sit and look at it until you tell them where to go. And that I find scary. So the whole … and I think <u>that</u> comes out of if you go back … if you go right back to really … there's this whole big thing about teaching them to think in prep school. [...]. Imagine if we had those kids coming into Grade 10 – 15 or 16 year-olds – where we didn't have to teach them the content of South Africa. We can now talk about development and those kind of things. It would be a totally different thing. And that's where I think we're missing out. You know, technology of all … technology in its broadest … in its broadest sense.

Information literacy skills are introduced into his Grade 8 curriculum through resource-based learning strategies. Henry has developed a specific methodology for students to use to interrogate information. He is critical of other teachers who he believes do not employ and support question-based methodologies. His views correlate with my observations on this matter. Although all students are provided with a short intensive course in information literacy at the start of Grade 8, there is no process to ensure that the skills and the tools that they are introduced to are used and built upon by teachers across the curriculum, although support for this purpose is readily available.

Higher order thinking skills are discussed in HOD meetings and in other forums (e.g. the Assessors' course). Henry makes two observations about thinking skills. Firstly, he firmly believes that the development of thinking skills underlies students' use of information. Secondly, in his opinion, it is critical that these skills are imbued at the right stage of a student's development. He advocates a stronger focus on basic content in preparatory schools, with thinking skills introduced at a later developmental stage. Further, he points out that the school is not using its ICTs to help develop such skills in students. To Henry, ICTs are key to helping the school achieve its wider goals such as developing the thinking curriculum.

6.4.3.4 Enablers and constraints

Henry highlights a fundamental difference between the school's ICT policy and teachers. There has been a greater focus on limiting and controlling access to information rather than developing ICTs as learning tools with most of the IT budget committed to technological implementation and very little on pedagogical support (Anderson & Becker 2001, p.3). A further example is that the mobile phone policy bans their presence in the classroom rather than exploiting their potential. Like Arthur and Hennie (AS 233/HJ 234), Henry criticises limitations set by the school on mobile phone use:

> **AS233:** *Boys use a lot of cell phones to record experiments. In many of my Matric experiments …*
>
> **HJ234:** *Stop watches. I don't order stop watches any more. Don't tell [the principal] Actually, tell him. I think … we're so stupid in banning this tool. [laughter]*
>
> **HN17c:** *[…] I think there's a technology where the power is not being harnessed because we say "Ah, cell phones are bad". Fountain pens were banned when they were first introduced. And what do we do? We ban cell phones, instead of saying "What is the power of this thing? What can we do with it?" […]*

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Henry is the only teacher to provide evidence of attempted use of social networking tools with students, online access to which is also restricted:

> **HN19b:** *[…] [The students are] talking to each other all the time. […] But, let's use Mxit. Let's get … the power of co-ed without having to put them in the same classroom where they're going to disrupt each other. Um … you know, let's … let's put out this thing that the Science Department does: the question of the week. It goes out … it gets put in hard copy and gets stuck up on the Science walls and the guy who sends in the best answer wins a prize. Why aren't we doing that on cell-phones? And you'd get a far wider response. Um … so, ja, in terms of change I think, we've missed out big time. I think the way that computers have come in we've missed out because we haven't managed the process. The kids are accessing the Internet and they are learning stuff.*

> *******

> **HN23:** *No, we've over-managed the access, but we've under-managed the learning tool … um … in the sense that … ja … I mean you understand exactly what I'm saying.*

> *******

> **HN17d:** *[…] and um… you know that kind of thing. I don't know if you know I had a … an internal Blog on my… with year's Grade 12s Geographers.*

> **HN19a:** *[...] Now, as long as I was driving it, it worked brilliantly, but the moment I pulled back and said "Guys, just keep going" the questions just stopped. And the discussion stopped. I would, if I'd logged them all in said: "Right, we're going to talk today about this, and I'm going to give you marks for the questions you ask", then they were there and their inter-reaction was phenomenal. […] And you put in a question … um … a climatology question say "What is going to be the first impact of global warming?" They all then send their answers to each other and that. And you do get a few side conversations going, but it had to be driven by me to work. Now, I think there is a world, a whole world waiting there where we can teach the kids how to use that to their own advantage as they … I mean, they know it already. […]*

The blog that Henry created for classroom use ran on the Intranet only. However, the limitations of the use of this technology arose as much from student factors as well as policy factors. To succeed, use had to be driven by Henry

himself or it had to be marks-driven and did not occur as a natural consequence of students embracing social networking beyond the classroom. There is a contradiction here, in that while on the one hand he describes students' natural affinity for using social networking tools, on the other he identifies student indifference to applying the tools in the classroom.

While Henry is a constant user of ICT his enthusiasm and ideas do not reach across his department and he appears to be out on a limb. His beliefs about geographers influence his opinion and he has made it his mission to keep his colleagues informed of developments in the hope that, in time, they will use ICTs in the same way as he does. In this case, Henry is the teacher that champions ICT use, but lack of like-minded responses to ICTs thwarts more extensive use across the department. Henry explains the link between ICTs and geographers:

> **MR105:** *Do you think the fact that you're a Geography teacher … influences your approach to ICTs?*

> **HN106:** *Oh ja, I mean geographers … um … are big picture people and I think, you know, that's acknowledged … that scares the geographers [here] because they haven't integrated their big picture view of the world which obviously the Internet lends itself to. […]*

> **HN108a:** *Ja, absolutely … so it's the big picture thing that allows one to access the Internet. It's about modelling. Um … all of those things that geographers … Geographers are by far the biggest users of computers in the real world, by far ... in terms … in terms of academic use. […] Um … so the … the world of geographic skill has invaded all other worlds through GIS[20] and that influences the way geographers think about things and do things. […]*

> **HN108b:** *[…] I mean, access to Google Earth changes the way one looks at things. And I think that is… that having … we've only just now in the last three months had Google Earth made available on computers. Because of the over-control, we weren't*

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[20] GIS: Geographic Information Systems (see http://www.gis.com/)

allowed to have it. So, we now have one computer in each classroom that accesses Google Earth. Um … I think I'm still the only one that's using it. What I am doing is downloading pictures off Google Earth, giving it to the other teachers [???]. [...] They don't go looking for interesting stuff. When I give them stuff, they're very interested. So, in that sense, the geography has impacted on all of this. More the ICT on Geography, than Geography on ICT and the department as a whole, although my approach as the geography … big picture, looking for knowledge, looking for connections. It's as it's always been … well, I've only used it in that sense.

