MINISTRY OF EDUCATION
Te Tāhuhu o te Mātauranga

Curriculum support in science: Patterns in teachers' use of resources

Rosemary Hipkins and Edith Hodgen

Science in the New Zealand Curriculum

This report is one in a series written for the Ministry of Education by The New Zealand Council for Educational Research in collaboration with Learning Media and The University of Waikato. The work was divided into three strands: Curriculum support for science, science community engagement, and e-learning in science.

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Report prepared for the Ministry of Education

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2012

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ISBN 978-1-927151-70-9

Acknowledgements

Our first thanks go to all the teachers who took time from their busy schedules to answer the survey on which this report is based, and to encourage their colleagues to do the same. Thanks are also due to individuals who helped us circulate notification of the survey using their contact networks, particularly Jessie McKenzie at the Royal Society, and Sandie Aitken at NZEI.

The design of the survey benefited from input from our collaborators: Cathy Buntting and her ICT advisory group at the University of Waikato; Kath Norton and her media team at CWA New Media; and Bill MacIntyre at Massey University. Members of the NZCER team who contributed at different stages of the research were Ally Bull, Rachel Bolstad, Lorraine Spiller, Chris Joyce and Graeme Cosslett. Jane Gilbert provided invaluable feedback in her role as quality assurer for the overall project. Christine Williams formatted the report and provided other support services as needed. Thank you everyone.

Finally, this work would not have been done without the funding provided by the Ministry of Education. Thank you for making science education an important research focus for 2012–13.

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A brief introduction to the survey and methods used

This report documents results of a short online teacher survey that asked about teachers' access to, and use of, a range of resources that could potentially support teaching and learning in science. The survey asked about teachers' use of currently available curriculum and community resources and the uses to which they put various ICTs to support teaching and learning in science. The Survey Monkey platform was used to deliver the survey electronically. We used existing contact networks (particularly the Royal Society's email network) to invite responses. The survey was open for 3 weeks in March 2012.

A consortium of researchers from NZCER, the University of Waikato, CWA New Media worked together to design the survey, initially in a face-to-face meeting, and then by a rolling series of virtual interactions. The whole project team generated items for the survey and by negotiation a smaller group streamlined these "wish lists" so that the response time required should be no more than 20 minutes, depending on how fully the few open questions were answered.

Altogether, 343 teachers (n = 122 primary; 179 secondary[1]) completed a sufficient number of survey questions to be included in the final sample. Demographic data indicated that respondents were spread out across New Zealand and came from schools across the full size spectrum from the very small to the very large. Nearly two-thirds of respondents worked in schools in urban areas. Low-decile schools were underrepresented in the sample we achieved, and more experienced teachers were overrepresented relative to those newer to the profession.

All responses were routinely cross-tabulated against demographic variables, with chi square tests used to search for differences. Differences significant at $p < .05$ are reported. Factor analysis was used to check for patterns of coherence in responses to items where the respondent had to select a point on a Likert-type scale such as "strongly agree" through to "strongly disagree" which measures *how much* of a specific perception they had (e.g., the teachers' confidence to implement the New Zealand Curriculum (NZC) reported in Section 8). Other questions—such as the wide range of resources in Questions 1 and 3 and of e-learning activities in Section 5—had options that were qualitatively rather than quantitatively different. We carried out a series of correspondence analyses to check for patterns of responses in these item sets.

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[1] Forty-two teachers did not specify which level of the school system they taught within.

Overall patterns of resource use

Teachers were asked to indicate which resources they had accessed from lists provided. One set of items named types of curriculum resources and another set named types of community resources. Possible ICT uses were briefly described as specific types of activity. In a separate open response section teachers were invited to nominate “best” resources for specific uses.

Most frequently used curriculum resources

Sixty-seven percent of primary respondents had used journals from the Connected series during the past 12 months. In the open response section, Connected was the most frequently nominated best resource for integrating literacy and primary science. Booklets from the Building Science Concepts (BSC) series had been used in the past 12 months by 65 percent of the primary teachers. Teachers said BSC resources were among the best for: engaging students via practical learning activities; getting good teaching ideas; and updating their personal knowledge for teaching science.

Eighty-nine percent of secondary respondents said had they accessed the NCEA science exemplars in the past 12 months with the predominant use being to support student learning, not their own professional learning. The cluster analysis suggested that NCEA resources were the main—and possibly only—source of curriculum support for 20 percent of the responding teachers. However, NCEA is still seen as a barrier to curriculum change: 51 percent of the secondary teachers agreed with this statement and a further 22 percent were unsure. Sixty-nine percent of secondary teachers had accessed the senior secondary subject guides, predominantly for their own learning. The guides have been recently developed to reflect the intent of NZC and provide some explicit support for the Nature of Science (NOS) strand. However, no teachers nominated the guides as a best resource for learning about NOS.

Most frequently used community resources

Museums, science and technology centres, aquariums, zoos and planetariums and their staff were the most frequently utilised type of community resources. In the past 12 months, 65 percent of primary and 58 percent of secondary teachers had accessed such resources, either for their own or for student use.

Primary teachers were much more likely than secondary teachers to access the expertise of parents/whānau in their science programmes and to use Education Outside the Classroom (EOTC) providers such as regional councils and Enviroschools facilitators. Secondary teachers were more likely to access support from faculty in tertiary education settings and to say their students had opportunities to interact with tertiary science students, although this use was relatively low in either sector.

Community resources such as those named here were seen as being among the best for: connecting school learning to real-world contexts; extending gifted and talented students; and providing students with insights into science careers.

Relationships between use of curriculum and community resources

Further analysis provided clear evidence that non-users of curriculum resources were also likely to be non-users of specific community resources. Conversely, innovative users of curriculum resources (11 percent of the overall sample) were also more likely than all other respondents to be active users of community resources (26 percent of the overall sample).

Most common uses of ICTs

Most teachers said they used the Internet to: find science learning resources; find activities for students to download; and demonstrate concepts using video clips or similar e-resources. Secondary teachers were more likely to do these three things on a weekly basis whereas primary teachers were more likely to do so sometimes.

Three types of e-learning activities were characterised as not happening very often, or even sometimes, for the students in many secondary and primary classrooms. These activities were: collaborating and sharing their work with other students; communicating with people beyond the school who are involved in science activities; and publishing on the Internet. A large proportion of the respondents who did not currently do these things said they would like to do so.

Just under half the secondary teachers said students often or sometimes collected and analysed scientific data using ICTs, but this was the lowest ranking item for primary teachers (just 18 percent said they did this). E-tools such as data-loggers and science databases were the lowest ranked science resources for overall ease of access: more than half the primary and secondary teachers said they had no access, or limited access, to such tools.

Electronic resources such as websites, YouTube and video clips were the most frequently nominated by both primary and secondary teachers as best for making science more engaging for students.

Relationships between ICT use and curriculum/community resources

Further analysis revealed that innovative users of curriculum resources were also more likely to be cautiously innovating with ICTs (27 percent of the overall sample) or were e-learning innovators (12 percent of the overall sample). Non-users of curriculum resources were also more likely to be non-users of ICTs for *learning* purposes (but not necessarily for accessing teaching resources).

Non-users of community resources were also more likely to be non-users of ICTs for learning purposes. Active users of community resources were more likely to also be e-learning innovators or to be often using ICTs to access teaching resources.

Resource implications for changing pedagogy

Many comments made in the open response sections indicated that teachers were aware that making science more engaging and relevant for students could be as much about *pedagogy* as the actual resources being used. There was broad agreement with the *idea* of innovation in science pedagogy as a preparation for life in the 21st century. For example, almost all the teachers thought that use of ICT should be an important part of a science programme and that engagement with people from the science community should be part of a learning programme. Nevertheless, it was apparent that both resources and pedagogical support were needed in at least two key areas.

Meeting specific types of learning needs

Just 10–15 percent of respondents made suggestions about best resources for supporting special needs, Māori and Pasifika students within their science programmes. Many of the comments that were made asked for help rather than nominating best resources. Some non-responding teachers did not perceive a need for specific support for Māori and Pasifika students and said so. Elsewhere in the survey, 41 percent of primary teachers and 36 percent of secondary teachers agreed that "science is the same for everyone: we do not need a specific emphasis on Māori or Pasifika students". However, more than a quarter of the teachers were unsure of their position on this challenge. The meaning and pedagogical implications that different individuals attach to this statement could be a worthwhile focus for deeper exploration.

Similarly, relatively few suggestions were made about best resources for helping students make good pathways decisions as they transitioned from primary to secondary school or from secondary to tertiary learning. Teachers did not appear to differentiate between this sort of support and the provision of careers information, and some primary teachers said this was not relevant to their work.

Around 11 percent of secondary teachers said their best resources for integrating science and literacy were those they made themselves, often with the support of a school-wide literacy programme. Since these self-made resources were the most frequently nominated category for secondary teachers, it may well be that other secondary teachers need access to more resources in this area. In view of the NOS focus on science in society, it is notable that so few secondary respondents, and no primary respondents, mentioned media sources such as newspapers or magazines where science-related issues are most likely to be reported and discussed as best resources for integrating literacy and science.

Given the methodology employed for soliciting responses, and some clear indications of a sample skewed towards engaged and actively networked teachers, it seems safe to assume that the need for resources in the areas just outlined is even more acute than these responses would suggest.

Teachers' own NOS learning

More than half of both primary and secondary teachers were unsure or disagreed that the NOS strand was changing the way they taught science. This signals a need for a focus on the pedagogical implications of NOS as the integrating strand, not just a focus on NOS ideas as potential content for learning.

The Te Kete Ipurangi website (TKI) was mentioned more often as best for accessing resources for NOS learning than for any other purpose. Even so, relatively few teachers said that this was a best source of support. Furthermore, some of the other resources named were not developed with NOS in mind (e.g., the BSC resource series). The curriculum itself was seen by some as a resource yet, while the NOS strand provides a broad overview of possible learning outcomes, it does not provide specific guidance as to the specific types of NOS understandings that should underpin teaching and learning.

Challenges for professional learning about NOS could well be more apparent to researchers than to teachers. Overall, teachers' confidence levels to implement the science learning area of NZC were high. A clear majority thought they could implement the science strands well or very well. However, it is also notable that close to a quarter of the teachers in both primary and secondary sectors were less confident that they understood the *Essence Statement* for the science learning area. This is of concern given that this statement conveys the "big picture" framing of the purposes for including science in the overall curriculum.

Confidence to implement NZC formed a factor that we called *NZC-confidence* (α = .90). We found evidence of relationships between this factor and perceptions of barriers to the implementation of NZC. The strongest relationship resided in the NOS strands rather than the contextual strands of NZC. Teachers who felt they could implement the NOS strand well were less likely to cite access to resources as an issue. Which comes first—the access or the confidence with NZC—is an interesting question that the data in this report cannot answer.

Indications of barriers to resource access and use

As already noted, we asked about ease of access to various resources because this is a potential barrier to the use of resources. Responses formed a factor that we called *resource-access* (α = .81). It would seem that teachers who are well connected to resources are able to access and use a whole range of these, while those who perceive access issues cannot or do not access resources of all different types. The correspondence analysis revealed that teachers in the lowest quartile group[2] for the *resource-access* factor were also in: the non-user or NCEA-focused clusters for overall use of curriculum resources; the non-user or past user clusters for community resources; and the non-user or cautious innovator clusters for ICT use.

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[2] Each quartile group includes around 25 percent of all responses. Respondents in the lowest quartile group would have given the most negative overall responses.

We also found a clear set of relationships between the *resource-access* factor and responses to a series of statements about teaching and learning science. Ideas/ideals that are strongly signalled as important in NZC (21st century learning, equity, student voice) now seem to have wide acceptance and did not show an association with resource access. However, the group of items that addressed possible influences on what actually gets taught (e.g., NOS strand changing the way science is taught; NCEA as a barrier to change) and processes for professional learning were associated with the *resource-access* factor. Respondents in the lower quartile groups for this factor were more likely to give negative responses about change in classroom practices and about their own professional learning opportunities. It would appear that a complex set of relationships mediate between curriculum thinking, professional support, actual or potential access to resources and perceptions of barriers to curriculum change.

Access to networks for professional learning and support

Support from other teachers, advisors and subject associations was seen as the best resource for providing good teaching ideas generally, yet 50 percent of primary teachers and 38 percent of secondary teachers said they did not have access to a network of peer support. Furthermore, there were decile-related differences in perceptions of access to such support.

Decile-related differences in resource access and use

We found a number of decile-related differences in resource access and use. Collectively these imply that the socioeconomic status of the school's community can be a barrier to the access of certain resources. Note that decile is confounded with the demographic variables of Māori and Pasifika enrolment levels in the school. Some of the decile-related differences that follow were also found for these other two variables.

Teachers in decile 9–10 schools more likely to say they accessed the Connected or Applications journals for either student or teacher learning and that they had ready access to scientists who could talk to students about their work, or that they could access this community resource given time to plan. They were also more likely to say they had used parents or other whānau to support student learning. By contrast, teachers in decile 1 or 2 schools were more likely to say they had limited or no access to science museums or similar EOTC initiatives, or to scientists who could talk to students about their work. For the *resource-access* factor in general, teachers in decile 1 or 2 schools were overrepresented in the little/no access quartile group and those in decile 9 or 10 schools were overrepresented in the readiest access quartile group.

Secondary teachers in decile 9 or 10 schools were more likely than all other secondary teachers to say that students did not search for information during class time but they would like them to be able to do so. By contrast, secondary teachers in decile 1 and 2 schools were more likely to say their students did classroom-based Internet searching at least weekly. Yet these teachers in decile 1 or 2 schools were also more likely to say they never set homework that required students to access the Internet, or to say they did not do so but would like to.

Teachers in the highest decile schools were also more likely to say they had ready access to a network of peer support and to strongly agree that teachers at their school had good processes for learning and changing pedagogy together. Those in decile 1–2 schools tended to say they had limited access to such support. In the sample we achieved, low-decile secondary schools also tended to be the smaller secondary schools so there would be fewer science teachers to work together day to day. Nevertheless, access to support networks appears to be an important resource issue for further investigation.

Where to next?

Ongoing work in three separate *Science Initiatives* projects will be informed by the findings outlined in this report. Each project was designed to begin with a survey of the resources being used, with indications of why these and not other resources are currently accessed. Had a separate survey been conducted for each project we would not have been able to establish the relationships between patterns of resource use in each of the three areas as outlined above. The action plans to be developed by the three *Science Initiatives* projects will now continue to address the interrelated challenges that the survey analysis has highlighted.

1. Introduction

This report documents results of a short online teacher survey that asked about teachers' access to, and use of, a range of resources that could potentially support teaching and learning in science. The survey was carried out as an initial activity designed to integrate three specific curriculum support projects proposed by the Ministry of Education (MOE):

- an exploration of teachers' use of currently available *curriculum* resources to support teaching and learning in science
- an exploration of teachers' use of currently available *community* resources to support teaching and learning in science
- an exploration of teachers' use of *ICT and specific types of e-learning* opportunities to support teaching and learning in science.

The ultimate outcome of all three projects is to make recommendations that will allow MOE to develop a coherent action plan to address challenges for science education raised by the recent report to the Government presented by the Chief Science Advisor (Gluckman, 2011).

The approach to this work proposed by our team takes as its starting point the clear vision for the education of New Zealand's young people signalled by the New Zealand Curriculum (NZC) (Ministry of Education, 2007). In particular, we take seriously NZC's concern that *all* students should experience success in their learning and be appropriately supported to embark on a lifetime of ongoing learning. For the science learning area of NZC we see the integrating Nature of Science (NOS) strand as key to the achievement of this high-level aspiration. Accordingly, we have focused on resources that have the potential to help teachers embed a NOS focus in ways that meaningfully enrich students' learning encounters with science.

In addition to sections that explore teachers' use of curriculum resources (Section 3), community resources (Section 4) and e-learning (Section 5), we report on teachers' self-nominated favourite resources for specific purposes (Section 6). With the intention of shaping possible explanations for any patterns in responses to these sections we also asked about ease of access to a range of resources (Section 7), and teachers' confidence in their own understanding of science in NZC (Section 8). We also canvassed their reactions to a range of statements about science teaching and learning, and their own professional learning opportunities (Section 9). Section 10 presents the results of a cluster analysis that explores broad patterns of associations in the data.

2. Methodological notes

Survey development

This survey is an initial integrating phase for three projects. Each is being led by different members of our consortium of researchers from NZCER, the University of Waikato, CWA New Media, with some involvement from science educators from other institutions (Massey University, Learning Media). The combined expertise of the consortium informed the development of the survey, initially through a face-to-face meeting, and then by a rolling series of virtual interactions. The e-learning project team, based at the University of Waikato, convened a meeting of their advisory group to review the survey items as these were being developed.

The whole project team generated items for the survey and by negotiation a smaller group streamlined these "wish lists" so that the response time required should be no more than 20 minutes, depending on how fully the few open questions were answered. The rationale for each bank of items is explained briefly in the introduction to the section that reports on the findings for those items.

The Survey Monkey platform was used to deliver the survey electronically.

Survey dissemination

Requests to complete the survey were circulated in several ways: a direct request was sent via the Royal Society's email network of science teachers; a general announcement was posted on the front page of NZCER's website and the same announcement was posted on the TKI Curriculum Online front page. In the final week we circulated an additional request via NZEI's principal network, with the aim of boosting numbers of responses from primary teachers.

As the following sections will show, certain response patterns suggest that primary teachers who responded were mostly already engaged and paying attention to science education contexts and resources. To what extent this is a consequence of the networks used for dissemination we cannot tell. It may be that some teachers who did not think science education is important to their work were simply not prepared to take the time to respond. Similarly, the survey would not have directly reached secondary teachers who are not networked to the Royal Society, or visitors to Science Online or NZCER. It could have reached them via their peers (we encouraged faculty leaders to encourage their teams to respond) but, again, more disengaged teachers could well have lacked the motivation to respond. Given the overall purpose of the work, this bias is not necessarily a disadvantage but it is important to keep it in mind when considering the findings.

Challenges for the teachers who did respond are likely to be even more so for those who are not currently engaged with the dissemination/resource support avenues we used.

The sample achieved

Altogether, 343 teachers (122 primary and 179 secondary teachers) completed a sufficient number of survey questions to be included in the final sample. However, some of these respondents did not complete all the demographic questions at the end of the survey. This accounts for the NR (non-response) columns in the demographic tables that follow. Note that numbers omitting the various demographic questions varied. They were lowest for each respondent's own role in the school and highest for percentage of Pasifika students on the school roll.

Primary and secondary numbers

Given the differences in teaching emphases and resources available for different year levels, we saw it as important to achieve a good spread between primary and secondary teachers. Table 1 shows this aspect of the sample achieved.

Table 1 **Year levels taught by responding teachers (*n* = 343)**

Levels	Yrs 1–3	Yrs 4–6	Yrs 7–8	Yrs 9–13	NR
Percentage	7	14	15	52	12

Numbers may not add to 100 because of rounding.

Secondary teachers are included as one group because just six of them said they taught Years 9–10 but not Years 11–13.

Responses by gender

There were more responses from female teachers (57 percent) than from male teachers (29 percent). Fourteen percent did not respond to this question.

Nearly three-quarters of the male teachers were in secondary schools (73 percent). The difference was not as marked for female teachers: 47 percent were in primary schools and 53 percent in secondary schools.

Representation by decile

Table 2 shows the deciles of the schools in which the responding teachers worked. Our experience with analysis of data for the NZCER National Surveys has shown that school decile groupings are most meaningfully clustered if the lowest and highest quintiles are separated from the mid-decile range of schools. (In other research we have found distinct differences in the characteristics of the high- and the low-decile schools respectively, but more similarities than differences through the middle range.)