In his response to the question on how he would rate the significance of ICTs compared to other changes at Wilding Henry, like Ineke, expresses the belief that the use of ICTs is far below the potential, given the network. To rectify this would require a radical change in systemic factors which he no longer has the energy to strive for. Henry explains:

HN110/112: I think that we've done about 20% of what we could have done, given the network that we've got. Um … […] Because of everything we've said earlier about the way we approach computers and that … and … and … you know that blogging thing … we could have revolutionised the way we taught. "Kids, don't come to school today. Let's all stay at home and we'll talk by computers; not because we're lazy about coming to school or producing our homework [???] or anything, but because it creates a record of what our conversation is". You get … and you're forced to think about what you're doing. You're not just going to … and this is why the kids are so into Mxit. Because it's intellectually stimulating. Even if they're just exchanging humorous trivia, it's intellectually stimulating and we are missing out massively on the potential of the network […]   Do any of [the computers] talk to each other? Not … not as far as I know.

HN116: I mean there is an opportunity waiting to be explored. So we're way, way short of where we could be. There is none of the … I mean we're talking outside of the computer department. I don't know what's happened there. There's none of … imagine if we could get a debate going on why gravity's important among the Grade 10s in the Science department. And then they teach gravity. That comes after. So I really believe 20% is a fair figure … potential compared to what we've achieved.

> *HN121: I don't think so. Um … if I was 40 I would probably approach it far more aggressively and make it happen, but at this stage of my life I tend to think it's not worth the effort that's necessary to get it to happen. But also, we are locked into such a model that you've actually got to just about tear the buildings down and start again, let alone … let alone the management structure of the school in order to make real learning happen. And that is a frustration … […] But within … within the learning model that we've got, it comes down to individual enthusiasm, and while I have the enthusiasm I personally [???] classroom.*
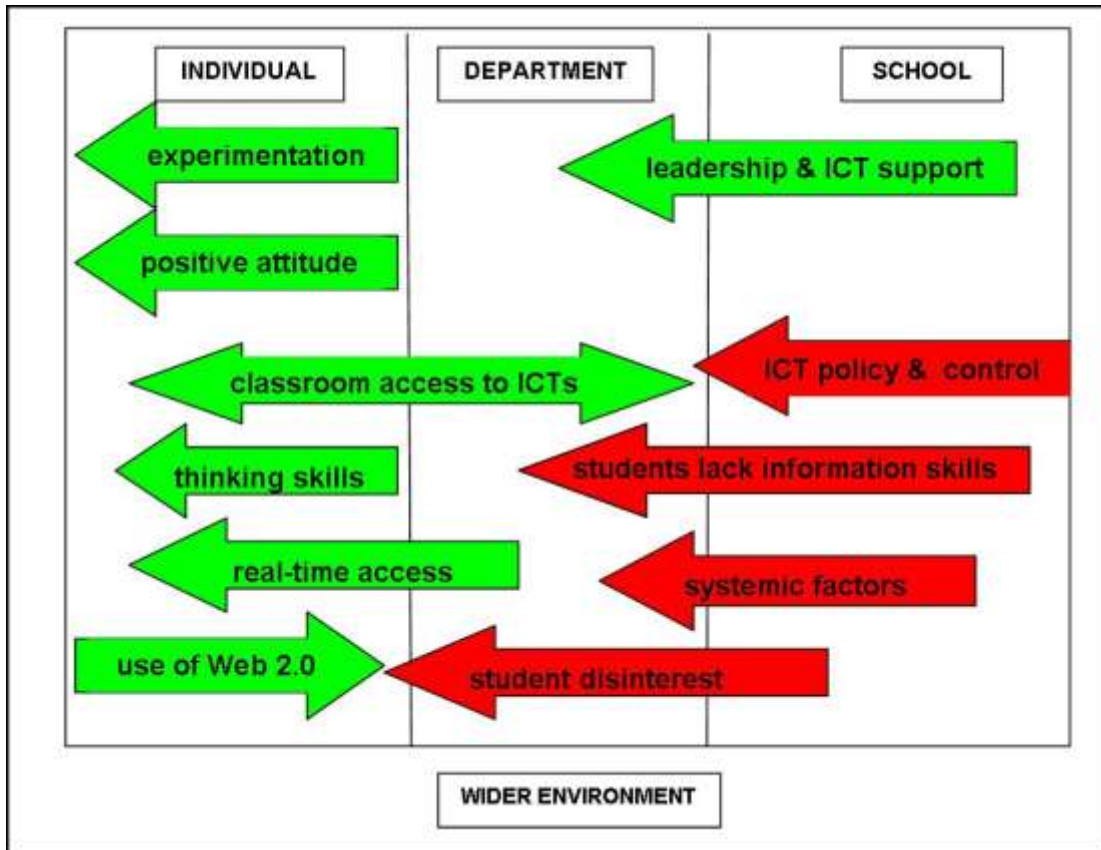
Whilst Henry acknowledges the support of individuals in the school leadership and the IT department, he believes that the ICT policy and the learning model as implemented in the school limit innovative use. The example he provides of restrictions on Google Earth illustrates technology-based rather than curriculum-based decision-making, although bandwidth is a very real factor. Part of the problem is that there is no access to social networking technologies (blogs, wikis etc) and students are not permitted to publish their work to the Internet via the school network. Students use their own mobile devices for social interaction, but are prevented from using them as learning tools.

6.4.3.5   Summary and preliminary findings: Henry

The pattern of convergent and disconvergent factors that affect Henry's use of ICTs are illustrated in Figure 6.4.

Henry is enabled in his innovative use of ICTs through his comfort with technology and his approach to constructing knowledge. Classroom access to ICTs allows him to incorporate real-time global or local events or conditions into his practice. In this case, the nature of the subject, his enthusiasm for his subject, the presence of ICTs and his ability to exploit opportunity timeously converge to allow real-time learning experiences. Lacking ICTs, such experiences could not have occurred.

Figure 6.4: ICTs and innovation: Henry

Despite the convergence of many factors in enabling his innovative use of ICTs, disconvergent factors limit the extension of his innovations on a broader front. Whilst he acknowledges the support of the current leadership as well as the support of individuals in the IT department who help facilitate his incorporation of ICTs into his practice, technology-based rather than curriculum-based decisions frustrate him. There is a contradiction between students' social networking skills based on mobile technology and their inability to work co-operatively in the classroom. Students need extrinsic motivation to use social-networking tools for school purposes. Access to online social networking tools is prohibited and students are unable to publish their work via the school network. His thinking is out of alignment with that of his colleagues in his department and his championing of ICTs therefore goes partly unheeded and limits extensiveness.

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He is also critical of other teachers' shot-gun approach to research which adversely affects students' information literacy abilities.

Henry describes a mismatch between the capability of the network and how it is used for learning. He concurs with Arthur and Richard that access to ICTs is over-managed whilst learning is under-managed and that the school is locked into a model that is limited by systemic factors. Henry describes not only what is, but what he would like to see. His creative thinking continues through the interview which he uses as an opportunity to share ideas. He believes that his ideas are ahead of the school's thinking, but he cannot progress further personally because of the policy and systems that control the use of ICTs.

Systemic factors are the greatest constraint to Henry's ability to innovate with ICTs and relationship factors curb the influence that his creative thinking might have had. Age and experience resign him to the problems rather than encourage him to contribute to a solution.

When Henry refers to his practice he uses the singular "I" and when referring to the school he uses "we". He speaks either for himself or for the school, but not for his department, illustrating the lack of alignment with his department's thinking.

6.4.4 ICTs and innovation: the case of Richard

There is contradiction in the case of Richard in that, despite his affinity for innovation with ICTs, his goals are constrained by student-related factors as well as fellow-teachers in the practical component and by limited information literacy skills in the theoretical. The school's approach to ICTs also has a limiting effect.

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6.4.4.1 Process innovation

Richard is a highly competent user of ICTs with responsibility, *inter alia*, for the school website. He has introduced Computer Art (RL20a: Ch.4 Section 4.5.4.2, p.188) into the IEB curriculum nationally. However, contrary to expectations of students as digital natives (Prensky 2001, p.1) his students have not taken to Computer Art as anticipated. Richard describes his dilemma in detail and offers possible reasons for the lack of success with the medium:

> **RL77:** *It's definitely something in the way they use it. Obviously it's not being … something's wrong. I mean I also did … I gave a course on teaching the IEB teachers. So one would have thought there would have been more IEB schools using … well, pushing that area in the arts and there have been – slowly. As I said, there were these two girls last year and a couple of schools have done computer art now. But it didn't … most teachers when I'd finished my demonstration and presentation I felt were scared. And I tried to take away the fear. My whole point of the demonstration was to show teachers that they don't need … I gave them techniques on how to teach without knowing anything, without knowing any software. How … that was my problem when I started teaching … um … using more sophisticated tools than chalk … was how do you teach something if you don't know how to use it? How would you teach how to drive a car if you don't know how to drive a car? So that was my problem. That's what I tried to teach the teachers. So I developed techniques for that because obviously … teaching, you … I think you learn more because now you've got a lot of people teaching you back … students teaching you back. And I think if you can just motivate it and use it and that was a technique I came across quite early in my teaching of computer art. Because, as I say, I started it, but it doesn't mean that you know everything. Even today, even now, the students will come and teach me. And that's what … but the teachers didn't quite get it … I felt [laughs]. But there has been a gradual increase of teachers now allowing students … like I was discussing at the last conference … the one teacher came and said I should come and do a demonstration at their school because they don't know anything how to teach them … ja, and to me that's just fear, I suppose. That's what I was just talking about … you've got to lose that. <u>And</u> if you're interested, then you just do it. I feel it's <u>essential</u> that those things are taught, that's why I offer it. But I have allowed this window, this door and … um … you know, the student is really, they just can't get it. I don't know what you do. My technique at the moment is now really going … because I'm now like going like I would go with … I suppose as if I was teaching Grade 4 [laughs]. So*

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far, that's the speed I'm working at now with this technology. So we've had to go really slowly.

RL79: It's not only what I have time for, it's not what I believe in teaching. I don't believe in teaching applications. I'm still trying to find a way of solving that problem. For me it's basically the students don't have the background. Um … and I don't know if they see the worth of the tool – technology. Either it's that <u>or</u> … the technology, the Internet, the computer is outdated already. Computers and PCs need to be thrown away – basically - in education. So, it could be that and that the new tool is the cell phone.

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RL83: […] I went to a conference on communications in Africa. [...] They made … one of the statements that struck me was Africa […]. But they were saying that Africa has the highest sophistication of cell phones. [...] There's a guy who's come out here promoting some … I think it's like a Mxit kind of thing. But he was saying exactly … they <u>want</u> this market because Africa is … has the most sophisticated … uses the cell phone in the most sophisticated way [...] compared to American and the Europeans.

RL85: [...] phones are becoming more … Internet based as well. So you're going to have more and more of that kind … but I personally haven't yet seen a way of being creative on it. You can be creative <u>with it</u>, but not on it … in it [laughs]. You know, I think it then goes into the field of programming and that's where I would go, but it would move away from what I teach.

Richard is surprised and disappointed at the resistance to computer art from his students as well as from teachers at other schools. His personal experience with the medium has been extensive and he has run a course in computer art for IEB teachers i.e. his level of innovation has extended to professional training of teachers from other schools.   He identifies that *'something's wrong'*, and suggests theories for what that might be.   However, Richard also imposes self-constraints in that he does not believe in teaching applications. His methods encompass the acceptance that teachers can learn much from their students and he tries to transmit the concept of fearlessness of the unknown to other teachers, but with little apparent success.   In this case, his difficulty in sustaining the

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innovation arises from the distance between his own creative ability and that of his students and colleagues. The innovation has extended to the highest level and the ICTs are accessible, but the perceived benefits are not yet mutual and sustainability of the innovation is very tentative.

6.4.4.2   *Factors influencing ICT use*

In response to the question about the significance of ICTs compared to other changes at the school Richard contextualises ICTs, suggesting that there are a number of issues:

> ***RL91/93:*** *It'll be interesting … I think it's … I think there's a lack of [use]. I think traditionally in schools there's always been … it comes from the education and training. There's always been a lack of how one would use … um … equipment and what it is … and I think you basically summed it up when you sent around that document. For me, I sort of agreed with it. […] The [document] where you[21] basically said the administrators of the network can control the managers … um … through [laughter]. So I think we're at that place, we're at that point. You know, I don't think we've moved … and I think we're there, ja. So, it's like, I think, traditionally you had your accountants controlling managers. […] And I think now what's happening is that accountants still have their power, but the network administrators … I think can control the way that education … the use of the tool. And I think that is … and management doesn't understand that yet, in this environment.*

> ***RL95:*** *Well, obviously … you see, this is why one wonders if it is a tool that getting outdated and outmoded. The network has become so restrictive that its almost redundant … um … through security on the one level and on the other level its … um … in an environment, in a school like this where possibly there's such a huge usage … um … and I'm not too sure what … its obviously just got to do with money … one needs a broader band or something … but the bandwidth is too small. So, for example, when one is researching … I think when you ask students … not just researching … and to go on and to get information using the technology available, I think the educationalists need to sit down and try it themselves first, in the class, with the students. I know I've done that –*

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[21] The article that Richard refers to is one that I circulated but which I have been unable to trace again. The article, as far as I recollect, is one that intimates that schools are under the control of ICT managers.

often - and I can understand why they go berserk. It's like watching paint dry. It's really frustrating, so ...

RL97: […] Now I'm talking about more the loading of … of information. So we're talking … even test. So if you sit and you're sitting with the student and you set them a task, sit with them and try and do the same task, it's so frustrating. Now working … and I found this right from … because I used to actually run a network at the last school I was at … except I ran it. It's always been an issue, this bandwidth issue. Its money versus who's going to put it in and who's going to pay and management normally doesn't see the value in it and they'd rather have another rugby field and another rugby ball because there you can fill your numbers because there you can see what you're doing whereas this is invisible. So why should you plough too much finances in? And I was quite … [this school] obviously ploughs millions into it … meant to be cutting edge, etcetera … of education. But it hasn't taken off that way and also … because of things like that … one is restrictiveness. The other is the bandwidth. It just doesn't load, it doesn't work fast enough. And I know about schools and models. I was involved with all that many years ago. [...] I've sort of been through that route and it still hasn't taken off. Is it just because its not management driven – which is, to answer your question, I don't know. Or, is it because it's redundant already? That I don't know either … um … but I'm open to both possibilities [laughs].