Table 2 **Deciles of teachers' schools**

	Decile 1–2	Decile 3–8	Decile 9–10	NR
% respondents	7	49	29	3

Numbers may not add to 100 because of rounding.

Relatively more secondary teachers came from low-decile schools (5 percent of primary sample; 10 percent of secondary sample) or mid-decile schools (46 percent primary; 61 percent secondary). Conversely, relatively more primary teachers came from high-decile schools (44 percent primary; 25 percent secondary).

Responses by school location

After considerable debate we opted not to ask for school names. To check for geographic spread we instead asked people to indicate the location of their nearest MOE regional office. As Table 3 shows, the achieved sample does provide a good representation across the country as a whole. There were no significant differences in the by-region representation of primary and secondary teachers.

Table 3 **The geographic distribution of responses**

Nearest regional office	Total %
Whangarei	3
Auckland North	11
Auckland South	8
Hamilton	6
Rotorua	3
Napier	2
Whanganui	8
Wellington	17
Nelson	4
Christchurch	14
Dunedin	9
Invercargill	2
No response	14

Numbers may not add to 100 because of rounding.

Nearly two-thirds of the teachers (64 percent) worked in schools in urban areas; 22 percent worked in rural schools; and 14 percent did not provide this detail. Again, there were no significant differences in representation of primary and secondary teachers from urban and rural schools.

Most secondary teachers in decile 9–10 schools worked in urban schools, as did around three-quarters of the teachers in decile 3–8 schools. Numbers were more evenly split between urban and rural schools for the secondary respondents in decile 1–2 schools.

School size

Responding teachers came from schools of all sizes, from the very small to the very large. There are few very small secondary schools, so as we might anticipate, respondents from the smallest schools were more likely to be primary teachers while those from the biggest schools were more likely to be secondary teachers.

Table 4 **Distribution of sample by school size**

Under 100	100–199	200–399	400–599	600–799	800–999	1,000–1,499	1,500+	NR[3]
6	10	11	19	14	6	12	9	13

Numbers may not add to 100 because of rounding.

The largest secondary schools (those with rolls over 1,000) were more likely to be decile 9–10 schools while the smallest secondary schools (roll under 300) were more likely to be decile 1–2 schools. We found no equivalent size/decile relationships in the primary teacher sample (or for that matter any other demographic differences across all the primary teacher responses). It may be that a larger sample would have allowed some such differences to show up.

Ethnic composition of student population

The project has a specific focus on meeting the learning needs of Māori and Pasifika students in science. We gathered demographic data to check the spread of the achieved sample for these variables, and so that we could look for any relevant differences in response patterns. Table 5 shows the results.

Because we did not have the school names, teachers were asked to estimate this characteristic for their school. The higher non-response rate, compared to other questions, doubtless indicates some teachers' uncertainty about this, particularly in relation to the percentage of Pasifika students on the roll.

3 "NR" means no response.

Table 5 **Distribution of sample by ethnic composition of school roll**

	0–7%	8–14%	15–30%	31%+	NR
% students who identify as Māori	33	28	13	11	16
% students who identify as Pasifika	51	11	6	5	26

Numbers may not add to 100 because of rounding.

Respondents from schools with at least 15 percent of Māori students on the roll were somewhat more likely to be secondary than primary teachers. We did not find such differences in relation to the Pasifika student numbers on the roll.

Decile and percentages of Māori or Pasifika students on the roll tend to be conflated variables. Experience in the NZCER National Surveys suggests this is the case in both primary and secondary schools. In this survey we found that secondary teachers in schools with higher numbers of either Māori or Pasifika students were also more likely to say they taught in decile 1 or 2 schools. The sample was not large enough to establish this pattern in the primary teacher responses.

Teachers' professional experience

We gathered some data in relation to the professional experience of the responding teachers. Table 6 shows that our sample is strongly skewed towards more experienced teachers. This doubtless reflects our recruiting methods, as discussed above.

Table 6 **Number of years respondent had been teaching**

Number of years in teaching	Under 2	3–5	6–10	11 or more	NR
% respondents	2	8	16	61	12

Numbers may not add to 100 because of rounding.

Most (89 percent) of the respondents who were in their first 2 years of teaching were in urban schools. Very few of these beginning teachers were in schools in more rural locations. While all the groups were weighted towards urban schools (because they made up more of the overall sample) this was the group with the greatest urban/rural difference in ratio.

The skew towards more experienced teachers also shows up in the roles these teachers reported. Congruent with the longer service reported, 47 percent of the responding teachers held middle or senior leadership roles in their schools.

As Table 7 shows, those with senior management responsibilities were more likely to be in primary schools and those with middle management responsibilities in secondary schools.

Table 7 **Roles held by the responding teachers**

Role	Primary (n = 122) %	Secondary (n = 179) %	Total %
Senior management	21	6	12
Middle management	18	46	35
Mainly science teacher	6	56	35
General classroom teacher	60	6	28
In charge of science in primary school	31	1	13

Columns add to more than 100 because multiple roles could be indicated.

The relative weighting towards longer serving teachers with greater responsibilities is also doubtless a result of the methods we used to enlist support for the survey. Curriculum leaders, who tend to be more experienced teachers, are more likely to access networks such as the Royal Society one that we used. However, the example set by more experienced teachers and curriculum leaders could impact on the ability of newer teachers in their teams to access and use the available resources so this characteristic of the achieved sample should not compromise the usefulness of the findings.

Notes on the data analysis

Frequency data are reported graphically in Sections 3–8. Given the differences we would expect to see for some aspects of primary and secondary responses, we decided to separate these and report on them in side-by-side graphs for ease of comparison.

All responses were routinely cross-tabulated against the demographic variables outlined above. Chi square tests were used to search for differences. Those significant at $p < .05$ are reported.

Factor analysis was used to check for patterns of coherence in responses to items where the respondent had to select a point on a Likert-type scale such as “strongly agree” through to “strongly disagree” which measures *how much* of a specific perception they had (e.g., the teachers’ confidence to implement NZC reported in Section 8). Other questions—such as the wide range of resources in Questions 1 and 3 and of e-learning activities in Section 5—had options that were qualitatively rather than quantitatively different. We carried out a series of correspondence analyses to check for patterns of responses in these item sets.

Broader patterns in the data

A correspondence analysis is a statistical search for *groups of questions* to which responders give similar answers. Groupings are then positioned in a pattern in two dimensions across four quadrants. Individuals are also represented as patterns of dots superimposed on the item cluster markers. It is up to the researchers to determine what each dimension and quadrant means by thinking about the items and people that end up clustered there.

The results of correspondence analyses make it possible to search for relationships between patterns of answers in different question sets. For example, it is possible to inquire whether particularly innovative resource users (Question 1) are also innovative users of community resources (Question 3) and/or ICTs (Question 5). Results of this broader pattern seeking are reported in Section 10.

3. Teachers' awareness and use of curriculum support materials

This section reports on a bank of items that probed for use of available curriculum support materials. The main emphasis is on MOE-funded materials and those funded by other government sources such as the then Ministry of Research, Science and Technology (MoRST) or New Zealand on Air. Some of the materials we included were developed to support the 1990s curriculum document (e.g., Building Science Concepts, Science Exemplars, Making Better Sense series). These were included because they represent a substantial investment and evidence suggests they are still used in the absence of more recent equivalents. Others, such as the Science and Biotechnology Learning Hubs and Senior Secondary Subject Guides were more recently developed and could be expected to develop direct links to the science learning area of NZC.

The New Zealand Science Teacher magazine is an initiative of the New Zealand Association of Science Educators (NZASE), funded by membership subscriptions. This was included because it is widely circulated, at least in secondary schools, and NZASE is active in providing teacher professional learning opportunities via its suite of conferences for teachers. The NZCER Kick Start resource was included because this was developed to support implementation of the NOS strand of NZC, which is a specific focus for this research. NZCER also produces the content for the science Assessment Resource Banks (ARBs) but these are MOE funded.

We did not include commercial resources such as textbook series. MOE has no direct influence over these so they cannot have a direct bearing on the action recommendations to come out of this project. We do recognise, however, that textbook treatments of curriculum guidelines can have a powerful, mainly tacit, influence on practice. For this reason some examples have been included in the support materials audited in another part of the overall project.

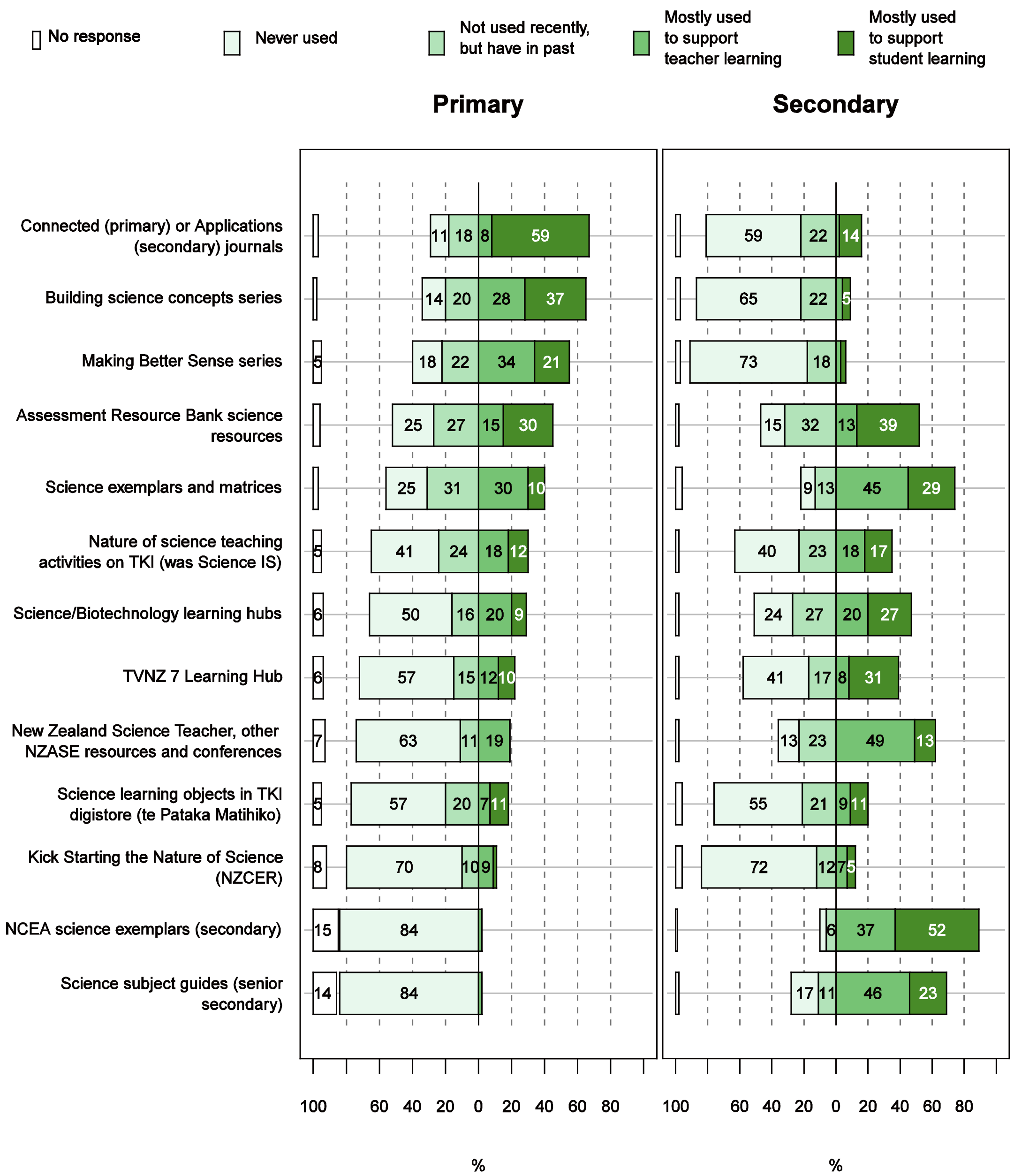
Resources more likely to be used in primary schools were placed at the top of the list and those for senior secondary came last. We did not want primary teachers to begin the survey with the impression that it was mainly relevant to secondary schools.

Overall patterns of resource use

Primary and secondary responses are shown separately in Figure 1. Responses are ordered from the most to the least frequently accessed resources in primary schools. Note the higher levels of non-responses from primary teachers, especially for items near the bottom of the figure that are more relevant in the secondary sector.

Current use is located to the right of the solid vertical line, differentiated by whether this predominantly relates to teacher support or to use by students. Past use and non-use are shown to the left of the solid line.

Figure 1 **Patterns of use of various curriculum support materials by secondary (*n* = 179) and primary (*n* = 122) teachers**



The three curriculum support resources most frequently accessed in the last 12 months by teachers in primary schools are:

- **The journals in the Connected series:** 67 percent of primary respondents used these, mainly for student learning, but in some cases mainly for their own professional purposes. This is a "live" resource in that new editions of the journal continue to be developed, with the most recent editions reflecting an emphasis on links between science and basic reading literacy. Note, however, the low levels of use of the Applications series which is the lower secondary school equivalent, but which has not been updated since 2007 (16 percent).

- **Booklets from the Building Science Concepts (BSC) series:** 65 percent of primary teachers said they used these. As would be expected given their emphasis on building primary teachers' own conceptual knowledge, higher numbers said they were predominantly accessed for their own professional learning. Unlike the Connected journals, BSC resources have not been updated to reflect current policy work and their curriculum links are to the 1993 document, although they continue to be relevant to NZC.
- **The four Making Better Sense (MBS) books:** 55 percent of primary respondents used these, with teacher use somewhat more predominant. These four books explicitly reference the four contextual strands of the 1993 curriculum and were widely used at the time in the professional learning programmes that supported its introduction.

The three resources most frequently accessed in the last 12 months by teachers in secondary schools have a rather different focus to this ideas/concepts focus of the frequently used primary school resources:

- **NCEA science exemplars:** 89 percent of all secondary respondents said they used these, and for 52 percent of the secondary group the predominant use was to support student learning, not their own professional learning. This high level of support reflects the commonly held belief that NCEA drives the curriculum in secondary schools (for evidence of the prevalence of this view, see Hipkins, 2010a, and also Figure 6 in this report) but what we also see here is that *student* views of the learning that matters in science are likely to be strongly influenced by these resources.
- **The science exemplars and matrices:** 74 percent of secondary teachers said they accessed these. Given this very high response rate we think it is likely that many secondary teachers confused these exemplars with the NCEA science exemplars.
- **The senior secondary subject guides:** 69 percent of secondary teachers had accessed these, predominantly for their own learning. These have been developed to reflect the intent of NZC and provide some explicit support for the NOS strand.

It is also worth noting that 62 percent of secondary respondents said they accessed the New Zealand Science Teacher and other NZASE resources. This could be a reflection of the sampling bias discussed in Section 2: these were teachers who are active users of opportunities supported by their subject association. As such they are likely to be members of contact networks such as that used by the Royal Society.

Just three resources that did *not* show significant primary/secondary differences in patterns of access were: Kick Starting the Nature of Science; Nature of science teaching activities on TKI; and the science learning objects in the TKI digistore. Use of these resources was low in both sectors.

Differences in patterns of access

We found just one decile-related difference: teachers in decile 9–10 schools were somewhat more likely than those in decile 1–8 schools to say they accessed the Connected or Applications journals for either student or teacher learning.

When responses of teachers in schools in the Auckland/Wellington regions were compared with those of all other teachers we found that those in Auckland/Wellington were more likely to have used the ARBs for teacher learning, and there was also a trend for them to have been more likely to use the BSC series for teacher learning.

There were no overall differences related to the number of Māori students on the school's roll. There were, however, two differences related to Pasifika enrolment levels. Relative to all other respondents, teachers in schools with the highest level of Pasifika enrolment (32+ percent) were more likely to say they used the BSC series for teacher learning, those in schools with a 15–30 percent enrolment to say they had not used this resource recently and those in schools with an 8–14 percent Pasifika enrolment to say they had never used this resource. Teachers who did not estimate the numbers of Pasifika students on the roll were more likely to say they used BSC as a student learning resource. The same pattern of associations held for use of the ARBs.

We found a small number of differences by teachers' gender, but these seemed likely to simply reflect differences in primary/secondary responses. For example, female teachers are overrepresented in the primary sample and female teachers were more likely to indicate that they used BSC, Connected/Applications and the MBS series, all of which are more widely used in primary schools. Male teachers are overrepresented in the secondary sample and male teachers were more likely to indicate that they used the NCEA exemplars and less likely to say they never used the senior subject guides in science.

There were no differences associated with years of teaching experience. Differences by role, like gender differences, seemed likely to reflect primary/secondary differences because middle managers and science teachers were secondary, whereas classroom teachers and teachers in charge of science in the school were primary teachers.

Other commonly accessed resources

A wide range of resources were mentioned in response to an open question about the other resources that teachers access. The responses of primary and secondary teachers are summarised separately to highlight several noticeable differences in response patterns.

The resources that primary teachers say they value

Some primary teachers made very general reference to the usefulness of e-resources: for example, "kids' science websites" or "Google searches". Others were more specific. YouTube was named by three primary teachers, with two of them making specific reference to clips posted by Stephen Spangler. Science Postcards (www.sciencepostcards.com) and resources on the Department of Conservation website both received two mentions. All of the following received one mention: curriculum resources on the Australian Primary Connections website (www.science.org.au/); the website of the Monarch Butterfly Trust NZ (accessed via the Science Learning Hub); the National Geographic website; http://thehappyscientist.com; the LEARNZ virtual field trips site; www.sciencekids.co.nz; BBC's bite-size science; and a site called NeoK12. One primary teacher mentioned being on the mailing list for CSIRO's e-newsletter and several referred to sites where teachers could share ideas:

> Pinterest[4] boards set up by science teachers. A wealth of shared resources from around the world, often accompanied by photos of experiments at different stages. Saved my life several times this term.

Some comments gave indications that teachers' access to e-resources and associated print resources is supported and mediated by science advisors and by organisations that have provided specific support for primary science teachers in New Zealand:

> Bill McIntyre: www.exploratorium.com, website for the Exploratorium Museum of Science in San Francisco. [Bill is a Massey-based advisor with a specific interest in astronomy education.]

> Active Assessment by Stuart Naylor and Brenda Keogh, Creative Science by Rosemary Feasey, Cartoon Concepts by Stuart Naylor and Brenda Keogh. [The UK-based people referenced here have all been participants in NZASE-supported primary science conferences.]

Compared to the wide range of e-resources, relatively fewer references were made to books or other print resources, although omnibus books of science experiments for children were still used by several primary teachers and one mentioned the continuing usefulness of Science in the New Zealand Curriculum (Ministry of Education, 1993) "for some of the experiments and understandings". Other print resources to receive specific single mentions were: the Sunshine Science series; Science Alive; The Science Roadshows resource book; Scholastic's books; and the periodicals New Scientist and Science Week.

Anticipating the next survey question concerning the use made of community resources and people, several organisations were named as helpful places to access advice and knowledge when needed: The Royal Society; Waikato, Victoria and Otago Universities; Futureintech; One Crown Research Institute (NIWA) and the Department of Conservation. Finally, one teacher took the opportunity to request the expansion of a specific type of resource to support the science learning area of NZC:

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[44] This is not a typo. It is the name of a social network that operates along similar lines to Facebook, where self-forming groups share predominantly visual resources on a topic of mutual interest.