The disconvergent issues that Richard raises are fundamental:

- the basic understanding of what a computer is and how it can be used in schools
- the predominance of the technical view rather than the educational view
- lack of understanding of the problem on the part of the school leadership: the use of ICTs is not driven by the leadership
- whether the PC itself is outdated
- restrictions on the network that inhibit the educational purpose that it is intended to serve
- lack of understanding of the reality of classroom use by the network administrators and

- competing priorities.

6.4.4.3   Intra-departmental collaboration in the use of ICTs

In response to the question regarding working together with others in the use of ICTs, Richard re-iterates what he said earlier (RL24-28 Ch.5 Section 5.8.1, p.247) about his collaborative relationship with his colleague. Good relationships are essential to the successful functioning of a department.   An earlier experiment by the school with different roles had proved unsuccessful and been dropped in favour of a single HOD:

> *RL87: […]   I think if you're working with somebody who you relate to it works well, the system works well. The system didn't work well when she had less time, when she … when she was made HOD of Arts & Culture or something. Then the system didn't work because there were no guide … no leadership. So I think it works well when there's a leadership … because then we were two leaders trying to lead and we were walking with one foot forward … [laughs] … strapped at the ankle, going nowhere. One going that way, one going that way [gestures left and right].*

6.4.4.4   Enablers and constraints

Student application skills do not meet the expectations that Richard has of them. While the students come from privileged backgrounds and have access to a range of sophisticated technology, Richard claims that students still do not know how to apply them appropriately:

> *RL68: […] the parents are normally providing and with all these modern gadgets which are quite costly. But what you find – I find – is that in actual fact the students don't know how to use those tools still. […] And I thought that this would get <u>better</u>. You know, when I started teaching computer art which is most probably about 15 years ago, maybe longer … that … I thought in about 5 or 6 years time these kids will be coming through and they will already know everything and I'll … you know … won't need to teach them silly basic stuff. […] I try and teach the thinking skills behind it. We try and get over the software. […] I find that the students are still coming through without the basics […]. So*

> *I think, if you speak to most students, they've got them at home, they've got them in the education environment, but they don't <u>really</u> know what they're supposed to do with it.*

Similarly, Richard finds that students lack information literacy. His views concur with those of Bronwyn, Ineke, Thabo, Magriet and Henry as well as my observations. Richard finds this particularly evident in their Internet searches for the theory component:

> **RL73/75:** *But even for the theory there's a lot of Internet research. […] And they're quite naïve about … seeking out information around the Internet which is shocking. […] I don't like to call it research because it's not really research, but their seeking of information, images and information. Um … which is very poorly done, poorly understood. Working in documents, text documents which is the lowest level of working possibly with the computer. They struggle … they seem to struggle. […] Ja, so the technology … I don't know where it's … where it's going to run. I've had to change my technique with the Grade 10s from last year, this year already … last year … last year I had 100% drop out in computer art. That was merely my misunderstanding, I think. Because I thought … […] My misunderstanding of the level of their understanding of the tool. Because I tried to get away from all the software teaching and moved towards the creative teaching too quickly. And … it just never finished … the whole class just dropped out. […]*

Richard eventually concedes that he misunderstands students' levels of understanding.

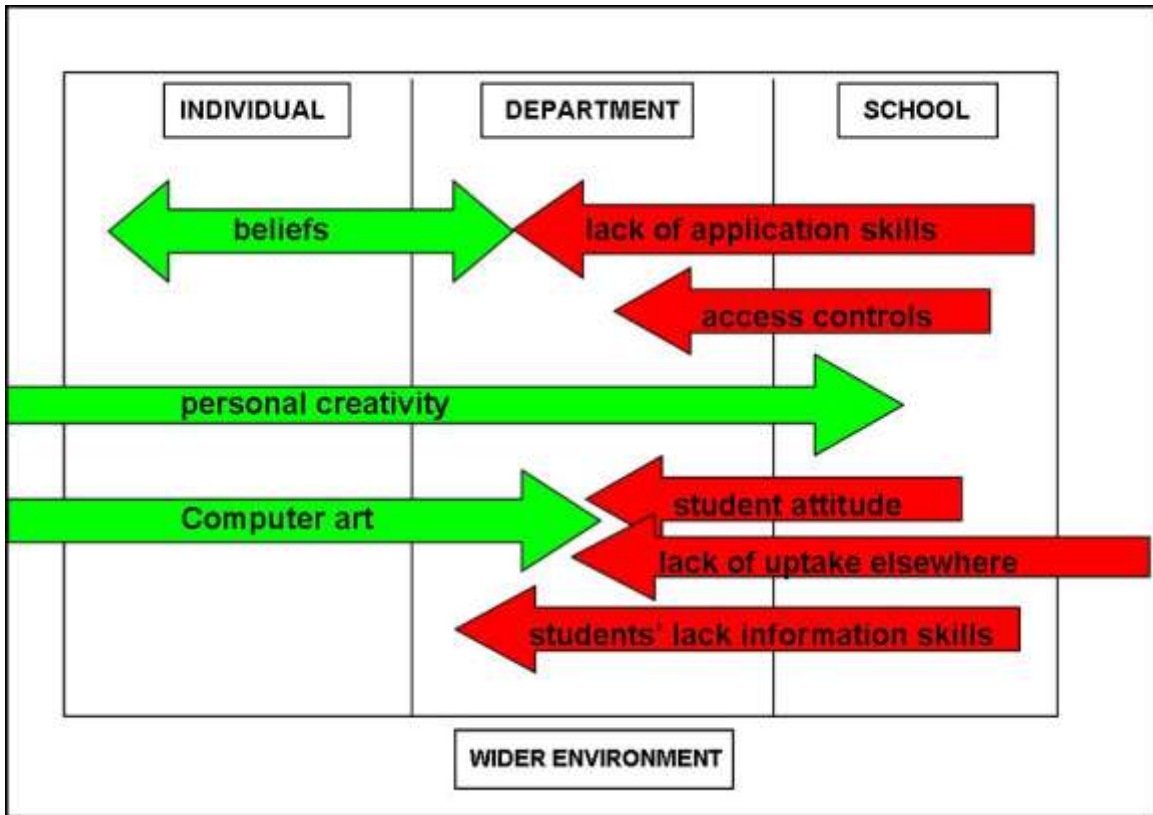### *6.4.4.5   Summary and preliminary findings: Richard*

The pattern of convergent and disconvergent factors that affect Henry's use of ICTs are illustrated in Figure 6.5.

Richard is highly competent in his personal use of ICTs and a creative innovator in the classroom. He has wide experience of ICTs, including experience of managing a network. However, he is frustrated by apparent student disinterest in

using ICTs as a creative medium in Art and by lack of open and consistent access to information. Richard also suggests that these factors are linked in that access control inhibits learning to the extent that students are turning to their own mobile technology for solutions. What this might indicate is a developing disjuncture between what is now a traditional provision of ICTs to schools and a more flexible mobile future that needs to be factored into long term planning. It is therefore possible that students' increased reliance on their own mobile technology is driven by their frustrations with access to information as this disconvergence occurs in all learning areas and not just in Art. However, difficulties associated with student learning may also be a factor in this particular case. Whilst there is convergence of a creative mind and provision of ICTs, the potential is countered by disconvergent factors and sustainability is tentative.

Figure 6.5: ICTs and innovation: Richard

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The question that arises in Richard's mind is whether students have now gone beyond the personal computer as a tool and have, instead, a greater affinity for mobile technology that does not offer the necessary scale for computer art. There is a parallel between Richard's belief and what Henry finds with his students' apparent disinterest in using social networking tools in the classroom. Both teachers link this resistance to the influence of mobile technology. However, while Richard is disappointed in his students' attitude towards computer art, his view contrasts with that of Bronwyn and Ineke who believe that the effects of ICTs are very visible in the products of student learning. Secondly, although Henry and Richard concur on social networking and mobile technologies, Henry's use of ICTs for real-time learning parallel those of Bronwyn and Ineke suggesting that there is still very much a need for 'traditional' PCs. The variation is in the nature of the subject and the degree of specialised tools that each requires. The tendency is to refer to ICTs in schools in generic terms, whereas each subject area requires a different set of tools and a customised response to its needs.

Similar to his colleagues, Richard makes the assumption that students acquire information literacy skills elsewhere. This is a further fundamental point which begs the question of what can be assumed of student skills, particularly as they reach high school, and what has to be specifically taught. If lack of information literacy, for instance, is recognised by almost all teachers, where does the responsibility lie for rectifying this situation? Information literacy is embedded in the critical outcomes of the curriculum and needs therefore to be incorporated in every subject. It would appear that the requirement is being embedded without the scaffolding of the complex skills that comprise information literacy.

6.4.5 ICTs and innovation: the case of Maria

For Maria, process innovation is essential due to the nature and circumstances of the subject. She is reliant on the integration of information literacy skills in certain modules.

6.4.5.1 Process innovation and information literacy

Although she experiences logistical challenges in delivering the LO curriculum across the entire school, Maria embraces the idea of ICTs as part of the solution, particularly for Grade 8 and 9 students. She is influenced by the expertise of others and expresses keenness to experiment herself:

> **MW158:** I want to use it more. I know <u>I can</u> and I want to use it, especially in LO, I <u>think</u> I can definitely.

> **MW162:** I think its right at the forefront, at the top, honestly. Um … I think its something that the teachers must and should use more and its there and it's available, I think, and there are people who can help us. […] [T]here are people in place like yourself etcetera who we can approach to help us if we don't know how.

Maria is modest about her own abilities and acknowledges that it is through collaboration that she is able to integrate ICTs into the LO curriculum. Through our working together in the information literacy course she experienced the extent of students' PowerPoint technical skills. The methodology we use relies on customised templates to scaffold the learning process. Rather than teach applications the acquisition of technical skills is integrated into tasks using templates that require e.g. text-box controls, hyperlinks and inserting graphics. Research skills and presentation skills are also built into the task. The design of the tasks is originally based on a format gleaned from the *Intel Teach-to-the-Future* course. Initially, I would do most of the skills teaching, but Maria now facilitates the classes on her own. Maria describes the positive response of the

boys to the variety that these methods provide and the benefit to student learning:

> *MW130/134: Oh … OK. So that's been a huge … that AIDS brochure has been fantastic. Then obviously your … the presentations, but that wasn't what … but, you know for B2K, that you did with the Grade 8s. Then also last year we did a very nice project on religion … the religious leaders that they actually saved into Assignments. You know, that was also … I think it was … I can't remember if that was a PowerPoint? […] But that was very good. But I think I've still got a way to go with the IT.*

> *MW140: I had to do HIV AIDS with my Grade and I approached [laughter] this phenomenal lady. Mary, I have learnt so much from you and you have never had a moment when you couldn't find a solution for me. So, I don't know if I can talk to you personally, but every time I have approached you, you have made a plan. Um… that religious project was <u>huge</u> and you had that Intel thing set out and they … it was fantastic, so … and the AIDS brochure and the B2K project presentation … I don't know where you get all your ideas from. But anyway, you have been a life-saver to me.*

> *MW142: Yes, it does, it does [make a difference]. Um … I do believe, you know, if you vary the way you teach or facilitate teaching to happen, it benefits the boys. That goes back to the question you asked me just now. I think it helps them if there is a bit of a variety. You know, they expect entertainment 24 hours a day which we can't accommodate them. And I … I do get … I do resist that at times. I think, you know, you can't be entertained all the time. But that variety and the … to ask them to do something in a different way, in a different format, that definitely, I think sparks something in many of them.*

6.4.5.2   Constraints

Lack of access to the labs inhibits Maria's further use of ICTs. She identifies projectors and electronic whiteboards as possible classroom solutions, but graciously concedes that, although the lack of such tools in her classroom limits her, the school has more ICTs and better circumstances than most other schools:

MW166: Ja, well. Maybe we're restricted, logistically, by the fact that we have only two computer rooms that's allocated to the teachers which I can fully understand. I don't know if we'll reach the stage where we'll have more teachers fully equipped with Smart boards and projectors because I think that's a fantastic way to go. And we're so privileged that we do have, that we do have that. I met a lady on Friday from Pietersburg. She teaches Grade 8s. She's got 60 learners in her class, who cannot … most of them cannot understand English yet and she's got to teach them Afrikaans. She at least knows a little bit of Sepedi. So she does three languages to 60 children in a classroom. And I just realised again, we are really privileged. We might moan now and again that some of our classes are big etcetera, but we've got so much that others do not have and I think we must really use that.

MW168: Ja, ja. So, the fact … look, I was so inspired after the B2K presentations, so maybe the fact that I don't have the projector in my classroom can be seen as a bit of an inhibition. So, I think that would be more the fact that we don't have a projector in all the classrooms or a Smart board in all the classrooms or whatever. But, you can always make a plan. You know, its not, I think, a train smash at this stage. The biggest problem is that when you want to take your kids to the computer room, you are not always able to do that. But you can also understand that. It's not … its one of those things. I mean, its not … we do have the facilities, its just that there's a big need, maybe.

6.4.5.3   *Summary and preliminary findings: Maria*

The pattern of convergent and disconvergent factors that affect Maria's use of ICTs are illustrated in Figure 6.6.