> It would be good to have some guidelines for assessment of key concepts—we have used ARBs [Assessment Resource Banks] in the past, but the exemplars are a little limited in the range of activities at each level.

Secondary teachers' responses to the open question

Like their primary counterparts, the secondary teachers mentioned a very wide range of e-resources—too many to list individually. A number made reference to simulations, or other resource materials that their students would not otherwise be able to access:

> Flash animations to explain concepts that can be used as standalone resources (i.e., not tied to a website). High-quality video clips of experiments that are not able to be performed in the science lab. Short snappy standalone PowerPoints (or similar) relating work of NZ research scientists to Yrs 11–13 curriculum.

This comment, in common with a number of others, hinted at being a wish list rather than an accounting of valued resources used often. There was a noticeably critical edge to some of the comments made by the secondary teachers, particularly when these made reference to resources already listed in the first question:

> Clear, objective STANDARDs need to be written for senior levels, and exemplar units showing differentiation OTHER than geology units please! Practical help and guidance from the Ministry, not empty rhetoric.

> Digistore was really good, now too hard to use!

> Ministry made/funded resources are not so good. They ironically do not fit the NZ curriculum at all.

> I find it hard to use many of the [materials on] Science Learning Hub as they are above the level and often not presented as a task which is usable in the class without major modification.

There were also a few bouquets, such as this one for the LENS programme funded by the Liggins Institute at Auckland University:

> LENS Senior Biology seminars—these were an invaluable resource for preparing students for Scholarship Bio. This is an area where the need for currency means that teachers sometimes struggle without the support that LENS provides, using real scientists and real contexts.

As illustrated by the LENS example, a number of the comments secondary teachers made, and the resources they named, were linked to student learning needs in a specific manner that was not as evident in the primary teachers' responses. Several secondary teachers made reference to resources that provided helpful literacy support or that could support students who were working below the level of their peers (for example, BBC's bite-size science; and examiners' NCEA reports that discussed specific literacy challenges). Several made reference to the usefulness of the Study It website that supports independent study by senior secondary students and helps them prepare for assessments.

Secondary teachers also made reference to a wide range of print resources. Commercial resources published by all of the following companies were mentioned, in most cases only once: Pearson/Longman, Nelson Thornes, Cambridge Education, Macmillan, Biozone, ESA, Scipad, and ABA. Helix and Cosmos were mentioned as periodicals that older students could access and some teachers mentioned reading New Scientist.

Like the primary teachers, a number of secondary respondents anticipated the next survey question by naming community people and organisations to whom they could turn for support and resources. The Liggins/LENS programme received four mentions and the LEARNZ virtual field trips two. NZCER's Science Thinking with Evidence test received two mentions, as did the New Zealand Institute of Physics and its support for physics teachers. (Several other positive references were made to the support of subject associations more generally.) Also mentioned were the Portobello Marine Centre associated with Otago University and access to resources from Canterbury and Lincoln Universities. An indirect and somewhat cryptic reference to Waikato University was "CoRes and PaPeRs". These acronyms reference approaches to building teachers' pedagogical content knowledge (see, for example Eames, Williams, Hume, & Lockley, 2011). Presumably the responding teacher assumed this would be self-evident.

4. Teachers' awareness and use of community resources

One strand of the overall project is exploring access to, and use of, people and resources in the wider community that have the potential to support and enrich school science programmes.

The great variety and number of such resources presented a challenge when assembling this item bank for the survey. We grouped all the different types of resources we could think of into broad clusters to keep the number of items manageable. The obvious drawback is that only some resources within one cluster might be accessed (for example, zoos or museums, but not both) and the survey responses cannot be differentiated at this level of detail. Nevertheless, some interesting differences in patterns of use were found.

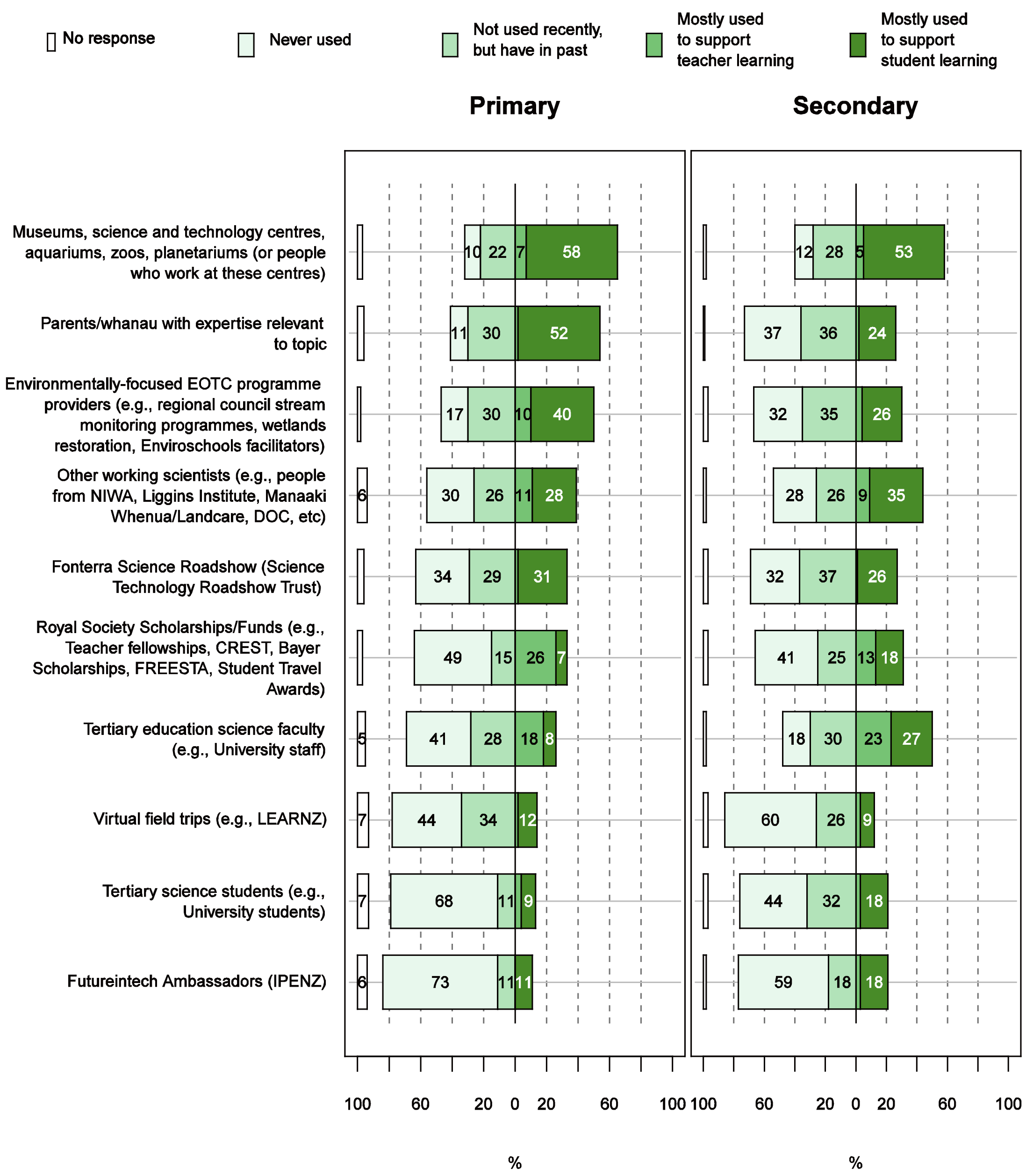
Overall patterns of use of community resources

Primary and secondary responses are shown separately in Figure 2. Responses are again ordered from the most to the least frequently accessed resources in primary schools. Current use is located to the right of the solid vertical line, differentiated by whether this predominantly relates to teacher support or to use by students. Past use and non-use are again shown to the left of the solid line.

Figure 2 shows a number of differences between the responses of primary and secondary teachers. As for the print/Web-based resources discussed in Section 3, just four types of community resources did *not* show significant differences in use patterns by sector:

- Educational facilities and people in museums, science and technology centres, aquariums, zoos and planetariums were the most frequently utilised community resources for both primary and secondary teachers (65 percent of primary and 58 percent of secondary teachers accessed such resources for either their own or for student use).
- The other three items that did not show differences were characterised by much lower usage in either sector: other working scientists (i.e., those not in regional council or EOTC roles); the Fonterra Science Roadshow; and virtual field trips offered by LEARNZ.

Figure 2 **Patterns of use of various community resources by secondary (*n* = 179) and primary (*n* = 122) teachers**



Primary teachers were much more likely than secondary teachers to access the expertise of parents/whānau in their science programmes. There was a difference of 28 percentage points between sectors when use for student and teacher learning were combined. Similarly, primary teachers were more likely to use EOTC providers such as regional councils, Enviroschools facilitators and so on. Exactly half the primary teachers, but just 26 percent of the secondary teachers, said they accessed such resources for their own learning or for direct use with students (with the latter predominant). This is a difference of 24 percentage points between sectors.

Secondary teachers were more likely to access support from faculty in tertiary education settings (another difference of 24 percentage points between sectors). They were also twice as likely to say their students had opportunities to interact with tertiary science students, although this use was relatively low in either sector: 18 percent of secondary and 9 percent of primary teachers said they did this. The greater difference for this particular item was in the numbers who said they had never accessed tertiary students as a resource: 44 percent of secondary and 68 percent of primary teachers.

Differences in use of resources provided by the Royal Society are more subtle. While overall levels of use are much the same, at around a third of each responding group, primary teachers were more likely to say they used such resources for teacher learning and secondary teachers to say they used them for student learning. This pattern is likely to relate at least partly to the sampling bias discussed in Section 2. Present and past primary teacher fellows would be expected to be members of the Royal Society's contact network, and to have responded disproportionately to other primary teachers. However, another reason for the difference could be that a number of Royal Society resources for student use—such as their various competitions for elite students—are focused at the secondary level.

Use of the IPENZ-funded Futureintech ambassadors was more common in secondary schools. Given their focus on career opportunities in STEM fields (science, technology, mathematics) this seems predictable, although the Futureintech programme does offer support for enthusing primary students with the excitement of science learning in authentic contexts (Lin & Bolstad, 2010). A few primary teachers did suggest they used Futureintech in this way when they nominated "best" resources for specific purposes (see Section 6).

Differences in patterns of access

Teachers in decile 3–8 schools were more likely than other teachers to say they accessed tertiary science faculty to support student learning. Teachers in decile 9 or 10 schools were more likely to have used parents or other whānau to support student learning.

Teachers in urban schools were more likely to have used Futureintech ambassadors to support student learning, either in the last 12 months or in the past, while those in rural schools were more likely to have never accessed this resource. The converse applied for use of the Fonterra Science Roadshow: teachers in rural school were more likely to say they had accessed this resource in the past 12 months to support student learning, while those in urban schools were more likely to say they had not used this resource recently, or had never used it. Teachers in rural schools were also more likely to say they had used parents/whānau to support student learning while those in urban schools were more likely to say they had never done so.

Teachers in Auckland/Wellington region schools were more likely to have used Futureintech to support student learning and those in schools in other regions were more likely to have never used this resource. The reverse pattern applied for LEARNZ virtual field trips: teachers in Auckland or Wellington were more likely than all other respondents to say they had never used these. Teachers outside the Auckland or Wellington regions were less likely to say they had accessed Royal Society teacher fellowships.

Female teachers were more likely to say they had used parents/whānau to support student learning while males were more likely to say they had never done so. This could well reflect the differential gender compositions of the primary and secondary samples, since there are more rural primary schools, and the primary sample is weighted towards female teachers.

Teachers in their first 2 years in the role were more likely than all other respondents to say they had never used tertiary science students, working scientists, parents or whānau with expertise, the Fonterra Science Roadshow, LEARNZ virtual field trips or Royal Society resources to support their classroom programmes. Interestingly, teachers with more than 11 years' teaching experience were more likely to say they had not recently accessed these same resources.

Other uses of community resources

An open question at the end of this item bank invited teachers to provide a brief description of "any other ways you or your students have been engaged with/supported by the 'science community'". Compared to the patterns of responses at the end of the item bank discussed in Section 3 there were fewer responses overall, and fewer substantive differences in the *types* of responses made by primary and secondary teachers. Perhaps because they had already provided a range of ideas about resources that supported their teaching, this time respondents tended to focus on ways community resources could be used to enrich and extend students' learning. Those comments made about support for teaching tended to refer to support for primary schools by nearby secondary schools, or support from people personally known to the respondent:

> I trained as a zoologist at University of Otago, so still have friends in the Dept and get the newsletter that gives out details of lectures of interest in Science at the University of Otago and Museum. This gives me a heads-up to useful info. Usually by attending open lectures I get insights that help my teaching and learning. [Secondary teacher]

There were a number of references to university outreach programmes. These provided support for activities such as student investigations and experiences such as viewing an electron microscope at work, or seeing equipment used for DNA investigations. These were seen as opportunities that might not otherwise be available to students. While most references to this type of activity were made by secondary teachers, there were also some from primary teachers. Similar use was made of other organisations such as regional councils that supported environmental investigations such as stream monitoring. Other types of EOTC experiences mentioned were visiting a named nature reserve, zoo or observatory, and science as part of school camp activities.

Experts were invited into schools for a range of purposes. One secondary teacher mentioned running a "science cafe" conversation in the evening, led by an expert in the area being discussed. Congruent with the responses reported earlier in this section, primary teachers were more likely to mention accessing the expertise of *parents*:

> Parent who is a vet lead dissection type activities throughout the school for anatomy/body systems study. Local Polytechnic has an expert in meteorology. He ran staff workshops prior to our study. He also visited and spoke to children. [Primary teacher]

> In 2009, Year 7&8 students and teachers, working with parents and environmental architecture students (through a parent), to plan and further develop our school gully back to how it was 100 years ago, and turn it into a student learning hands-on experience. Run out of money to put plans in place! [Primary teacher]

> Used the Community Policeman to enhance teaching about speed—radar and laser. [Primary teacher]

> We have a database of parent and community members with interest/passion/expertise in science. We use them on a topic/needs basis in the classroom or visit their workplace. [Primary teacher]

One secondary teacher mentioned a students/scientists interaction via which the students were supported to contribute to scientists' work:

> Students 'employed' as observers giving feedback on river waste water impacts—ran by NIWA for paper mill company. [Secondary teacher]

There were several indications of barriers that can prevent direct interactions between students and members of the community with expertise to share. Lack of funding at the school level has already been mentioned by one teacher cited above. As the following comment shows, lack of funding can also impact on what tertiary institutions are able to do:

> Unfortunately this programme [Liggins Institute programme for scholarship biology students] is unavailable to us this year due to a lack of funding. It really was a fantastic way to connect our students with real NZ scientists and to pique their enthusiasm for various areas they may be interested in studying at university. [Secondary teacher, not the same person as quoted in the previous section]

The school's location can be a barrier in some cases:

> We are an incredibly isolated area and do not get access to most of these types of support. For us to travel to get to such support is not possible due to the time and cost involved as it would be a full day out of school. [Secondary teacher]

Several comments pointed to internal organisational matters as a barrier to accessing community resources for school science programmes:

> I would love to use these things but the school makes it really difficult to get people in to talk to students. [Secondary teacher]

> As I have each class of children for six sessions only I don't use visitors. We concentrate more on hands-on experiences. [Years 7/8 specialist science teacher]

> I am a specialist teacher this year but my specialist slot supports classroom release, so I'm restricted in my ability to take children off site. Ideally I would be taking children out to habitat areas, for example, but instead we'll work within our school grounds. We will be Skyping experts and have had a lot of support from Futureintech. [Primary teacher]

As the last of these quotes shows, some barriers can be transcended with determination and creative thinking. The second part of the report will return to this question of barriers and the circumstances in which they are more or less likely to be overcome in practice.

5. E-learning in science

The items in this set were adapted from a set used in the 2010 NZCER National Survey of Primary Schools. The advisory group for the e-learning project reviewed the existing item bank but recommended some small changes and additions, most of which were able to be accommodated without expanding the item set too greatly.

Note that the possible responses for this item set are different from those used for both resource item sets.

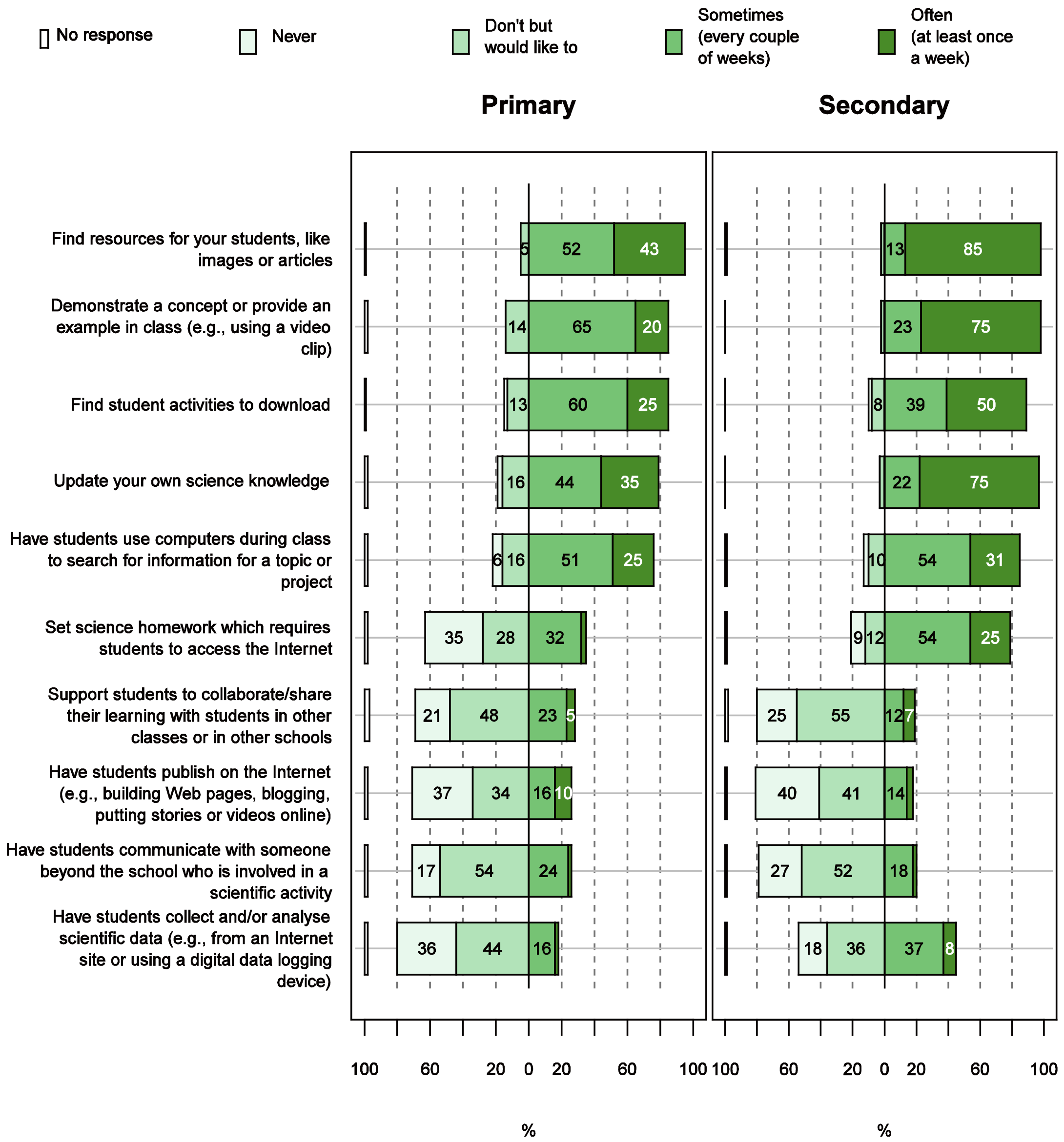
Patterns in ICT possibilities

As Figure 3 shows, we again found differences between primary and secondary teachers' responses to the set of items concerning various possible uses of ICTs to support learning. The most frequently reported use was the same for both sectors when weekly and more irregular use responses were combined: almost all secondary (98 percent) and primary teachers (94 percent) used the Internet to find resources for students to use for their science learning. However, secondary teachers were more likely to do this on a weekly basis whereas primary teachers were more likely to do so sometimes. This makes sense given that science is not as frequently taught in many primary classrooms, and this difference doubtless pertains to the other differences in frequency of use described next.