Maria rates ICT use at the forefront of change and has a positive attitude towards them. Although her own skills are limited, she is aware of what can be achieved through using ICTs through her willingness to work collaboratively. She is confident in her students' ability to use ICTs, if not in her own competency. Maria invites collaboration and is grateful for what she has learnt from colleagues in different departments. She believes that with the available support there is no excuse for any teacher to not use ICTs. Access to the labs is, however, a constraint, particularly as she has expended effort in designing ICT-based tasks.

Figure 6.6: ICTs and innovation: Maria

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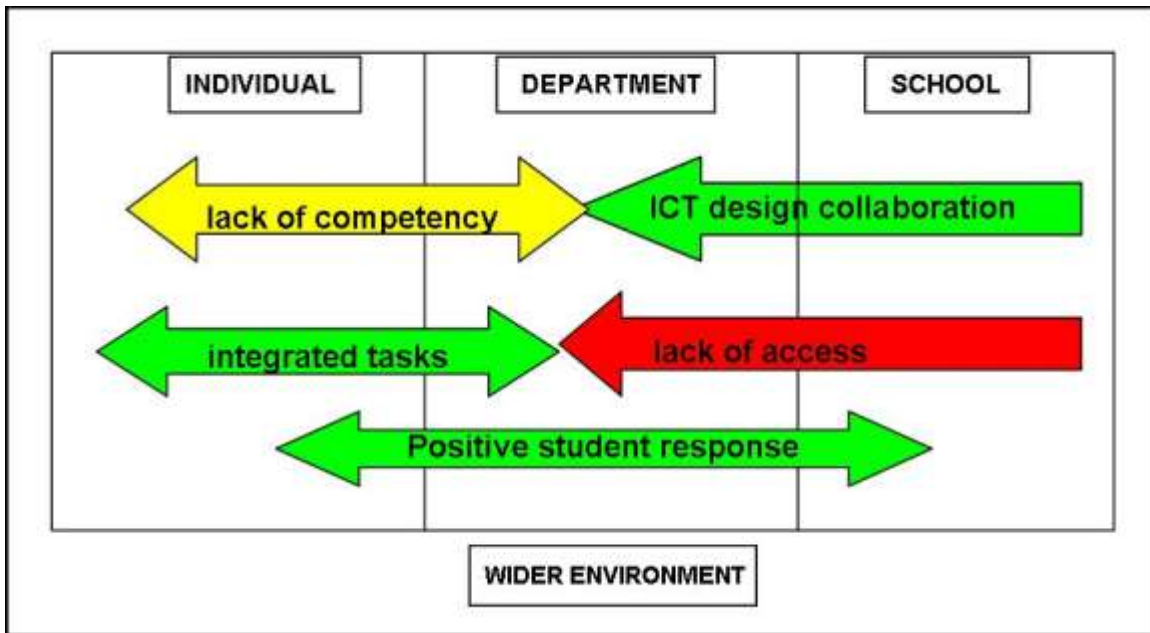
6.4.6   ICTs and innovation: the case of Francois

While Francois' aim is process innovation the beliefs he shares relate to product
innovation. Systemic constraints play a significant role in the case of Francois.

6.4.6.1   Product innovation

Francois believes that the socio-economic status of the students drives ICT-
based innovation at the school. His use of language (*'alarming'*, *'frightening'* and
'terrible') conveys his view of the school's and the teachers' race to keep up with
technology.   Francois shares his beliefs and suggests some solutions to the
dilemma:

> **FP88:** *I'd probably say … I think there is a huge significance to using [ICTs]. Um … you
> know if you look at what is available as such and then … the jargon that the boys have
> got as far as … it's just frightening, it's alarming. And I suppose … you know, to an
> extent … you … it's terrible to think that it's all a race and you've got to keep up and
> provide them with that all the time etcetera, etcetera. But I think realistically that's what it
> is.*

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FP90: Well, [its] terrible in the sense that … well I wouldn't say terrible … I just think its great having those things and being exposed and all of that. But it's time-consuming too from the point of view as I mentioned. I mean, take the software programme. I need to go … I need to go and do a course to become literate in that. Um … you can't be expected to teach that if you're not literate … if you're not literate in the subject at all. And you've got to provide the service etcetera, etcetera. So that … that's difficult. I find that hugely daunting. That, you know, well … time, time's the biggest thing [juggles hands]. It's the biggest constraint. And the matter of extending yourself and learning something else … it's fantastic. But within the broader [school] community I think it's essential. You have to, being the school we are and the community we service. It's essential, it's a necessity.

FP106/108: The need is there [for laptops]. Definitely. Definitely. […] Absolutely. Absolutely. And I think also, you know, just going with the way time … things are moving – um portfolios, projects, etcetera, etcetera – you know, if you could do a lot of that in class as opposed to sending them home, I think that could be a solution too. Because I think the boys are feeling the pressure just as much as we are.

FP110: [The pressure] [i]n terms of workload and expectations and being compliant as such [gestures " "]. You know, the lingo for Grade 11s at the moment is "You know. Job. Prospects for the future. Subject choices. Are my marks sufficient?" So I think they're feeling those pressures and, you know, are they sufficient? And if you provide a service where the boys are certified in Pastel, as an example – an accounting software programme – by the time they leave Matric, then it's … its another big tick on their CV, which makes it so much more marketable. So that's the big need as far as I'm concerned. You know, for instance if we could have, you know – coming back to that – having a classroom that's set up for that … is compatible, Wi-fi, computers … everybody brings their notebook. "And for the next two weeks we're in this classroom. We're doing our software package and your projects come in at the same time. And at the end of it you're getting a certificate which you can apply to that software package. You're killing two birds with one stone".

FP112: Ja. […] So that to me is just hugely beneficial. But when we get to that stage, it'll be great.

> *FP114: […] It's just the exposure to … access to the software programme for the boys and giving them the exposure and the time to do it is … is the biggest … the biggest thing.*

6.4.6.2 Constraints

The use of ICTs is mandated in Accounting as students are required to be able use an Accounting software package. However, an overloaded curriculum and lack of access inhibit the use of ICTs in this learning area. Francois explains the particular problems associated with his subject:

> *FP12: We're scurrying … trying to say "What do we leave. What can we give them for self-study", just to [get] through the syllabus. That's it. And not to mention doing the software packages.*

> *******

> *FP68-76: […] Well, I keep coming back to the software programme. We went and purchased the software programme with the intention of getting it going or showing them some exposure in the classroom. Um … we canned the idea. We lost the computers. […] Well, the software programme we bought initially couldn't be uploaded on the system because we'd have to get them … um user rights or something. So it means that … not just accessing that software but they'd be able to access more documents on the network. […] Yes, it's like an admin rights issue […] that was supposed to be a problem. And to order a … a sort of a <u>dumping</u> ground to store that … that software in and for them to use it, it was going to be too expensive. So they've chucked that idea and they've bought other accounting software now. So, ja, so it's been a bit of a process to get that. And, I'm not au fait with the software programme so it's a matter of being retrained and a whole new approach. […] Yes, yes [other schools have used the previous software]. And that seemed to be no problem. Now, whether they've got it installed on just isolated computers in the classrooms, I'm not sure. So, we just need to have a look … But, I mean, the software programme that the school's acquired is great. Um … it's just a matter of finding time. So the idea now is we're probably playing with boys running a six-weeks … a six-week course on Saturday mornings. And then they'll get a certificate that they're competent and that sort of thing. So that's the other alternative because syllabus-wise there's no time to fit it in. We could actually give up six*

full days to get on top of the software package, to introduce them to it. […] So, ja, it's a difficult one.