Almost all secondary teachers (98 percent) and almost as many primary teachers (85 percent) demonstrated concepts using video clips or similar e-resources at least sometimes. Again, secondary teachers were more likely to say they did this on a weekly basis whereas primary teachers were more likely to do so sometimes. The same patterns pertained to finding student activities to download, with slightly lower frequencies for reported use (secondary: 89 percent often or sometimes, with "often" the predominant response; primary 85 percent often or sometimes, with "sometimes" the predominant response).

There was an 18 percentage point difference between primary and secondary teachers' use of ICT to update their own knowledge. Almost all secondary teachers (97 percent) said they did this often or sometimes, with "often" the predominant response. By contrast, 79 percent of primary teachers said they did this often or sometimes, with "sometimes" the predominant response.

Figure 3 **How secondary (*n* = 179) and primary (*n* = 122) teachers use ICTs in their science classes**



The largest percentage point differences related to two items that are arguably more appropriate for older students. Just over three-quarters of secondary teachers (79 percent) said they often or sometimes set science homework that required students to use the Internet, compared to just 33 percent of primary teachers (a 46 percentage point difference). Just under half the secondary teachers (45 percent) said students often or sometimes collected and analysed scientific data using ICTs, compared to 17 percent of primary teachers (a 28 percentage point difference). This was the lowest ranking item for primary but not for secondary teachers.

Again, just four of the items did not show significant differences. As we also saw in the community resources responses, three of these four items described lower rating activities:

- A clear majority of teachers (secondary, 85 percent; primary, 76 percent) said students often or sometimes used computers in class to search for information for a topic or project. Unlike the items reported above, there were no overall differences in frequencies of doing this.
- Three types of e-learning activities were characterised as not happening very often, or even sometimes, for the students in many secondary or primary classrooms: collaborating and sharing their work with other students; communicating with people beyond the school who are involved in science activities; and publishing on the Internet.

Notice that all the lower ranking items in Figure 3 include a large number of respondents who would like to do these things even though they currently do not do so. Even for most of the higher ranking items, between 13–16 percent of primary teachers made this response. The 2010 NZCER National Survey of Primary Schools reported a similar pattern of responses (Burgon, Hipkins, & Hodgen, 2012).

Differences in patterns of responses

Teachers in decile 1 or 2 schools, and those in schools with more than 31 percent of Māori or Pasifika students on the roll,[5] were more likely to say they never set homework that required students to access the Internet, or to say they did not do so but would like to. Those in decile 3–8 schools were more likely to say they did this sometimes. Presumably students from well-resourced homes are expected to be able to access the Internet in their own time, should their teachers want them to do so, but teachers in the low-decile schools may not see this as a viable option for at least some of their students.

Secondary teachers in decile 9 or 10 schools were more likely than all other secondary teachers to say that students did not search for information during class time but they would like them to be able to do so. It would be interesting to know what types of barriers these teachers perceive. By contrast, decile 1 and 2 secondary teachers were more likely to say their students did classroom-based Internet searching at least weekly. This is likely to be the flip-side of the homework response: if students cannot be expected to access the Internet at home teachers may well perceive that it is important for them to do so in school. What we cannot tell from these data is what type of information searching tasks they are set or what they are expected to do with the information they find (which are both potential indicators of how demanding the thinking required of students might be).

There were several differences by location in the things that teachers would like students to do but currently did not. Teachers in rural schools were more likely to say they would like to be able to set homework which required students to access the Internet, or have students collect and analyse scientific data. Teachers in urban schools were somewhat more likely to say they would like students to use the Internet in class to search for information for a topic or project.

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5 Decile and roll composition tend to be confounded variables.

Female teachers were more likely to say they often found student activities to download and that they would like students to be able to communicate with people outside the school about a science activity but currently did not. Male teachers were more likely to download student activities only sometimes and to never have students communicate with someone beyond the school about a science activity.

Teachers in their first 2 years in the role were more likely to say they found students activities to download at least weekly. This group was also the most likely to be using animations to demonstrate concepts in class.

6. The best resources for specific uses

Survey respondents were invited to name the resources they found most useful for specific purposes. A number of purposes were listed and individuals could provide suggestions for as many of these or as few as they chose. This section reports on these responses, broadly categorised into the following types of resources:

- print resources for teachers: specifically BSC and the MBS series
- print resources for students: specifically the Connected and Applications journals
- electronic resources: such as the Internet, videos etc.—focus usually not specified
- Web-based New Zealand-specific resources: TKI; Science and Biotechnology Learning Hubs; ARBs; LEARNZ virtual field trips; TVNZ 7 resources etc.
- resources to support practical work
- community resources and people: EOTC; museums etc.; scientists; Royal Society etc.
- support networks: other teachers; science advisors; local branches of subject associations etc.
- conferences, workshops, other professional learning.

These are very broad categories. In the tables that follow, brief detail within each category is provided in brackets, with the most frequently mentioned resources listed first. Other less-often cited categories have been added to the discussion of the various purposes as needed.

Responses from primary teachers (up to and including Year 8) have been collated separately from those of secondary teachers because we found rather different patterns of responses in each category.

The number of teachers responding to each category is shown as part of the table heading and responses are reported as actual numbers. Percentages have the potential to be misleading for two reasons: very different pictures can be painted by percentage of all respondents vs. percentage of those who made a reply; and percentages based on smaller sample groups can be misleading.

In the interests of brevity, only resources mentioned by five or more teachers are included in the tables.

Finally, the specific purposes have been grouped thematically for discussion purposes. The order in which they appear in this section is not the order in which they appeared in the survey itself but teachers would not necessarily have answered sequentially because they were invited to respond only to those categories where they felt they had something to add.

The best resources for making science more engaging for students

The Gluckman report[6] canvassed the issue that many students do not find science engaging as they move through school, and so stop studying it as soon as they can (Gluckman, 2011). When confronted with this challenge, for which considerable international research evidence exists (see, for example, Bull, Gilbert, Barwick, Hipkins, & Baker, 2010), what sorts of resources do teachers think will help? Table 8 shows the resources teachers said they used to make science more engaging for their students.

Table 8 **Engaging resources named by teachers**

Resource type	**Number of mentions**	
	Primary (*n* = 75)	**Secondary (*n* = 89)**
Electronic resources (websites, YouTube clips, short videos)	28	42
Resources to support practical work	22	17
Print resources for teachers (mainly BSC)	17	
Community resources and people	10	7
Web-based New Zealand-specific resources (Science Learning Hub, LEARNZ)	8	7
Print resources for students (Connected, Science Postcards)	7	

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

For both primary and secondary teachers, non-specific electronic resources such as websites, YouTube clips and short videos were the top rating resource type. Some secondary teachers also listed animations or virtual models of abstract concepts. Note that Web-based materials produced specifically to support school science learning in New Zealand have been collated in a separate category. It will become more evident that this is a helpful distinction for some of the purposes yet to be discussed.

For both groups, the second most frequently nominated category was resources for "hands-on" or "practical" learning. Here the need for certain types of resources was typically implied rather than explicit. One primary teacher specifically linked the BSC series to ideas for practical work: "hands-on led by BSC" and several others said they got practical ideas from NZASE primary science conferences. Resources more relevant for primary science were not mentioned by the secondary teachers. In fact the latter group made very few references to print-based materials of any kind when thinking about student engagement.

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[6] This report provided the trigger for this research.

Ten secondary teachers and four primary teachers said that resources should be authentic and linked to real contexts but did not name specific types of resources with these qualities. One secondary teacher who nominated practical work qualified its nature if it was to be engaging:

> Upskilling teachers for practical/experiment ideas that are RELEVANT to our youth of today!! Esp. PD [professional development] and support for beginning teachers on the practical side of learning. [Secondary teacher]

Several secondary teachers mentioned the importance of variety and two noted the need to find contexts of relevance to Māori and Pasifika students. Two teachers made reference to the need to cover content as a barrier to more engaging learning:

> This is difficult in Y11 as we are constrained by the boring content of the AS [achievement standards]. Even teachers think it is boring but we recognise the necessity for later learning. [Secondary teacher]

Where good teaching ideas come from

As just outlined, many teachers acknowledged that making science more engaging for students could be as much about pedagogy as the actual resources being used. In a related category, teachers were asked to name the best resources for getting good teaching ideas generally. Table 9 shows the types of responses they made.

Table 9 **Resources that provide good teaching ideas**

Resource type	Number of mentions	
	Primary (*n* = 69)	**Secondary (*n* = 79)**
Support networks (other teachers, advisors, subject associations)	31	40
Print resources for teachers (both BSC and MBS)	23	
Electronic resources (websites, YouTube clips, short videos)	19	34
Web-based New Zealand-specific resources (Science Learning Hub, TKI, ARBs, LEARNZ)	13	5
Conferences, workshops, other professional learning		10
Science magazines (NZ Science Teacher, Helix, American Biology Teacher)		5

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

When good teaching is in the frame, it would appear that many teachers turn to their peers and other teachers and advisors with relevant expertise. The Internet is also a popular source of ideas and several people mentioned blogging with other teachers. A number of secondary teachers, but no primary teachers, mentioned professional learning events such as conferences. No doubt as a result of professional learning activities, single references were made to the Best Evidence Syntheses and to the Te Kotahitanga research. Print resources such as BSC and MBS used by primary teachers were not named by any secondary teachers as sources of good teaching ideas generally.

There were some hints of perceived barriers to good teaching in several of the comments made by secondary teachers:

> Blogs that EVERYONE knows about and can contribute to. [Secondary teacher]
>
> Decent texts professionally written and illustrated. [Secondary teacher]
>
> New curriculum/AS—no time. [Secondary teacher]

The best resources for specific pedagogical purposes

Several of the purposes listed referred to specific, as opposed to more general, pedagogical challenges. These included: integrating literacy learning with science; integrating e-learning and science; supporting inquiry approaches to science; and locating science learning in real-world contexts. Each is now discussed in turn.

Integrating literacy and science learning

Using science as a context in which to build literacy skills has been a focus of recent attention in both primary and secondary schools, albeit for somewhat different reasons. With the introduction of National Standards for literacy and numeracy, primary teachers have been encouraged to utilise learning opportunities from across the full range of curriculum subjects as opportunities to strengthen children's basic literacy skills (i.e., reading and writing). Here the primary emphasis is often on literacy and science may play a subsidiary role by providing contexts of interest to support and encourage reading and writing. The emphasis tends to be the other way around in secondary school contexts: literacy skills are important to the extent to which they support or hinder students' access to the intended science learning. As Table 10 shows, these differences of emphasis are apparent in the somewhat different patterns of responses from primary and secondary teachers.

Primary teachers' most frequently nominated resource for integrating literacy and science was the Connected journal series. Fewer secondary teachers nominated the Applications series which is a similar type of resource for older students. Purpose-made materials were secondary teachers' most frequently named type of resource yet no primary teachers thought to say they developed these. A number of the secondary teachers who said they made their own resources also said how helpful the support of a literacy advisor had been, and that a focus on literacy was a shared professional concern in their school. The general tenor of these responses was that teaching materials and/or their teaching approaches were being adapted as they went along. However, just one secondary teacher named the Literacy Online website and one other named ESOL Online.

Table 10 **The best resources for integrating literacy and science learning**

Resource type	Number of mentions	
	Primary (*n* = 70)	**Secondary (*n* = 83)**
Print resources for students (mainly Connected but also Applications and other Learning Media journals)	48	14
Library books, science readers, textbooks at secondary level	14	12
Print resources for teachers (BSC)	9	1
Electronic resources (websites, YouTube clips, short videos etc.)	5	19
Web-based NZC support (Science Learning Hub, ARBs, TKI, LEARNZ)	5	9
Own resources or those shared/developed with other teachers in school		20
Science magazines (Cosmos, New Scientist, National Geographic), community-generated print resources (Kiwi Conservation, Royal Society pamphlets) and newspapers or other topical media (e.g., blogs)		6

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Compared to ideas about resources for engaging students, electronic sources were not named as often for literacy development. Print books, and magazines, pamphlets and newspapers were added as categories because they received somewhat more mentions (for most other purposes such resources were named by fewer than five individuals). The National Library was mentioned by several of the teachers who nominated print books for this purpose. Four primary teachers said they used Science Postcards to integrate literacy and science. In view of the NOS focus on science in society, it is notable that so few secondary respondents and no primary respondents mentioned media sources such as newspapers or magazines where science-related issues are most likely to be reported and discussed.

The best resources for integrating e-learning and science

Somewhat fewer responses were made in this category than in those already reported. For this purpose, electronic resources designed to support New Zealand students and NZC came into their own, at least for primary teachers. Ten primary teachers but only five secondary teachers mentioned the Science Learning Hub. Two secondary teachers named the Liggins Institute. Six secondary teachers, but no primary teachers, named tools that are specific IT applications.

Table 11 **Resources that integrate e-learning in science**

Resource type	Number of mentions	
	Primary (*n* = 47)	**Secondary (*n* = 58)**
Web-based New Zealand-specific resources (Science Learning Hub, TKI, Digistore, LEARNZ), Liggins (secondary only)	22	12
Electronic resources (websites, YouTube clips, short videos)	19	20
Support networks (other teachers, advisors, subject associations, blogs, *virtual learning networks* in secondary)	4	10
Conferences, workshops, other professional learning	1	6
IT tools: data-loggers, spreadsheets; Web 2 tools (secondary only)		6
Own resources or those shared/developed with other teachers in school (typically via school intranet)		5

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Resources to support student inquiry in a science context

As already noted, many primary and secondary teachers said that resources for "hands-on" or "practical" learning were useful for engaging their students in science learning. What sorts of resources did they see as useful for active inquiry purposes?

One primary teacher mentioned the Fonterra Science Roadshow starter activities and another named NZCER's booklet Kick Starting the Nature of Science. Two secondary teachers mentioned NCEA resources, one mentioned science fairs and one said they made use of movies to stimulate investigations.

Table 12 **The best resources to support student science inquiries**

Resource type	Number of mentions	
	Primary (*n* = 53)	**Secondary (*n* = 61)**
Print resources for teachers (BSC, MBS)	18	
Electronic resources (Internet, e-portfolios)	17	22
Community resources (scientists, Royal Society Crestlets, Enviroschools)	10	6
Web-based NZC support (Science Hub, LEARNZ, ARBs, Science IS)	8	4
Print resources for students (Connected, other books and journals)	6	5
Peers, advisors, other teachers with expertise	2	

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

A number of secondary respondents simply said that they used "experimental work in class" (or some equivalent statement) without actually naming any specific resources, or they made a comment about conditions in the school for conducting practical work. Consequently there are fewer resource ideas in total than the indicated number of respondents.

Resources that help students experience science learning in real-world contexts

When teachers think about resources that will help students connect their learning to real-world contexts, many of them name resources located in the wider community—often resources that would be accessed via special visits or events. The community resources mentioned by primary teachers had a distinctly environmental flavour (EOTC and Enviroschools received 17 mentions). Secondary teachers nominated a wide range of potential places to visit, or from which visitors might come to school. Types of work (waste management, farming, mining, fitness training, health care, aviation, car racing) were mentioned alongside organisations and their associated facilities (regional councils, CRIs, universities, marine centres, zoos, Stardome).

Where references were made to more routine, classroom-based learning, connections were usually virtual (via videos etc.), or involved practical work (usually in an unspecified manner). Two primary teachers and one secondary teacher mentioned working with the children's own experiences, or those of their families. Two secondary teachers noted the importance of developing assessment resources that reflected the emphasis placed on real-world contexts during learning.

Table 13 **Resources that link science to real-world contexts**

Resource type	Number of mentions	
	Primary (*n* = 57)	**Secondary (*n* = 69)**
Community resources (EOTC, scientists, field trips etc.)	29	27
Resources for practical work	10	7
Print-based teacher resources (BSC, MBS)	6	3
Web-based NZC support (Science Hub, LEARNZ, TKI)	5	5
Electronic resources (Internet, YouTube, video clips)	5	14

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Again, a number of teachers commented on the importance of helping students see links between their learning and real-world contexts rather than nominating resources per se:

> Absolutely. How else do students see the relevance in science? [Secondary teacher]
>
> Is there any other way??? [Primary teacher]

Resources to meet the learning needs of specific groups of students

Given the emphasis NZC places on equity in learning opportunities, and the importance of catering for the learning needs of *all* students, we thought it would be helpful to find out what teachers thought about their access to resources that could help them address these challenges in science. We next report on teachers' perceptions of the best resources for: engaging Māori or Pasifika students in science; working with special needs students in science; and extending students who are talented in science.

Resources that engage Māori or Pasifika students in science

Compared to the open responses already reported, fewer teachers gave responses in this category. Furthermore, many of the responses actually made did not name resources per se but rather made some comment about: whether this should be done; how it might be done in principle; and challenges and issues for accessing suitable resources. This was particularly the case with the responses from secondary teachers where just 20/52 comments are recorded on Table 14. Te Kotahitanga was the main professional learning experience named (one secondary teacher mentioned a Victoria University of Wellington course run by a Māori scientist) and there were a further two mentions of learning from peers or advisors. Neither primary nor secondary teachers mentioned use of ICT resources other than those on TKI and even here the total number of mentions was very low.

Table 14 **The best resources for engaging Māori or Pasifika students**

Resource type	Number of mentions	
	Primary (*n* = 37)	Secondary (*n* = 52)
Print resources for students (Connected/Applications)	7	3
Print resources for teachers (BSC, MBS)	6	1
Community resources (including whānau/iwi, tertiary outreach programmes)	7	8
Web-based New Zealand-specific support (TKI, LEARNZ)	5	3
Conferences, workshops, other professional learning		5

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Nine secondary teachers made specific reference to the importance of relevance for Māori and Pasifika students:

> We MUST do this. They currently cannot see its relevance to them. [Secondary teacher]

The use of relevant contexts (e.g., Māori uses of rocks, protocols for gathering flax; natural remedies) was seen as a way to do this. Four teachers (one primary, three secondary) said that beginning with students' own ideas was an important aspect of relevant, engaging teaching.

Four secondary and one primary teacher made comments that suggested science should not be differentiated on the assumption that these students might need or want something different:

> My (few) Māori and Pasifika five/eight-year-old learners have been interested in the same ranges of things their classmates have been … [Primary teacher]

> Recognise culture and equity but teach science as a method. [Secondary teacher]

A number of other responses raised specific challenges and asked for help. There would appear to be a need for more resources and support in this area:

> Never found much specific content available. [Secondary teacher]

> [Need] CULTURALLY RELEVANT assessments. [Secondary teacher]

> I have created my own resources for science in Māori contexts—have NEVER been able to find useful ready-made ones and feel there is only waffly help available for this. [Secondary teacher]

Working with special needs students in science

Again, fewer teachers chose to nominate resources that could help with inclusion and responses made by five secondary teachers were comments about the practicality of doing this, or signals that more resources and support are needed in this area.

Table 15 **The best resources for including students with special learning needs**

Resource type	Number of mentions	
	Primary (*n* = 35)	**Secondary (*n* = 37)**
Print resources for teachers (BSC, MBS)	7	2
Resources for practical work/hands-on activities/concrete experiences	7	3
Specific equipment (i-pads, clickers, other ICT)	4	
Specialist staff (RTLB, support staff)	2	10
Electronic resources (Internet, YouTube, video clips)	1	5

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

The most specific comments from primary teachers suggested that concrete and practical experiences could make science more engaging and accessible for special needs students:

> Practical—kitchen chemistry, real—real animals, plants in class/school, models (e.g., plastic models of life cycles). [Primary teacher]

Three primary teachers and two secondary teachers said they used the Connected journals when working with special needs students. Another three primary and four secondary teachers said they adapted their usual teaching programme or reading materials but did not specifically say how.

Extending students who are talented in science

Compared with the patterns of responses for supporting special needs students, or engaging Māori and Pasifika students, more ideas were given about resources that could be used to extend students with specific talents in the science learning area.

Table 16 **The best resources for extending students who are talented in science**

Resource type	Number of mentions	
	Primary (*n* = 48)	Secondary (*n* = 69)
Community resources (experts, Futureintech, Roadshow, Liggins, scientists)	13	22
Withdrawal programmes, resources to accelerate students to work with older age groups (primary), science clubs etc. (secondary)	10	8
Resources for inquiry events/challenges (science fair, Crest, BP Challenge, science badges, camps and competitions)	9	40
Print resources for teachers (BSC, MBS)	5	
Web-based New Zealand-specific support (Science Hub, ARBs, TKI)	5	5
Print resources for students (Connected/Applications)	4	
Electronic resources (web-quests, videos etc.)		10
Assessment-related mentoring (Scholarship, NCEA Excellence)		8

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

A noticeable difference between these sets of responses and the earlier ones is that these resources often took the learning away from the teachers' own classroom programme to special events or lessons that took place elsewhere. There was a small number of notable exceptions to this pattern, where teachers commented that all students needed to be extended, not just the most talented of them, or said that extension could be part of the planned programme:

> All students need this anyway!! Finding an expert to work alongside the children, such as Futureintech, is great for this, and CREST and NIWA regional science fairs. [Primary teacher]

> Built-in extension activities to many topics in the schemes of work (differentiation built into scheme). [Secondary teacher]

The best resources for increasing students' awareness of what scientists do/science careers

Considerable emphasis has traditionally been placed on the important role of science in ensuring a good supply of students headed towards future STEM careers (in science, mathematics and technology fields). What resources do teachers see as useful for making students aware of the career opportunities science can open up?

Providing opportunities for students to talk to experts in their field was the top-rated item for both primary and secondary teachers. Several secondary teachers made specific mention of university outreach programmes targeted at secondary school students and in one case school careers events were mentioned as a time when students could talk to scientists.

Table 17 **Resources that provide insights into science careers**

Resource type	**Number of mentions**	
	Primary (*n* = 64)	**Secondary (*n* = 77)**
Community resources (experts/scientists who can talk to students; Futureintech)	36	47
Electronic resources (videos, access to Skype conversations)	17	10
Web-based New Zealand-specific support (Hubs, Liggins/LENS, LEARNZ, TKI)	13	16
Print resources for students (Connected, Applications, other journals)	5	1
Parents/whānau	5	
Careers website/school careers counsellors and poster resources		6

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Three secondary teachers mentioned using magazines and newspaper articles. Five primary, but no secondary, teachers mentioned inviting parents or whānau into the classroom. One primary teacher and three secondary teachers mentioned using the NZ Careers website as an electronic resource and another three secondary teachers named access to in-schools careers support people.

Helping students make decisions about secondary and tertiary science

In addition to the provision of careers advice, we were interested in the resources that teachers access to help students make good *pathways* choices as they transition into and through secondary school or on into tertiary study.

It would seem that many primary teachers did not understand the question (only 20 responded) or perhaps did not see its relevance to their work (seven of the 20 who did respond said it was not relevant for them).

Secondary teachers mostly focused on the secondary/tertiary transition and again did not appear to see this as something they could or should do. As Table 18 shows, the resources they named mostly entailed independent research by the students, or work done by other people. Just three secondary teachers emphasised the importance of getting to know their students well and being enthusiastic and supportive of their ongoing participation in science.

Table 18 **Resources that help students make good pathways decisions**

Resource type	Number of mentions	
	Primary (*n* = 20)	**Secondary (*n* = 53)**
Specific careers/course advice (careers teacher, university liaison)		23
Community resources (tertiary staff and students who can talk to students; Futureintech)	5	12
Web-based information about tertiary courses, university open days		11
Web-based New Zealand-specific resources (Hubs, Liggins)		4

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

A few secondary teachers were explicit that this was not part of their role:

> Shouldn't the tertiaries be making more of an effort to entice our students? Primary school doesn't educate them towards a specific secondary school, why do secondaries have to do all the work for tertiaries? [Secondary teacher]

Resources to support teacher's own learning

The focus on NOS as the integrating strand of NZC points to the importance of professional learning opportunities. For many decades now, a persistent theme of science education research has been that teachers do not have the knowledge they need in this area, and that even when they do learn about NOS they need opportunities to explore how this new knowledge might relate to their own work in the classroom (for a comprehensive review, see Lederman, 2007). With these challenges in mind, we asked teachers which resources were best for learning about NOS and which were best for their ongoing professional learning more generally.

Resources to build teachers' knowledge of NOS

Teachers were asked to nominate the best resources for building their own understanding of the nature of science. As Table 19 shows, New Zealand-specific websites were the most frequently nominated resource for this purpose: some teachers do appear to be aware of the support that is available there.

One difference from previous mentions of these websites was that the TKI website was specifically mentioned (or implied by mentioning a specific subcomponent) as the source of professional support by 10 primary teachers and 13 secondary teachers. Eight primary and five secondary teachers named the Science Learning Hub.

Table 19 **Resources to support teachers' NOS learning**

Resource type	Number of mentions	
	Primary (*n* = 60)	**Secondary (*n* = 70)**
Web-based New Zealand-specific resources (Science Learning Hub, TKI, LEARNZ)	20	20
Print resources for teachers (BSC, MBS)	12	
Support networks (other teachers, advisors, subject associations)	9	21
Electronic resources (websites—mostly unspecified)	8	14
The New Zealand Curriculum	6	2
Conferences, workshops, other professional learning	4	10
Community resources (specifically scientists)	4	2
Own research and professional reading		11

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Primary teachers tended to nominate published resource series, and secondary teachers to nominate other people and learning networks such as subject associations. Eleven secondary teachers made reference to specific personal endeavours to read and learn about NOS as a subject of strong personal interest. However, only a small number of primary and secondary teachers (less than five in each case) mentioned NZCER's Kick Starting the Nature of Science booklet which was specifically written to support implementation of NZC.

It is notable that some of the named resources were not developed with NOS in mind (e.g., BSC/MBS resource series). The curriculum itself was seen by some as a resource yet, while the NOS strand provides a broad overview of possible learning outcomes, it does not provide specific guidance as to the specific types of NOS understandings that should underpin teaching and learning.

Again, a number of respondents gave views about this aspect of the curriculum ("important"; "I'm fine with this") rather than naming actual resources.

Updating own science knowledge and skills more generally

As well as asking specifically about NOS learning, we asked teachers about the best resources for updating their teaching knowledge and skills more generally. Table 20 shows similarities in the patterns of responses to those given for getting good ideas for teaching.

Table 20 **Resources for updating own knowledge and skills**

Resource type	Number of mentions	
	Primary (*n* = 63)	**Secondary (*n* = 73)**
Print resources for teachers (both BSC and MBS)	21	
Web-based New Zealand-specific resources (TKI, Science Hubs)	16	7
Electronic resources (including social sharing media, e.g., Twitter, blogs)	15	28
Conferences, workshops, teacher fellowships	13	25
Support networks (other teachers, advisors, subject associations)	8	21
Community resources (Royal Society, EOTC, tertiary staff and students)	7	11
Personal reading/research	6	13
Magazines (New Scientist, New Zealand Science Teacher, Cosmos, Scientific American)		17

Comments may not add to number of respondents because those not mentioning specific types of resources have not been included.

Four secondary teachers named the New Zealand Qualifications Authority's (NZQA's) subject moderators and other NCEA-related resources, and four nominated textbooks or other commercially published materials as being among the best sources for updating their knowledge and skills.

While it is not a resource per se, five primary teachers nominated "having a go" or some other variant on just trying things out.

Concluding thoughts

This section identifies some areas where teachers perceive a need for resources, particularly in relation to being responsive to the learning needs of specific groups of students. It is food for thought that only around 10–15 percent of the overall group who responded made suggestions about supporting special needs and Māori or Pasifika students within their own programmes, or about helping students make good pathways decisions. Many of these comments, few as they were, asked for help rather than making suggestions. Given the methodology employed for soliciting responses, and some clear indications of a sample skewed towards engaged and actively networked teachers, it seems safe to assume that the need for resources in these areas is even more acute than the patterns reported here would suggest.

The differences in response patterns also point to a need to be clear about the specific purposes for which resources are developed and to communicate to teachers how the different resources might best be used for these purposes. Access was not often mentioned as an issue (but then the focus of the open question was on naming resources). The question of access is what we turn to in the next section of the report.

7. Is access to resources a barrier to their use?

Barriers to the use of resources are a specific focus for this research. We included a short item set that specifically asked about access to resources. We included resources where anecdote or our collective experience has suggested the potential for barriers to exist. For example, comment has often been made that teachers do not access the BSC resources because in many primary schools they have languished unopened, or that secondary science teachers do not use Applications because they are diverted to reading programmes on arrival in the school. While we cannot report on actual reasons, the following response patterns do provide some indication of the extent to which access per se is actually a barrier to use of the types of resources named.

Primary teachers were more likely than their secondary colleagues to report *ready* access to Learning Media's print resources (a very large difference of 50 percentage points). While BSC and Connected are targeted at the primary level, Applications is a resource for lower secondary students so this is an important signal of a potential access barrier.

Primary teachers were more likely to report ready or planned access to science museums or similar EOCT initiatives and to scientists who could support student inquiry.[7] Secondary teachers were more likely to say they had ready or planned access to a network of peer support or to e-tools that support science inquiries.

Secondary teachers were more likely than their primary colleagues to report *ready* access to online resources during class, but the difference was not nearly as large as for the Learning Media journals and was not significant. There were no overall differences in access to scientists who could talk about their science or to professional advice and support for implementing the NOS strand, both of which were characterised by low levels of ready access.

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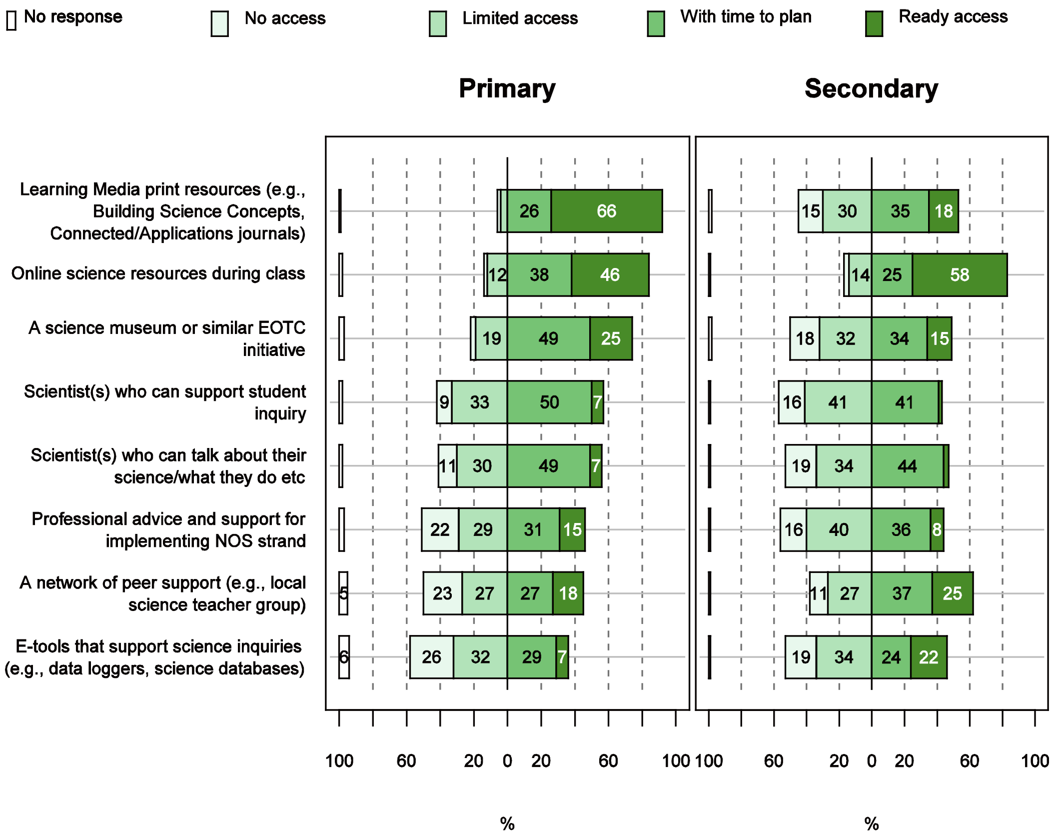
[7] The latter response could be indicative of a survey recruitment bias towards primary teachers who have had teacher fellowships or other similar contact with the Royal Society or other science organisations.

Figure 4 **Secondary (*n* = 179) and primary (*n* = 122) teachers' perceptions of their ease of access to science resources**



Other differences in patterns of access

Teachers in decile 9–10 schools or in schools with no decile rating[8] were more likely to say they had ready access to scientists who could talk to students about their work, or that they could access this community resource given time to plan. By contrast, teachers in decile 1 or 2 schools were more likely to say they had no access to this type of resource. A similar pattern held for access to science museums or similar EOTC initiatives, but in this case teachers in decile 1 or 2 schools were more likely to say they had limited or no access. Teachers in the highest decile schools were also more likely to say they had ready access to a network of peer support and those in decile 1–2 schools to say they had limited access to such support.

Teachers in schools with the highest levels of Māori student enrolment (30+ percent) were more likely to say they had no access to scientists who could support student inquiry, or talk about what they do. They were also more likely to say they had no access to a science museum or similar

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8 Likely to be private schools.

EOTC initiative. These associations are doubtless confounded with the decile-related differences already noted.

As might be expected, teachers in urban schools were more likely to say they had ready or planned access to certain resources for which their rural counterparts were more likely to have limited or no access. This pattern held for: scientists who can support student inquiry; scientists who can talk about what they do; e-tools that support science inquiries; and science museums or similar EOTC initiatives. The same pattern also applied to access to certain forms of professional learning and support: access to professional advice and support for implementing the NOS strand and a network of peer support.

Females were more likely to report ready access to Learning Media's print resources, a pattern that is likely to be confounded with primary/secondary differences in the gender composition of the sample.

A factor for ease of access to resources

Factor analysis revealed a strong degree of coherence in the manner in which individuals responded to this set of items, even though a range of different resources were covered (Cronbach's alpha, α = .80). We called this factor *resource-access*. We investigated the impact on the Cronbach's alpha of removing the item about access to "online science resources during class" since that is an infrastructure matter likely to be beyond an individual teacher's control and it had the weakest correlation with the overall factor. Doing this strengthened the factor only slightly (α = .81). It would seem that teachers who are well connected to resources are able to access and use a whole range of these, while those who perceive access issues cannot or do not access resources of all different types.

To which resources is access most problematic?

Respondents were divided into quartile groups according to their overall responses to the *resource-access* factor. We called these quartile groups: readiest access; planned access; more limited access; and little/no access. These quartile groups were cross-tabulated against the item sets discussed in Sections 3–5. Several demographic differences were found:

- Compared to their primary colleagues, secondary teachers were overrepresented in the little/no access quartile group and teachers of Years 4–6 students were overrepresented in the readiest access quartile group.
- Compared to teachers in urban schools, teachers in rural schools were overrepresented in the lower two quartile groups.
- Teachers in decile 1 or 2 schools were overrepresented in the little/no access quartile group and those in decile 9 or 10 schools were overrepresented in the readiest access quartile group.

Those in the lower two quartile groups for access were more likely than those in the higher two quartile groups to say they never used: the MBS series; the Science/Biotechnology Learning Hubs; the TVNZ 7 Learning Hub; and the science learning objects in the TKI digistore. MBS was primarily a resource for primary teachers and so this difference in access is likely to be confounded with the primary/secondary difference reported above. The other three resources listed all require good online access. The rural/urban difference reported above could be co-implicated here since urban schools are more likely to have ready access to a reliable broadband service. However, this pattern does *not* hold for NCEA resources, senior science subject guides or ARBs, all of which are also delivered electronically. NCEA resources, ARBs and even the senior subject guides could arguably support a “business as usual” approach to curriculum, depending on how they are used, while the hubs and the digistore provide resources that extend and open up opportunities at the intersection of the NOS and content strands. This suggests that perceived barriers to access of curriculum resources are not straightforwardly about online capacity. We will return to the question of teachers’ curriculum thinking in several subsequent sections of the report.

As might be expected, teachers in the readiest access and planned access quartile groups were more likely than those in the two lower access quartile groups to say they used certain community resources to support student learning while those in the little/no access quartile group were more likely to say they never used these same resources. This pattern held for three groups of *people* as resources: tertiary education science faculty; tertiary science students; and other working scientists. Use of museums, science and technology centres, aquariums, zoos and planetariums followed a similar pattern except those in the little/no access group were more likely to say they had not used this type of resource *recently*. Those in the little/no access quartile group were also more likely to say they never used: environmentally-focused EOTC groups; Royal Society resources; Futureintech ambassadors; virtual field trips such as LEARNZ; or parents/whānau with relevant expertise. (For this group of resources, patterns of use in the three other quartile groups were not as clearly differentiated as they were for the people resources already reported on.) The Fonterra Science Roadshow was the only item in this set that did *not* show a significant difference when cross-tabulated with the resource access quartile groups. As for the curriculum resources discussed in the previous paragraph, the wide range of community resources the little/no access quartile group were more likely to never use have the potential to extend and open up opportunities at the intersection of the NOS and content strands. Again, the impression is that perceptions of access are not just about actual physical barriers.

There were *no* overall differences by resource access quartile group for the more traditional uses of ICT: updating own science knowledge; finding resources for students; finding student activities to download; demonstrating a concept or providing an example in class; or setting science homework that requires student to access the Internet. (There was also no overall difference for having students publish on the Internet which could not be described as a traditional use of ICT.) On the other hand, those in the readiest access and planned access quartile groups were more likely to employ e-learning pedagogies that those in the little/no access quartile group were more likely to say they never used or would like to use but currently did not. This pattern applied to:

having students use computers during class to research information for a topic or project; having students collect and/or analyse scientific data; students collaborating or sharing their learning with students in other classes or other schools; and students communicating with someone beyond the school who is involved in a scientific activity. All of these activities do require good online access during class time. However, again, we see that the more traditional uses of ICT are not implicated in the access factor which suggests that physical barriers are only part of the access story. With this thought in mind, the next section of the report addresses teachers' confidence that they understand the intent of the various science strands in NZC.