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FP92: […] I mean, for instance, you know, I talk about booking the Computer Lab for 3 days of … computer training on the accounting package. You can't do that. Because Computer studies … or, ja Computer Studies, that's what it's called. That's their … that's their classroom. So that's not practical either.]

Accounting requires ICT-based methodology and specialised software, but in seeking to use it Francois has been thwarted by factors beyond his control. Specific software was purchased and he inherited a complement of 30 recycled computers adequate for running that software which would have worked perfectly as a stand alone system for the purpose as it does in other schools. However, school policy dictates that all computers must be linked to the network. The conflict could not be resolved and the Accounting department lost the computers in the classroom and their ability to teach with the most appropriate software. Instead, the software was changed. Francois and his colleague were required to retrain on the alternative software and now need to queue for an in-demand lab venue instead of a having a dedicated cost-effective facility. Francois' frustration is glimpsed in his words *'so they've chucked the idea'*: he is it at the mercy of the system.

Francois' frustration emerges again with the few options available to him. In response to the dilemma, with some irony, he considers a 'tour'[22] solution as a possibility for working with his students over an extended period of time. This is a further example of systemic factors inhibiting mandated curricular change. The system creates the problem, but the teacher has to find a creative solution out of necessity:

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[22] A tour is a diarised event, planned in co-operation with other departments, which takes the whole Grade or part of a Grade out of the classroom for a full day. Typically it is an actual day-tour, but FP suggests the idea to solve the access problem.

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FP78/80: Absolutely! Look, it's something that has to happen. I mean, we have to … but before the boys finish Matric they have to have had some exposure to a computer programme somewhere along the line. So, you know, there's … trying to get our head around what is the best option with everything that takes place … sports-wise, culturally, to say to the boys "Now, you need to give up your Saturday mornings or Friday afternoons or something like that to come and learn a computer programme" … it's a bit difficult. You know, and it's not one of those where you can probably say "Let's do a crash course for a full day". So, I'm at the point where I'm about to say "Well, you're going on an Accounting tour. Let's just do our computer department – for 3 days". And they get a crash course on it. [laughter] You know, it's almost getting to that situation [throws up hands] just to give them the exposure and some sort of feed back … […] so, ja. It's a difficult one at this stage.

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FP96: That's [access is] the problem. Absolutely.

Student factors also provide a point of conflict:

FP4: […] And also now, with the boys being so computer-literate as they are, they can't understand why they've got to do written work. Their theory is that it should all be done on computer which is what happens out there. So … so that's very interesting trying to incorporate the computer side and give them the foundations of … 'cos computers … you tell them the figures and it does it all for you automatically for you. You tell it it's an invoice and it gets put it in the right places. And that's what the boys don't understand. They need to understand <u>why</u> an invoice is put in those places not just assume that it's happened. So that's been a difficult one for them, to get across. […]

6.4.6.3   Summary and preliminary findings: Francois

Access to ICTs is critical to Francois' practice, yet access is restricted by systemic factors. With his creative solution curtailed by the IT management he has instead, to achieve his curricular goals with the standard ICT configuration, to consider running a course for his students during the school holidays as well as incur the expense of changing to a less effective software package. He has a clear vision of the way forward, but is constrained in what he has to do because

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policy does not match his curricular needs. Student expectations are that their course should be delivered entirely via ICTs and they appear to miss the point of learning principles. Francois offers an alternative solution that would require a change in the grammar of schooling: dedicated access for a two-week module in his subject. In this case necessity would be the driver of innovation. He also provides constructive suggestions on how the school might solve the problems he and others face.

Figure 6.7: ICTs and innovation: Francois
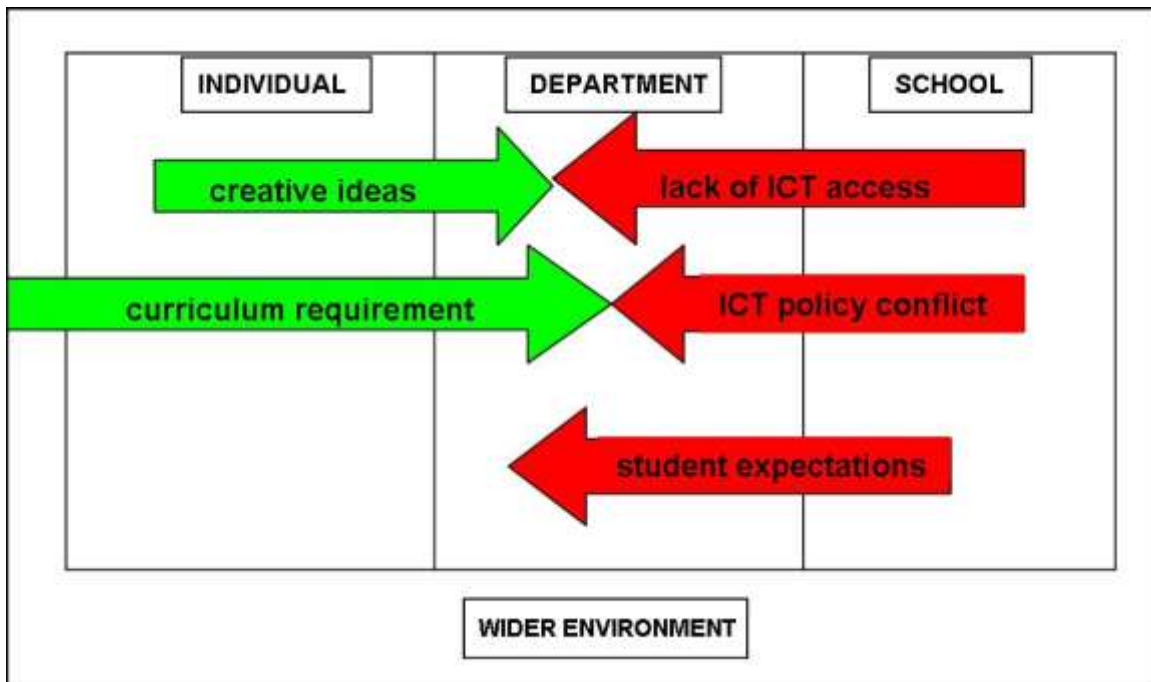
Francois envisions the laptop as a prerequisite, together with a wireless network, as a viable alternative within 5-10 years in Accountancy. He further suggests that the need for laptops[23] exists across the curriculum, arising particularly from project-based work and assessment portfolio requirements and that the school should respond to that need. Intertwined with the curricular needs are the demands of the job market and enabling students with specific work-place skills.