8. Teachers’ confidence to implement the various science components of NZC

We asked respondents to rate their confidence to implement the different strands of the science learning area of NZC. We named all four contextual (content) strands and the four substrands of the “overarching” NOS strand that is supposed to be integrated with the contextual strands. How you bring these pieces together depends at least in part on what you understand the purposes for learning science to be (for a discussion of four main purposes, see Bull et al., 2010). For this reason we also asked how confident respondents were that they understood the *Essence Statement* that outlines and justifies science’s place in the overall curriculum.

Overall response patterns

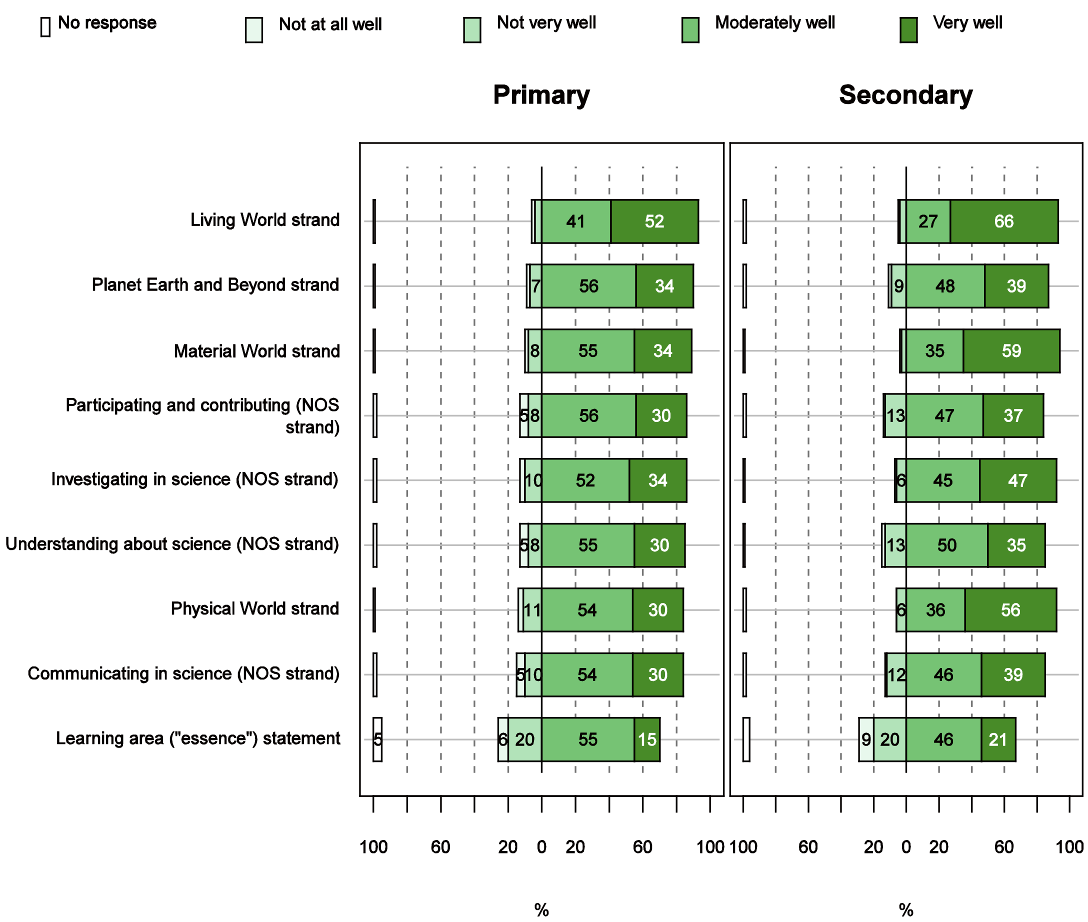
As Figure 5 shows, the confidence levels of both primary and secondary teachers are generally high. A clear majority think they can implement the various science strands well or very well. However, it is also notable that close to a quarter of the teachers in both sectors were less confident that they understood the *Essence Statement* for the science learning area. This is of concern given that this statement conveys the “big picture” framing of the purposes for including science in the overall curriculum.

Secondary teachers were more likely than primary teachers to say they could implement the Material World and Physical World strands very well: the difference was one of emphasis rather than overall confidence. This seems understandable given that secondary teachers are more likely to hold qualifications specific to the content of these aspects of science.

Each teacher was assigned an overall confidence rating for their responses to all four contextual strands and the whole sample divided into quartile groups. Secondary teachers were overrepresented in the highest quartile group and primary teachers were overrepresented in the lowest quartile group. We did not find this difference when overall confidence to implement the four NOS substrands was derived and then the sample divided into quartile groups. It seems that the relatively lower confidence being expressed by some primary teachers is more likely to relate to the content areas of science.

There were no overall differences in confidence ratings by school decile.

Figure 5 **Teachers' confidence to implement the various science components of NZC**



Males were more likely than females to say they understood the Physical World strand very well. Females were more likely to say they understood this strand moderately well. However, males were also more likely than females to say they did not understand the Learning Area *Essence Statement* very well, or to more emphatically say they did not understand this at all well.

Teachers in their first 2 years in the role were more likely to say they did not understand the Planet Earth and Beyond strand very well, while those with 11+ years' experience were relatively more likely to say they understood this strand moderately well, and those with 6–10 years' experience to say they understood it very well.

A factor for confidence to implement NZC

Factor analysis revealed a strong degree of coherence in the manner in which individuals responded to this set of items (α = .90). Teachers who were confident about one strand of the science learning area tended to be confident about most or all of them. Those who were not confident about one or more aspects tended to be not confident about most or all of them. We called this factor *NZC-confidence*.

The Cronbach's alpha measure changed slightly when we differentiated between the NOS/*Essence Statement* items (α = .91) and the four contextual strand items (α = .84). This result suggests that there was slightly more coherence in teachers' confidence with the NOS strand than with the various contextual strands.

Can lack of confidence be a barrier to use of resources?

We called the four quartile groups generated by the *NZC-confidence* factor: high overall confidence; moderate overall confidence; moderate-lower overall confidence; and lowest confidence. Some significant differences between these groups were found when they were cross-tabulated against the sets of items discussed in the preceding sections of the report.

There were no noticeable differences in patterns of responses to the various MOE and other resources discussed in Section 3. It does not appear that confidence with implementing NZC plays a significant part in hampering access to, or use of, these resources.

The pattern is somewhat different for access to community resources (Section 4). Those in the lowest quartile group for confidence with implementing NZC were overrepresented among those who never accessed and used: museums, science and technology centres, aquariums, zoos, planetariums and the people who work in those places; working scientists from institutions such as NIWA, the Liggins Institute, Manaaki Whenua/Landcare, Department of Conservation etc.; environmentally-focused EOTC providers; or parents/whānau with expertise relevant to the topic. It is interesting that this pattern does *not* hold for access to university scientists and students, to the Royal Society's resources, the Futureintech ambassadors or to the Science Roadshow. One way or another, the resources of this latter group can come "ready packaged" (e.g., meetings hosted at universities, visits to the school, resources able to be accessed by mail or email) and hence arguably do not require the same degree of proactive planning on the part of the teacher.

Respondents in the highest quartile group for *NZC-confidence* were more likely than all other respondents to often (at least once a week) access ICT resources to: update their own science knowledge; find student activities to download; have students collect and analyse scientific data; and have students communicate with someone beyond the school who is involved in a scientific activity. Teachers with the highest confidence in their understanding of NZC also appear to be more likely to be accessing and using a range of e-learning opportunities. Interestingly, those in the lowest quartile group for *NZC-confidence* were at least as likely to select "don't but would like to" as they were to select "never" as a response to all the items listed in this paragraph. This type of response does point to issues of access as well as of understanding the intent of the curriculum.

What is the relationship between perceptions of access and *NZC-confidence*?

When the *NZC-confidence* factor was cross-tabulated against the access items discussed in Section 7 a number of relationships were found:

- Teachers with higher overall confidence in their understanding of NZC (i.e., top two quartile groups for this factor) were more likely than those with lower self-reported levels of understanding to say they had ready or planned access to: scientists who can talk about what they do; professional advice and support for implementing the NOS strand of NZC; a network of peer support; and science museums or similar EOTC initiatives.
- Teachers in the highest quartile group for *NZC-confidence* were also more likely to say they had ready access to Learning Media's print resources and to e-tools that support science inquiries (data-loggers, databases, etc.).
- Those in the lowest quartile group for *NZC-confidence* were more likely to say they had limited or no access to all the resources listed in the above two bullet points.
- Just two items did not show a pattern of significant differences: online access to science resources during class; and access to scientists who can support student inquiry.

The same sorts of relationships are apparent when the cross-tabulations are run the other way and the *resource-access* factor is cross-tabulated with the NZC items:

- Teachers in the highest access quartile group (readiest access) were also overrepresented among all those who said they understood the following strands of NZC *very well*: Understanding about Science; Investigating in Science; Communicating in Science; Participating and Contributing; and the Planet Earth and Beyond strand. Note that all except the last of these are NOS substrands and, of the four contextual strands, the Planet Earth underwent the most changes compared to the 1993 science curriculum.
- Teachers in the lower two access quartile groups were more likely than their peers to say they understood all of the listed strands moderately well, at best, and a small number of this group said they did not understand these strands at all well.

Finally, cross-tabulating the two factors by each other confirmed what should already be apparent in the above detail. The strongest relationship between perceived levels of access to resources and *NZC-confidence* resides in the NOS strands rather than the contextual strands of NZC. Teachers who feel they understand the NOS strand well are less likely to cite access as an issue. Which comes first—the access or the confidence with NZC—is an interesting question that these data cannot answer. The next section continues this exploration by reporting on some other potential indicators of teachers' curriculum thinking.

9. Teachers' curriculum thinking

This survey was designed with the aim of reporting on the use of available resources and, where possible, to propose explanations for the patterns of use we have found. As discussed, perceived or actual barriers can be one reason for lack of uptake of available resources. There is also the possibility that teachers' curriculum thinking could impact on resource uptake and use. The items reported on in this section were assembled with this possibility in mind.

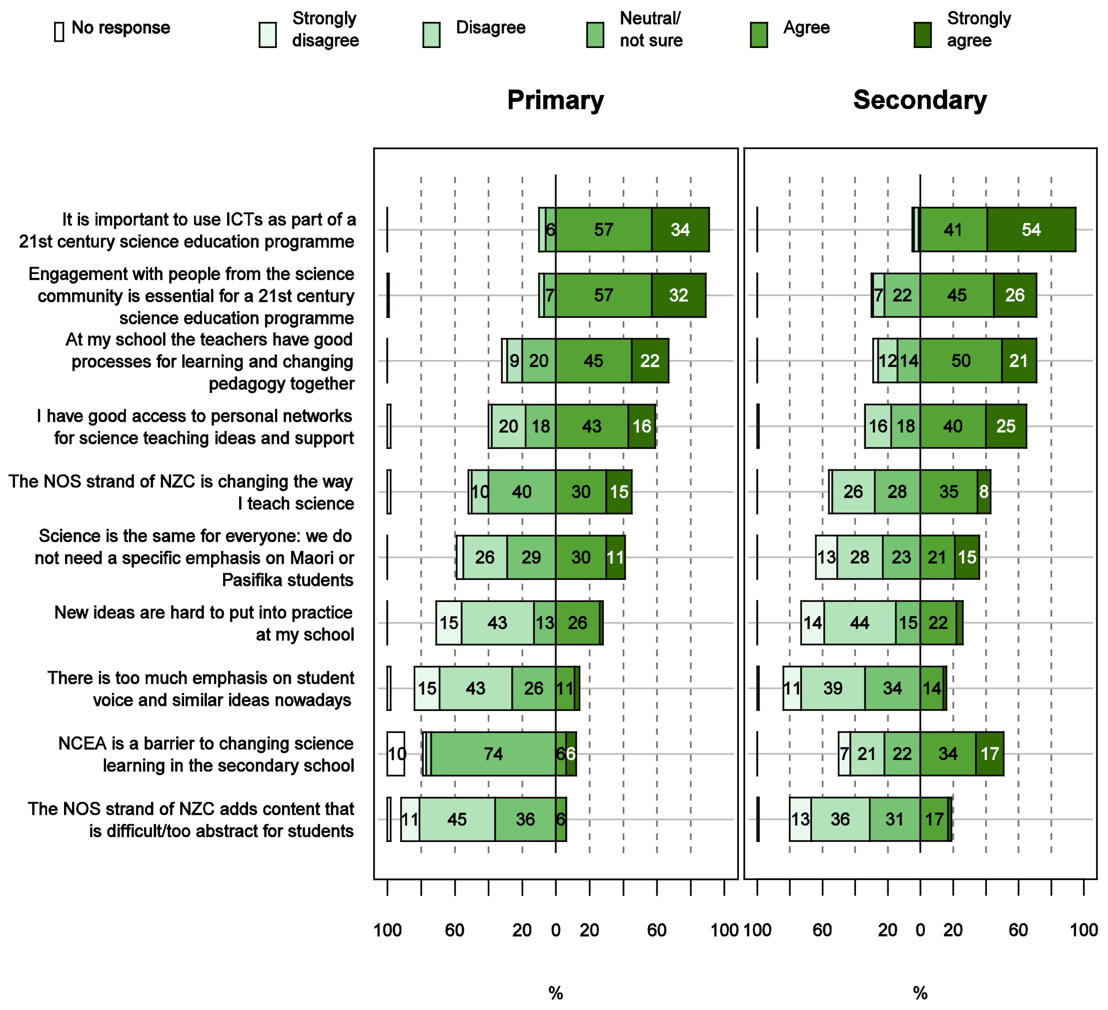
Section 8 noted teachers' overall confidence that they know how to implement the various parts of the science learning area, yet the overall framing of the *Essence Statement*—which should arguably guide all other curriculum decision making—is the aspect relatively less likely to be well understood. The *Essence Statement* in NZC points to the possibility that science learning can be framed in different ways depending on the purposes that teachers actually value and wish to foreground. The short version says:

> In science, students explore how both the natural and physical world and science itself work so that they can participate as critical, informed, and responsible citizens in a society in which science plays a significant role. (Ministry of Education, 2007, p.17)

This broad framing needs to be interpreted in the wider context of the "front half" of NZC, with its big-picture vision, its statements about the roles played by values and key competencies in learning, a set of principles to underpin decision making and advice on appropriate pedagogical approaches. The items below attempt to capture some key elements of this complex mix of influences and to locate responses to the underpinning ideas/ideals within the practicalities of teachers' day-to-day work. In a short survey, this item set could only ever be a snapshot from amongst many more possibilities. Some of the items were chosen because they have generated interesting differences in teachers' responses to other surveys. For example, "there is too much emphasis on student voice and similar ideas nowadays" generated divided opinions in the 2009 NZCER National Survey of Secondary Schools, and the position that each respondent took correlated with a wide range of other indicators of their curriculum thinking (Hipkins, 2010b). A similar format was used to capture views related to the current policy focus on success for Māori and Pasifika students (Ministry of Education, 2008a, 2008b). Past NZCER National Surveys have similarly highlighted the dominant influence of NCEA on secondary teachers' curriculum thinking and the importance of the wider school culture of professional learning and support.

Figure 6 introduces all the items and again shows the patterns of responses by sector. Note that some items were negatively worded so that disagreeing constituted a positive response.

Figure 6 **Teachers' views on curriculum-related emphases and their science-related professional learning opportunities**



There is broad agreement with the *idea* of innovation in science pedagogy as a preparation for life in the 21st century. For example, almost all the teachers thought that use of ICT should be an important part of a science programme, albeit secondary teachers were more likely than primary teachers to *strongly* agree. Almost as many primary respondents agreed that engagement with people from the science community should be part of a learning programme but, compared to the ICT response, numbers agreeing with this item dropped a little in the secondary sector (the overall primary/secondary difference was significant). Nevertheless, nearly three-quarters of secondary teachers agreed with this proposition.

Around half of each group (56 percent primary; 49 percent secondary) disagreed that the content of the NOS strand is too difficult or abstract for students, but around a third of each group were unsure about this. Note that those who did see this strand as inappropriate were more likely to be secondary than primary teachers.

There is of course a difference between in-principle ideals and the reality of actual classroom practice. Fewer than half of the secondary teachers (43 percent) and primary teachers (45 percent) agreed or strongly agreed that the NOS strand was changing the way they taught science. Of the rest, comparatively more primary than secondary teachers were unsure and more secondary than primary teachers disagreed. A very few strongly disagreed.

One reason for the relative lack of NOS-related change in secondary schools could be that NCEA is still seen as a barrier to curriculum change: 51 percent of the secondary teachers agreed with this and a further 22 percent were unsure.[9] We would expect most primary teachers to be unsure about the influence of NCEA, given that this item is not directly relevant to their practice.

Forty-one percent of primary teachers and a similar number of secondary teachers (36 percent) agreed that "science is the same for everyone: we do not need a specific emphasis on Māori or Pasifika students". Notice, however, that 29 percent of primary teachers and 23 percent of secondary teachers were unsure. The meaning and pedagogical implications that different individuals attach to this statement could be a worthwhile focus for deeper exploration. More encouragingly, very few teachers of either sector agreed that there is too much emphasis on student voice and similar ideas nowadays.[10]

All three items related to support for putting new ideas into practice showed similar levels of agreement from both secondary and primary teachers. (The third of these items was negatively worded so appears near the bottom of Figure 6.) Lack of support does not appear as likely to be a barrier to change as NCEA, or certain aspects of teachers' pedagogical beliefs.

Other patterns of differences in responses

Teachers in decile 9 or 10 schools were more likely to strongly agree that teachers at their school had good processes for learning and changing pedagogy together and those in decile 1 or 2 schools were more likely to disagree with this statement. This matches the pattern of responses in the bank of items about access (Section 6) where teachers in the highest decile schools were also more likely to say they had ready access to a network of peer support and those in decile 1–2 schools to say they had limited access to such support. This similarity is a useful indication that individuals were consistent in the way they answered these questions.

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9 In the 2009 NZCER National Survey of Secondary Schools, 30 percent of teachers saw "NCEA requirements" as a barrier to curriculum change and 30 percent saw the "time taken for NCEA assessments" as a barrier (Hipkins, 2010a). Caution is needed in interpreting differences because the samples cannot be directly compared. However, we might have hoped for this perception to show evidence of diminishing, given the work that has been carried out on aligning NZC and NCEA.

10 Twenty-seven percent of secondary teachers agreed with this statement in the 2009 National Survey, with science teachers overrepresented in this group (Hipkins, 2010b). Again, samples cannot be directly compared but it is noteworthy that this change is in the opposite direction to the NCEA one described in the above footnote.

Teachers in rural schools were more likely than those in urban schools to agree or be unsure whether NOS content is too abstract and difficult for students. Teachers in urban schools were more likely to agree they had good access to personal networks for science teaching ideas and support.

Gender differences are likely to be at least partly related to the sample characteristics: male respondents were more likely to be secondary than primary teachers. Males were more likely than females to agree or strongly agree that NCEA is a barrier to changing science teaching and learning in the secondary school. Males were also somewhat more likely to disagree that it is important to use ICTs as part of a 21st century science education programme. Males were more likely to be unsure, and females to disagree, that there is too much emphasis on student voice and similar ideas nowadays. For two items there were gender differences in the level of emphasis in responses. Males were more likely to strongly agree that science is the same for everyone and we do not need a specific emphasis on Māori and Pasifika students. Females were more likely to strongly agree, and males to agree or be unsure whether engagement with people from the science community is essential for a 21st century science education programme. The overall picture is for the responses of male teachers to tend towards more conservative pedagogical views.

Relationships between teachers' curriculum thinking and other aspects of NZC implementation

Compared to the *resource-access* factor and the *NZC-confidence* factors, there was less coherence in teachers' combinations of responses to these opinion statements (α = .61). While this Cronbach's alpha value does denote a *moderate* degree of correlation, it seems likely that there were a number of influences on teachers' responses here. Rather than cross-tabulating a somewhat weaker factor against other responses, we have instead opted to check for relationships between the stronger factors and the individual items in this section.

Relationships between the *resource-access* factor and indications of curriculum thinking

Compared to all other respondents, teachers in the highest two quartile groups for the *resource-access* factor (i.e., those who perceived they had ready or planned access to a range of resources) were more likely to *strongly* agree that: teachers in their school have good processes for learning and changing pedagogy together; the NOS strand is changing the way they teach science; and that they have good access to personal networks for science ideas and support. This group was also more likely to disagree or strongly disagree that: new ideas are hard to put into practice their school; the NOS strand of NZC adds content that is too difficult/abstract for students; or that NCEA is a barrier to changing science learning in the secondary school.

Converse patterns applied for teachers in the lowest quartile group (i.e., those who perceived they had little or no access to a range of resources). These teachers were more likely to agree or strongly agree that new ideas were hard to put into practice in their school and that NCEA is a barrier to changing science learning in the secondary school. They were more likely to agree or to be unsure whether the NOS strand of NZC adds content that is too difficult/abstract for students. Similarly, they were more likely to disagree or be unsure that: the NOS strand was changing the way they teach science; they had good access to personal networks for science ideas and support; or that teachers in their school have good processes for learning and changing pedagogy together. Uncertainty about these items suggests at least some of this group have not specifically tried to implement the NOS strand, access peer support or work with others to change pedagogy.

It is also worth noting that *no* overall differences in response patterns were found for several of the opinion items: it is important to use ICTs as part of a 21st century science education programme; engagement with people from the science community is essential for 21st century learning; science is the same for everyone, we do not need a specific emphasis on Māori or Pasifika students; and there is too much emphasis on student voice and similar ideas nowadays.

There are interesting differences in the character of the items that are associated with access matters and those that are not. The latter group are about ideas/ideals which are strongly signalled as important in NZC (21st century learning, equity, student voice). Such ideals now seem to have wide acceptance, at least in principle. However, the group of items that do show an association with perceptions of access could be characterised as being “where the rubber meets the road”. These items are about influences on what actually gets taught and about professional learning and change. Here the picture is not so optimistic. There would appear to be a complex set of relationships that mediate between curriculum thinking, professional support, actual/potential access to resources and perceptions of barriers to curriculum change.

Relationships between the *NZC-confidence* factor and indications of curriculum thinking

Compared to all other respondents, teachers in the lowest quartile group for the *NZC-confidence* factor (i.e., those with the least confidence that they understood the intent of the various parts of science in NZC) were more likely to be unsure or disagree that: teachers in their school have good processes for learning and changing pedagogy together; the NOS strand is changing the way they teach science; and that they had good access to personal networks for science ideas and support. They were also more likely to agree or be unsure whether the NOS strand is too difficult/abstract for students and that new ideas are hard to put into practice in their school.

Again, there was no overall difference in responses to the items that relate to the “high-level” messages of NZC. Rather, lack of confidence with NZC is associated with a group of items that suggest being disconnected from support for professional growth and change. And as we have already seen, these same items are also likely to be connected to perceptions of lower access.

This observation about complex relationships draws attention back to the question of whether similar associations might be found if we can characterise broad patterns of relationships between the various disparate items introduced in Sections 3–6. This challenge is the focus of the next and final section of the report.

10. Results of the correspondence analysis

A correspondence analysis is a statistical search for *groups of questions* to which responders give similar answers. Specific items that have been answered in the same way by a number of individuals are positioned as small triangles within an overall clustering pattern that spreads over four quadrants. The individuals are also represented as patterns of spots superimposed on the item cluster markers. It is up to the researchers to determine what each quadrant means by thinking about the combination of responses that end up clustered there.

Question 1: Use of curriculum resources

Figure 7 on the next page shows the results of the correspondence analysis of all responses to the set of items on the use of curriculum resources. The first 1 on each triangle denotes Question 1, the letter refers to the item number and the final number refers to the scale option chosen (1 = student use in last 12 months; 2 = teacher use in last 12 months; 3 = used to use but not in last 12 months; and 4 = never used).

The patterns in each of the four quadrants, with the names we have assigned to each, are described below. Any significant associations with demographic variables are also noted.

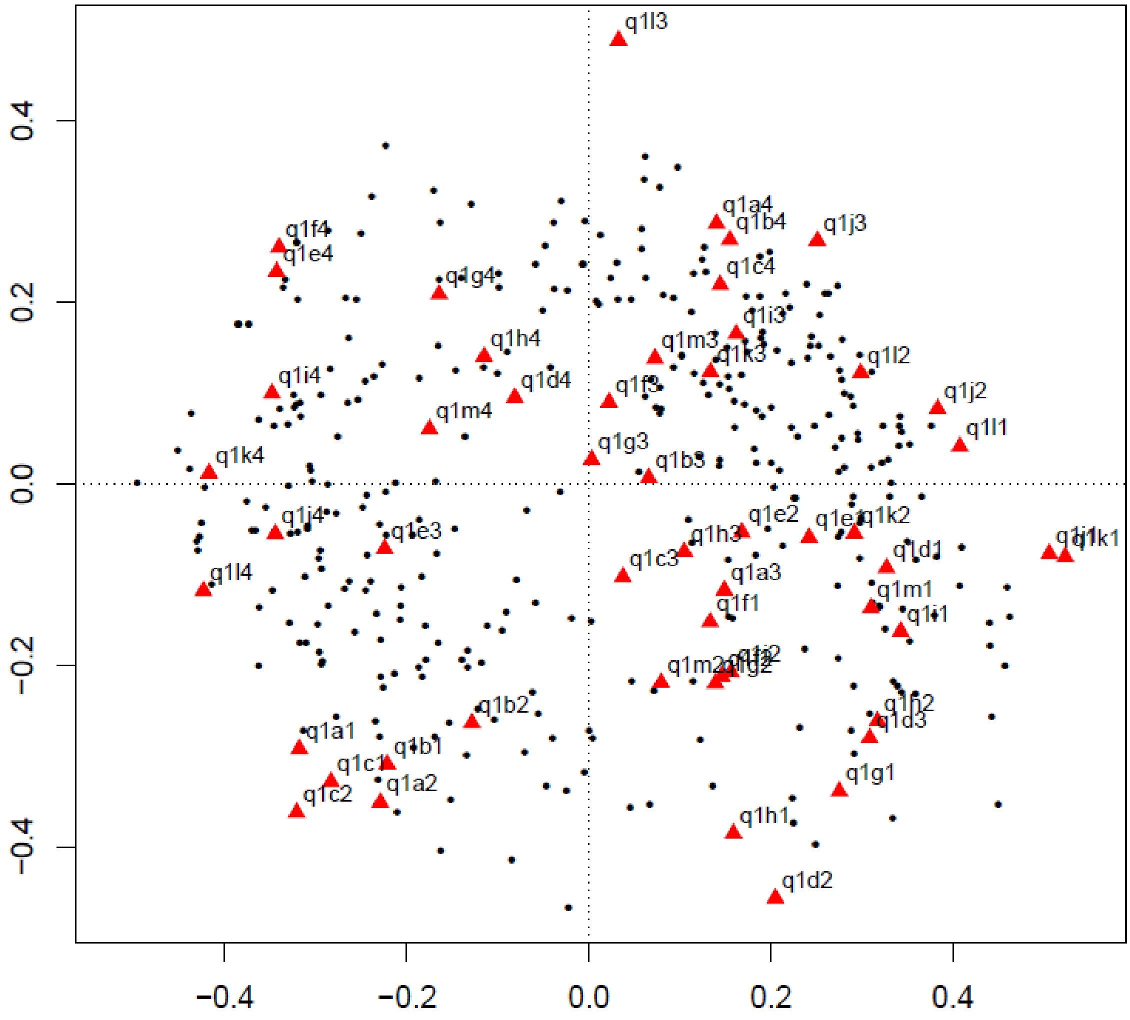
Note that there is a fifth group of teachers "in the middle" who have as much in common with each other as they do with the other teachers in the quadrant into which they actually fell. This middle group made up 30 percent of the overall sample and typically gave a "mixed bag" of responses. We have focused on the four quadrants because this is where differences between groups come most clearly into view. The quadrants are described in descending order of size.

Bottom left quadrant: Primary teachers (22 percent of sample)

This group is characterised by having recently (last 12 months) or previously used a combination of the following for their own or for their students' learning: BSC series; Connected or Applications journals; and the MBS series. They were also likely to have previously used the science exemplars and matrices. At least as much as the curriculum resources they did use, those that they have *never* used help to define this group: science subject guides (senior secondary); and NCEA science exemplars (secondary).

All but one of the respondents in this cluster was a primary teacher. As we might expect, given that many primary schools are smaller than the majority of secondary schools, teachers in smaller schools tended to be clustered here. There were somewhat more female teachers than male teachers in this cluster.

Figure 7 **Results of the correspondence analysis for curriculum resources (Q1)**



Top right quadrant: The NCEA-focused teachers (20 percent of sample)

All the members of this group were secondary teachers. The only student resources these teachers were likely to have used in the last 12 months were the NCEA science exemplars. For their own use they were most likely to have used the science subject guides (senior secondary) and the NCEA science exemplars. They may have used the following in the past but had not in the last 12 months: Connected or Applications journals; ARB science resources; Nature of science teaching activities on TKI; Science/Biotechnology Learning Hubs; and the Science subject guides.

Responses from teachers in decile 7 schools tended to be clustered here, as were those in schools with 800+ students. There were more male than female teachers in this cluster.

Top left quadrant: The non-users (17 percent of sample)

This group is mainly defined by what they have *never* used, which will be a combination of: Kick Starting the Nature of Science; science exemplars and matrices; ARB science resources; Nature of science teaching activities on TKI; science learning objects in the TKI digistore; Science/Biotechnology Learning Hubs; New Zealand Science Teacher and other NZASE resources; and the TVNZ 7 Learning Hub.

There were twice as many primary as secondary teachers in this cluster, no doubt at least in part because most secondary teachers access NCEA resources even if they access little else.

Bottom right quadrant: The innovators (11 percent of sample)

This group has in common that, over the last 12 months, they used a combination of the following to support either their own or their students' learning: Kick Starting the Nature of Science; Science exemplars and matrices; ARB science resources; Nature of science teaching activities on TKI; Science learning objects in TKI digistore; Science/Biotechnology Learning Hubs; science subject guides (senior secondary); New Zealand Science Teacher/other NZASE resources; TVNZ 7 Learning Hub. Also included in this quadrant are "used to use" responses to: BSC series; MBS series; Kick Starting the Nature of Science; and the science learning objects in TKI digistore.

These were all secondary teachers who are clearly well connected to a wide range of available resources. The impression is that they access and use these strategically, hence the title chosen for the quadrant. They are, however, the smallest group overall.

Teachers from "Decile 11" schools (private schools and those who did not give a decile rating) tended to be clustered here.

Relationships between these clusters and responses to other parts of the survey

The clusters were cross-tabulated with responses to the other survey questions. While there is some overlap with results reported in earlier sections, this additional analysis gets us closer to question the heart of this research: Why do some teachers make more (and better?) use of available resources than others?

Relationships between use of curriculum and community resources

As we might predict, there was clear evidence that non-users of curriculum resources were also likely to be non-users of specific community resources. Compared to all other respondents, those in the non-user cluster were more likely to say they never used any one of the community resources listed. Teachers in the mainly-primary cluster were also likely to have never used tertiary faculty and students, and teachers in the NCEA cluster were likely to have never used parents/whānau with relevant expertise.

Teachers in the mainly-primary and innovator clusters for curriculum resources were also more likely to have used the following to support their students' learning: parents/whānau with relevant expertise; museums, zoos, aquariums, planetariums etc.; and environmentally-focused EOTC programmes. Teachers in the innovator cluster were also more likely than all other teachers to have used Futureintech ambassadors; tertiary staff and students (those in the NCEA cluster were also somewhat more likely to access tertiary staff, but not tertiary students). Teachers in the innovator and NCEA clusters were more likely to have accessed Royal Society resources for their students' learning and those in the primary and NCEA clusters to have accessed these for their own learning (or, in the case of the NCEA cluster, to have done so in the past).[11]

Relationships with ICT use

Having students publish on the Internet was the only ICT-related activity that did not show an association with curriculum resources clusters, doubtless because so few teachers said they did this.

Compared to curriculum/community resource patterns of association there was an interesting shift in the overall curriculum resource/ICT use patterns we found. This time it was the innovators and the NCEA cluster teachers (rather than the innovator and mainly-primary cluster teachers) who were more likely to be the most active (weekly) users of ICTs to: update their own science knowledge; find resources for students; find students activities to download; demonstrate a concept in class; set science homework that required students to access the Internet; and have students collect and analyse scientific data. Innovators were also more likely to *often* have students use ICTs to: do research during class time; collaborate with students in other classes or schools; and to sometimes communicate with people outside the school about a science activity. Teachers in the NCEA cluster, along with non-users, were more likely to say they never had students use ICTs to communicate with other students, or with people beyond the school.

As we might anticipate, non-users of curriculum resources were the most likely to say they never did many of these things but for some activities they also were likely to indicate that they wanted to do these things.

Relationships with *resource-access* and *NZC-confidence* factors

As we might predict given earlier indications of relationships, there was a clear association between these clusters and quartile group for the *resource-access* factor. Teachers in the readiest access quartile group were more likely to be the in the mainly-primary and innovative clusters. Teachers in the low/no access quartile group were more likely to be in the non-user- and NCEA-focused clusters. Here we see a clear association between use of a range of resources and perceptions of access to resources.

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[11] As noted earlier, Royal Society networks were used to access the respondents and the patterns reported here are likely to be indications of having held a Teacher Fellowship administered by the Royal Society.

The strongest association between the clusters and the *NZC-confidence* factor was found when the factor used included just the NOS strand/*Essence Statement* items (i.e., confidence in understanding of the four contextual strands was left out of the factor). Teachers in the higher two quartile groups for confidence in their own understanding of the NOS strand of NZC were again more likely to be from the mainly-primary and innovative clusters. Teachers in the lowest quartile group for confidence in their ability to implement the NOS strand of NZC were more likely to be in the non-user- and NCEA-focused clusters. Again, there is a clear association between use of a range of resources and a confident understanding of the broader intent of the curriculum (i.e., not just the content strands).

Relationships between resource use clusters and teachers' curriculumthinking

Perhaps not surprisingly, teachers in the NCEA-focused cluster were more likely than all other respondents to strongly agree or agree that NCEA is a barrier to changing teaching and learning in the secondary school. Teachers in this cluster were also more likely to disagree that the NOS strand is changing the way they teach. Interestingly, along with teachers in the innovator cluster, they were nevertheless also more likely to disagree that the NOS strand is too difficult/abstract for students. It would appear that the demands of NCEA rather than any perceived intellectual demands of the NOS strand itself are likely to be the barrier these NCEA-focused teachers see to fully implementing the intent of NZC.

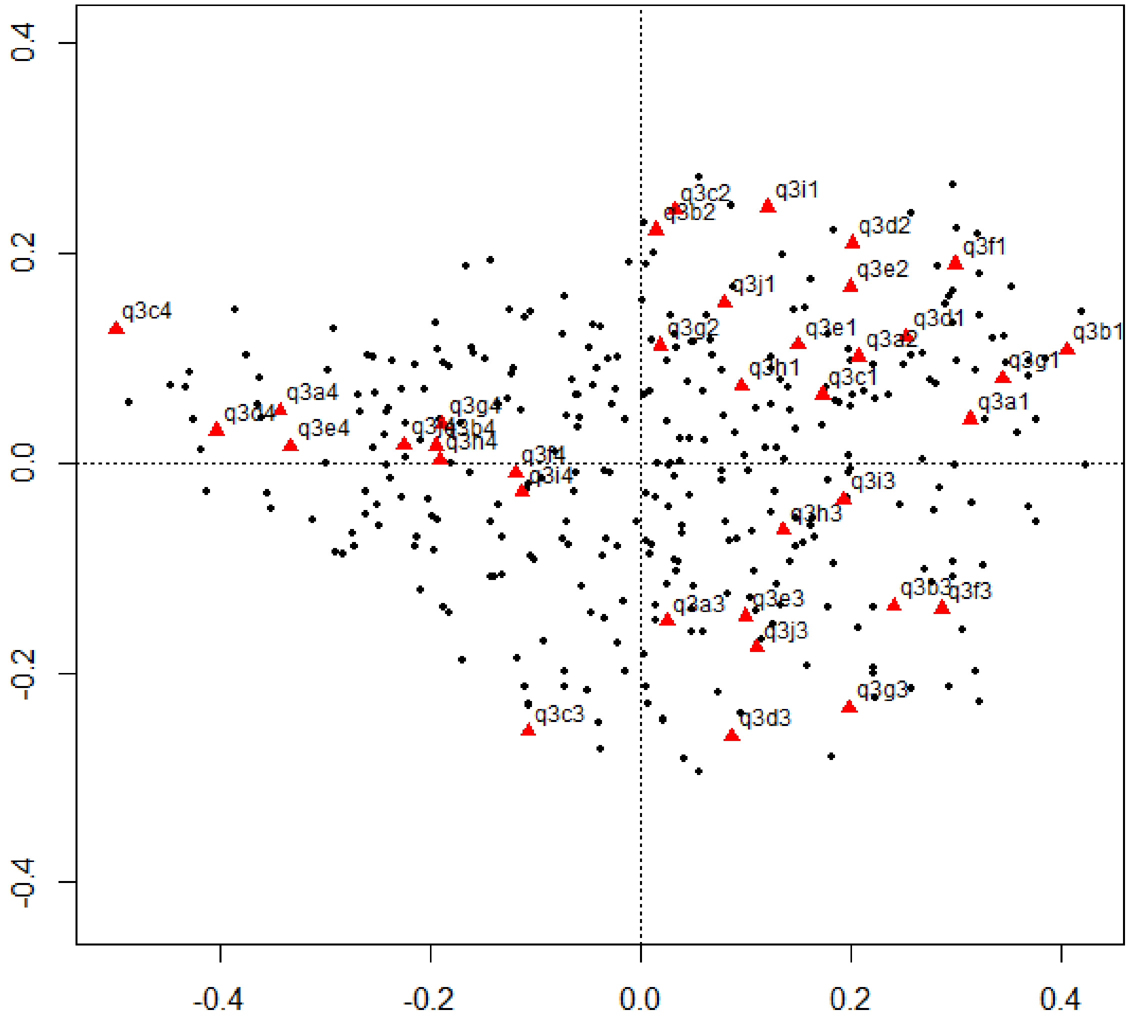
Teachers in the innovator cluster were more likely to *strongly* agree that engagement with people from the science community and use of ICTs are important components of a 21st century science education, and that they had good access to personal networks for science teaching ideas and support. It was not that others disagreed with these three statements but rather this group made a more emphatic response.

Question 3: Use of community resources

The correspondence analysis for the responses to Question 3 yielded the quadrants shown in Figure 8 and described below. Note that the group of teachers "in the middle" (who have as much in common with each other as they do with the other teachers in the quadrant into which they actually fell) comprised 20 percent of the sample.

Compared to the patterns of responses for Question 1, there were fewer differences associated with demographic variables. We found no pattern to responses by decile, roll size, percentage of Māori or Pasifika students on the roll or gender.