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[23] At the time of the interview alternative smaller-scale mobile technologies such as i-Phones were not yet as prevalent as they have become in the interim.

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In Francois' case, the conflict between policy and practice is blatant and an innovative solution has been curtailed by technology-based rather than curriculum-based decisions. Creative energy has to be directed at countering policy-based decisions instead of at the curriculum. Francois overcomes the limiting factors to do with the newness aspects of his role and there is convergence of opportunity, vision, physical facility and need, but disconvergent factors predominate.

6.4.7 Preliminary findings: ICT integration and innovation

ICTs at Wilding College serve four purposes: as a teaching tool, as a student learning tool, to support the wider curriculum and as an administrative tool for teachers. The intention of the use of the ICT tool in the curriculum varies according to the nature of the subject. In Accounting, ICT use in the curriculum is a practical necessity, while in LO Maria uses ICTs experimentally in developing her curriculum to suit student interests. For Henry, Bronwyn and Ineke, use of ICTs is integral to their practice, while for Richard ICTs are fundamental to the specialised sub-discipline of Computer Art. In Physical Science there is more emphasis on ICTs (and projectors in particular) as demonstration tools and on multi-media as a learning resource.

Teachers rating of the use or significance of ICTs in comparison to other changes at Wilding College were varied and unpredictable. It is apparent that most teachers saw ICTs as a significant means of meeting the requirements of the new curriculum in either productive or generative ways. However, despite the presence of an extensive network of computers, they were constrained by systemic factors such as the timetable which impacts access to the labs, inequitable distribution of ICT resources or teaching overload. ICT competency levels were not a factor with only Maria indicating any limitations to her ICT competency, although this did not deter her.

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The interactions between different factors were similar in a few cases, but varied overall. Convergent and divergent interactions with ICTs are identified and summarised in Tables 6.1 (convergent) and 6.2 (disconvergent). The factors included in the table are those mentioned in the extracts above and are intended to show the varying array of positive and negative factors from the above data that converge in the innovative use of ICTs. The table refers only to factors that were indicated by the teachers and is therefore not exhaustive. The tables therefore give an indication of the array of factors rather than an absolute measure.

Tables 6.1 and 6.2 indicate that the convergent and disconvergent factors interplay in different ways for each teacher. The nature of the subject, a focus on student-centred use and curricular goals are predominant convergent factors. Accessibility and lack of information literacy are dominant disconvergent factors. For Bronwyn and Ineke there is strong positive convergence and few disconvergent factors. In contrast, for Magriet and Thabo there are more disconvergent factors and less convergent factors. In a few instances, such as Richard's case, the teachers' intentions are positive, but other factors negate them. The intensity of the factor is indicated in the text.

Teachers' means of acquiring ICT skills influences their use of ICTs. In two cases (Ineke and Richard) their use of ICTs outside of school purposes has had a significant influence on their approach to ICTs in the curriculum, although their application is different. In contrast, Magriet has, since her appointment, been totally dependent on input from the school in developing her knowledge of ICTs, while Henry's curiosity led him into curricular use of ICTs through school-based and corporate contacts. Bronwyn and Arthur are among the few remaining teachers who completed the *Intel* course in 2003.

Table 6.1: Convergent factors between ICTs and innovative practice

Key: x = factor, **x** = intended, but not achieved, O = opposite factor to X							
	BK & IG	**AS & HJ**	**MD & TL**	**HN**	**RL**	**MW**	**FP**
Positive convergence							
Nature of subject	xx	xx	xx	x	x	x	x
Access to resources	xx	xx	xx	x			
Real-world contexts	xx	xx		x			x
Real-time learning	xx			x			
Adaptation to student needs	xx						
Incorporate wider curriculum				x			
Use of ICT student centred	xx	xx		x	x	x	x
Focus on curricular goals	xx	xx	x	x	x	x	x
Generative use of ICTs	xx			x	**x**	x	
Compatibility with assessment	xx			x			
Incorporates formative assessment	xx			x			
Value of *Pencil Box*			xx				
High expectations of student skills	xx	xx			**x**		
Peer teaching	xx	xx					
Use of mind-maps or concept maps	xx					xx	
Cross-curricular involvement				**x**			
Core competency skills	xx						
Powerful thinking tool	xx			x			
Blended learning	xx	xx					
Writing across the curriculum	xx						
ICTs as research tools	xx		xx	x	x	x	
Multi-media/Virtual environment		xx	xx	x	x		
Video technology incorporated		xx	x				
Use of specialised tools		xx		x	**x**		**x**
Positive attitude to mobile technology	O	xx		x	x		x
Student factors (positive)	xx						
Collaboration made explicit	xx					x	
Use of social networking tools				x			
Leadership support				x			

ICTs are sometimes seen as product innovations e.g. digital projectors or the *e-Beam* device. Some teachers find that student application skills are below expectations and assume that students acquire such skills naturally or they are

taught elsewhere. Students' lack of such skills and their lack of information literacy skills appear to be matters in need of addressing. In all cases, the focus of ICTs is on curricular goals and Wilding College teachers see ICTs as tools that enable them to innovate in delivering the requirements of the new curriculum. However, the problem of access is a serious deterrent to teacher intent and alternatives to the current traditional model of ICT delivery based on current grammar of schooling factors will need to be considered.

Table 6.2: Disconvergent factors between ICTs and innovative practice

Key: x = factor, x = intended, but not achieved, O = opposite factor to X							
Disconvergent factors	**BK & IG**	**AS & HJ**	**MD & TL**	**HN**	**RL**	**MW**	**FP**
Information literacy level of students	xx	xx	xx	x	x		
Conflict with technology-based decisions				x			x
Incomplete curriculum delivery			x				x
Accessibility issues	xx	xx	xx	x	x	x	x
Workload			x				x
Financial issues		xx			x		
Lack of technical support			x				
Lack of pedagogical support	x		x	x			
Lack of bandwidth				x	x		
Teacher overload			x				x
Student factors (negative)	x			x	x		x
Inequitable distribution or resources		xx	xx				
Size of department		xx					
Information overload		x					

6.5   Summary of Chapter 6

This chapter has described and illustrated the findings related to the question of how the presence of ICTs affects teachers' ability to innovate. The chapter has

provided a brief overview of the expectations of ICTs from the literature, described the infrastructure of ICTs at Wilding College, introduced the cases and then taken each case in turn in order to show the differing contextual effects. These effects were illustrated for each teacher or pair of teachers interviewed and summarised in tables. The next chapter will describe the findings from the data obtained from the interviews with members of the leadership of the school.