Figure 8 **Results of the correspondence analysis for community resources (Q3)**



Top right: Active users (26 percent of sample)

Note that this group of active users of community resources is twice the size of the "innovator cluster" for curriculum resources.

Teachers who were clustered in this quadrant had used a combination of the following (either in the past 12 months or previously) to support their students' learning: tertiary education science faculty; tertiary science students; other working scientists; museums, zoos etc.; environmentally-focused EOTC programmes; Futureintech ambassadors; Royal Society scholarships/funds; and the Fonterra Science Roadshow. They were also likely to have accessed the Futureintech ambassadors for their own learning. In the past, but not more recently, they had also used virtual field trips (e.g., LEARNZ) and parents/whānau with relevant expertise.

There was a relationship between these clusters and the teaching experience of the respondents. Teachers with between 6 and 10 years' experience were more likely to be active users of community resources than those who had been teaching for 5 years or fewer. By contrast, those who had been teaching for 11 years or more were overrepresented in the past users cluster (see below).

Top left: Non-users (22 percent of sample)

The next biggest group was characterised by never using: tertiary education science faculty; tertiary science students; other working scientists; museums, zoos, planetariums etc.; environmentally-focused EOTC programmes; Royal Society scholarships/funds/resources; Fonterra Science Roadshow; or parents/whānau with relevant expertise.

Teachers in the largest schools (1,000+ students) were overrepresented in this cluster. However, there was no sector-based difference: 22 percent of all primary teachers and 22 percent of all secondary teachers were in this group.

Bottom right: Past users (19 percent of sample)

This group was characterised by identifying a number of resources that they had used—but not in the last 12 months. These included: tertiary education science faculty; tertiary science students; other working scientists; Futureintech ambassadors; parents/whānau with relevant expertise; Royal Society scholarships/funds/resources; Fonterra Science Roadshow; and virtual field trips. Note that this list is very similar to the one generated for the group who had never used many of the resources named, except that museums and EOTC-type resources are omitted and virtual field trips are added.

Unlike the two clusters described above there was a sector-related difference for this cluster, with larger numbers of secondary than primary teachers represented in it.

Bottom left: Past/non-users (12 percent of sample)

This smaller group had in common that they all said they had used museums, zoos, aquariums, planetariums etc. in the past (and/or the people working there) and that they had never used IPENZ's Futureintech ambassadors or virtual field trips such as LEARNZ.

There was a sector-related difference for this cluster, with larger numbers of secondary than primary teachers represented in it. Teachers in the largest schools (1,000+ students) were also overrepresented and these two variables are doubtless confounded here.

Relationships between these clusters and responses to other parts of the survey

Relationships between use of curriculum and community resources

These relationships have already been discussed in terms of the community resources accessed by the different curriculum support groups. Now we can look at the pattern in reverse: Which curriculum resources did the teachers in the different community resource clusters access?

The following resources did not show any significant association with community resource clusters: Kick Starting the Nature of Science; nature of science teaching activities on TKI; science learning objects in the TKI digistore (all of which were characterised by low levels of use overall); and the senior secondary subject guides and NCEA science exemplars (both of which were used by most secondary teachers but few or no primary teachers).

Non-users and past/non-users of community resources were also likely to be non-users of almost all the remaining curriculum resources listed in Question 1: BSC; Connected or Applications journals; MBS series; science exemplars and matrices; Science and Biotechnology Learning Hubs; TVNZ 7 Learning Hub; and the New Zealand Science Teacher. By contrast, active users of community resources were also likely to be users of all these curriculum resources either for their own or for student use. They were also more likely to say they used the ARBs. The MBS series was an exception to the pattern: active users of community resources were more likely to say they had used MBS in the past.

The overall picture that emerges is that active users of curriculum resources are also active users of community resources, and vice versa. Non-users are less likely to access either type of resource for their science teaching programmes.

Relationships with ICT use

Compared to the relationships between use of curriculum resources and ICT use, we found only a few associations between community resources and ICT use. Non-users and past/non-users of community resources were less likely than the active user and past user groups to say they often found students activities to download but they were also more likely to say they would like to do this.

Active users of community resources were more likely than teachers in any of the other three clusters to say they sometimes had students communicate with people outside the school, or publish their work on the Internet.

Relationships with *resource-access* and *NZC-confidence* factors

There was a clear association between the community resource clusters and quartile group for the *resource-access* factor. Teachers in the readiest access quartile group were more likely to be active users of community resources. Teachers in the low/no access quartile group were more likely to be in the non-user, and past/non-user community resource clusters. Here we see a clear association between use of a range of community resources and perceptions of access to resources.

Again, the strongest association between the clusters and the *NZC-confidence* factor was found when the factor used included just the NOS strand/*Essence Statement* items (i.e., confidence in understanding of the four contextual strands was left out of the factor). Teachers in the highest quartile group for confidence in their own ability to implement the NOS strand of NZC were more likely to be from the active user cluster. Teachers in the lowest quartile group for confidence in their own ability to implement the NOS strand of NZC were more likely to be in the non-user cluster. Again, we see a clear association between use of a range of community resources and a confident understanding of the broader intent of the curriculum (i.e., not just the content strands).

Relationships with teachers' curriculum thinking

Active and past users of community resources were more likely than those in the other two clusters to agree or strongly agree that teachers at their school had good processes for learning and changing pedagogy together and that they had good access to personal networks for science teaching ideas and support. Non-users were more likely to disagree with both these statements.

Active users of community resources were more likely to strongly agree, and past users to agree (i.e., a less emphatic response) that the NOS strand is changing the way they teach science. Both these groups were more likely to disagree, and in the case of active users to strongly disagree, that NOS strand content is too difficult/abstract for students. Non-users were more likely than all other respondents to be unsure about both these statements.

Not surprisingly, active users of community resources were more likely to strongly agree that engagement with people from the science community is essential for a 21st century education.[12]

Question 5: Use of ICT

The correspondence analysis for the responses to Question 5 yielded the quadrants shown in Figure 9.

Again, there was a group of teachers "in the middle" who have as much in common with each other as they do with the other teachers in the quadrant into which they actually fell. This group comprised 30 percent of the sample.

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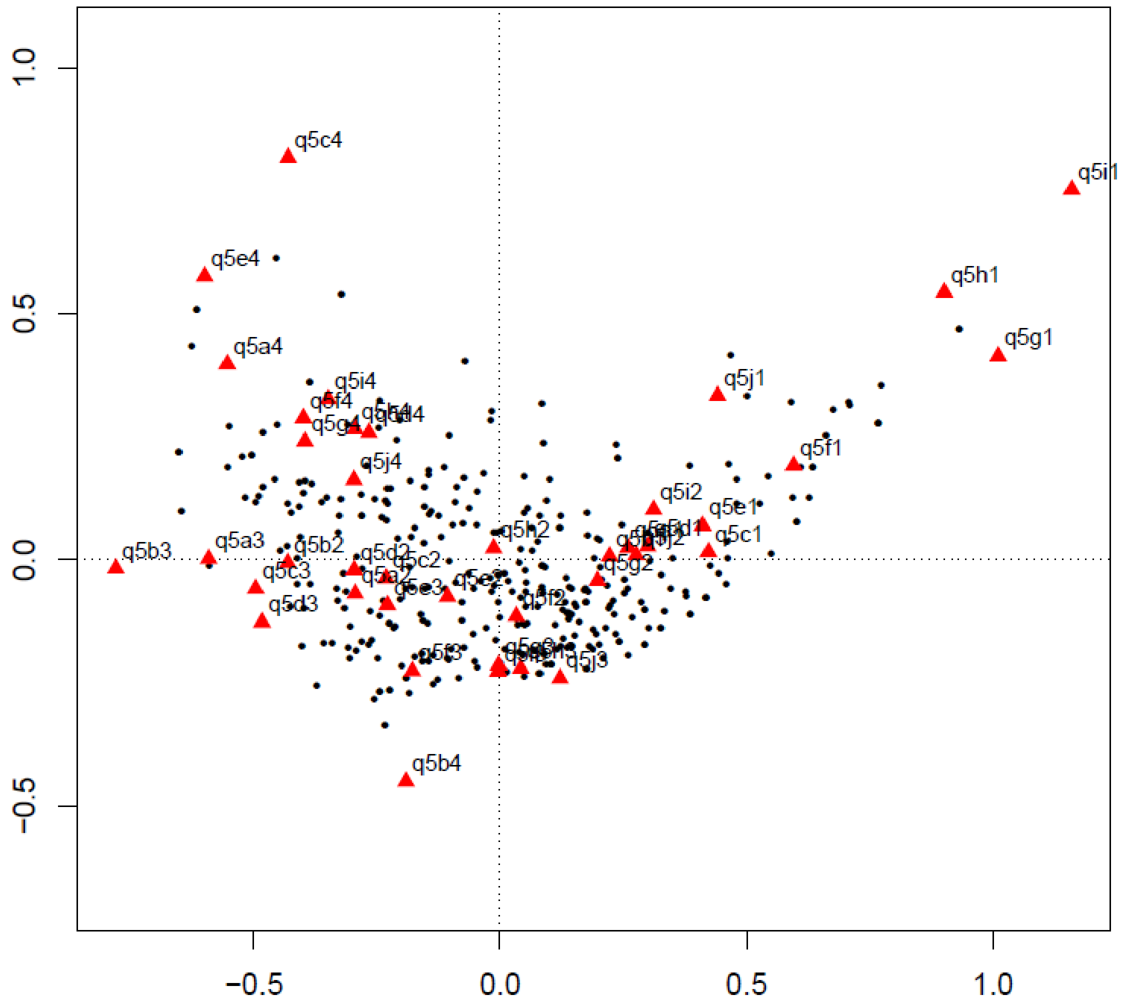
[12] This is another useful indication of internal coherence in these individuals' responses to the different item banks.

Figure 9 **Results of the correspondence analysis for ICT use (Q5)**



Bottom right: Cautious e-learning innovators (27 percent of sample)

This group was characterised by already occasionally using ICT to set science homework that required students to access the Internet or having students collect/analyse scientific data. They would also like to have students collaborate with each other, in school or beyond, and publish on the Internet. But they were not yet doing these things.

Top left: Non-users of ICT (19 percent of sample)

This group was characterised by never doing some combination of almost all the listed types of activities. They did want to use ICTs to update their own science knowledge, but were not currently doing so. And they occasionally had their students collaborate via ICT with those in other classes or schools.

Bottom left: ICT as a teaching resource (13 percent of sample)

This group had some similarities to those on the bottom right quadrant in that there were a number of things they would like to do and some things that they were already doing occasionally. However, for them the focus of these activities was more likely to be their *teaching* rather than the direct use of ICT by their students for *learning* purposes. This group said they occasionally used ICTs, or would like to make use of ICTs to carry out some combination of: updating their own science knowledge; finding resources for students; finding student activities to download; demonstrating a concept in class; or having students use the Internet in class to find information for a topic or project. They were also likely to say they did not currently, but would like to, set science homework that required students to access the Internet; have students collect/analyse scientific data; have students communicate with someone outside the school who is involved in a scientific activity. The outliers visible at the bottom of the quadrant (q5b4) said they never used ICT to find resources for students.

Teachers in urban schools were overrepresented in this group. This was the only demographic difference we found for the ICT-use clusters.

Top right: e-learning innovators (12 percent of sample)

The smallest cluster was characterised by their use of ICT to do some combination of all the listed activities on a regular basis (at least once a week). Some rated having students communicate with someone outside the school who is involved in a scientific activity as something they did occasionally and this pattern was also found for having students publish on the Internet.

Relationships between these clusters and responses to other parts of the survey

Relationships with use of curriculum resources

In contrast to the strong set of relationships we found between use of curriculum and community resources, there were just two for relationships between the ICT clusters and use of specific curriculum resources.

Non-users of ICT were more likely than teachers in the other three clusters to say they never used the science exemplars and matrices, and along with the cautious innovators, to say they had never used the Science or Biotechnology Learning Hubs. The latter resources were more likely to have been used often by the e-learning innovators.

Relationships with use of community resources

Non-users of ICT were more likely than all other teachers to say they never used: working scientists from CRIs etc.; Royal Society resources; and parents/whānau with relevant expertise. Along with the cautious innovators they were also more likely to say they never used virtual field trips or tertiary science students. The e-learning innovators were more likely than all other groups to have used all of these resources to support students' learning, except those of the Royal Society, which were as likely to be used by all except the non-users of ICTs.

Relationships with *resource-access* and *NZC-confidence* factors

Again, there was a clear association between the ICT-use clusters and quartile group for the *resource-access* factor. Teachers in the readiest access quartile group were more likely to be active users of ICTs for e-learning purposes. Teachers in the low/no access quartile group were more likely to be in the non-user and cautious innovator ICT clusters.

Interestingly, the stronger association between the ICT-use clusters and the *NZC-confidence* factor was found for the full factor with the four contextual strands included.[13] Teachers in the highest quartile group for confidence in their ability to implement NZC were more likely to be from the e-learning innovator and ICT as a teaching resource clusters. Teachers in the lowest quartile group for confidence in their ability to implement NZC were more likely to be in the non-user cluster.

Relationships with teachers' curriculum thinking

As we might expect, the e-learning innovators were more likely than teachers in the other three clusters to strongly agree that it is important to use ICTs as part of a 21st century science education programme. These teachers were also more likely to strongly agree that they had good access to personal networks for teaching ideas and support.

Teachers in the non-user ICT cluster were more likely to say they were not sure whether the NOS strand is changing the way they teach, while those in the e-learning innovator and ICT-for-teaching strands were more likely to strongly agree with this statement. Non-users were also more likely to agree that there is too much emphasis on student voice nowadays, or to be unsure about this. E-learning innovators were the cluster most likely to strongly disagree with this statement.

Relationships between the three sets of clusters

As might be predicted, given all the associations just reported, we found clear associations between the sets of clusters.

When the curriculum resource clusters were cross-tabulated with the community resource clusters the following patterns were found:

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[13] For both the curriculum and community resource clusters the stronger association was with the curriculum confidence factor that included only the NOS strands and the *Essence Statement.*

- Innovative users of curriculum resources were also more likely (than all other respondents) to be active users of community resources.
- Teachers in the NCEA-focused curriculum cluster were overrepresented in the past user and non-user clusters for community resources.
- Non-users of curriculum resources were overrepresented in the past/non-user cluster for community resources.

When the curriculum resource clusters were cross-tabulated with the ICT-use clusters the following patterns were found:

- Teachers in the mainly-primary cluster for curriculum resources were overrepresented in the ICT as a teaching resource cluster.
- Innovative users of curriculum resources were also more likely to be cautious ICT innovators or e-learning innovators.
- Non-users of curriculum resources were also more likely to be non-users of ICTs for learning purposes.

When the community resource clusters were cross-tabulated with the ICT-use clusters the following patterns were found:

- Non-users of community resources were also more likely to be non-users of ICTs for learning purposes.
- Active users of community resources were more likely to also be e-learning innovators or to be in the ICT as a teaching resource cluster.
- Non-users of community resources were less likely than all other teachers to be in the cautious innovators cluster for ICT use.

The overall pattern is clear, at least at the two extremes. Innovative teachers are active users of all the types of resources available to them. Non-users of any one type are likely to be non-users of all the types of resources available.

11. Implications for the ongoing Science Initiatives projects

Ongoing work in three separate projects will be informed by the findings outlined in this report. Each project was designed to begin with a survey of the resources being used, with indications of why these and not other resources are currently accessed. Sections 3–6 of the report build a picture of those usage patterns and also point to some potential challenges for the ongoing project to address. Each project will now pick up on specific challenges, as well as taking up opportunities to dig deeper where big-picture questions have been raised. For example, for the Curriculum Support project it is of concern that NCEA resources may be the *only* curriculum resources accessed by some secondary teachers. Equally concerning is that so few teachers—either primary or secondary—could name specific resources for meeting the learning needs of special needs students, or Māori or Pasifika students, or to support students in making good pathways choices.

Had a separate survey been conducted for each project we would not have been able to establish relationships between patterns of resource use in each of the three areas. The survey has demonstrated that innovative users of curriculum resources also tend to be active users of community resources. Relationships with ICT use are not as clear-cut, except that non-users tend to be non-users of all three resource types. The inclusion of a set of items that probed perceptions of access consolidated the emerging picture that access issues, while doubtless grounded in some concrete and contextually specific problems, include a dimension that is about *perceptions* of access. Furthermore, this dimension appears to be connected in complex ways to teachers' curriculum beliefs and to their overall confidence levels to implement NZC.

Some specific challenges for the three projects follow from this overall pattern of relationships. The Science Initiatives projects have been designed with the integrating role played by the NOS strand of NZC at their heart. From a researcher perspective, we would assert that the NOS strand should influence teachers' thinking about purposes for learning science, with associated implications for pedagogy. Yet the NZC *Essence Statement* (which sets the direction for science learning) and the NOS strands are the curriculum components which teachers feel relatively less confident to implement. This is another area where the teachers' recommendations of "best" resources do not inspire confidence that the majority will be enjoying opportunities to innovate in the classroom in ways that accord with the transformative spirit of NZC when taken as a whole.

Another challenge is that support from other teachers, advisors and subject associations, while seen as the best resource for providing good teaching ideas generally, does not appear to be readily available to many of the responding teachers. Decile-related differences in perceptions of access to such support add to this challenge. The action plans to be developed by the three Science Initiatives projects will continue to address these interrelated and complex challenges.

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Appendix A: Science Project Survey

Science Project Survey

Introduction

Welcome to the science resources survey. Thank you for your help.

View the ethical processes in place for this survey here.

There are 10 screens in total: you can exit the survey at any time but we hope you will complete at least all of the closed (check box) questions. This will take no more than 20 minutes.

Your use of print and on-line resources

1. Which statement best describes your *main* use of the following resources *in the past 12 months*?

	Mostly used to support student learning	Mostly used to support teacher learning	Not used recently, but have in past	Never used
Building science concepts series	○	○	○	○
Connected (primary) or Applications (secondary) journals	○	○	○	○
Making Better Sense series	○	○	○	○
Kick Starting the Nature of Science (NZCER)	○	○	○	○
Science exemplars and matrices	○	○	○	○
Assessment Resource Bank science resources	○	○	○	○
Nature of science teaching activities on TKI (was Science IS)	○	○	○	○
Science learning objects in TKI digistore (te Pātaka Matihiko)	○	○	○	○
Science/Biotechnology learning hubs	○	○	○	○
Science subject guides (senior secondary)	○	○	○	○
New Zealand Science Teacher, other NZASE resources and conferences	○	○	○	○
NCEA science exemplars (secondary)	○	○	○	○
TVNZ 7 Learning Hub	○	○	○	○

2. Please list any additional resources you'd really recommend for supporting science teaching and learning (no more than 3 resources)

3. Which statement best describes your *main* use of the following science community organisations in the last *12 months*?

This includes people and organisations who do science, provide professional support for science, promote science engagement and learning among school-age learners.

	Mostly used to support student learning	Mostly used to support teacher learning	Not used recently, but have in past	Never used
Tertiary education science faculty (e.g., University staff)				
Tertiary science students (e.g., University students)				
Museums, science and technology centres, aquariums, zoos, planetariums (or people who work at these centres)				
Other working scientists (e.g., people from NIWA, Liggins Institute, Manaaki Whenua/Landcare, DOC, etc)				
Environmentally-focussed EOTC programme providers (e.g., regional council stream monitoring programmes, wetlands restoration, Enviroschools facilitators)				
Futureintech Ambassadors (IPENZ)				
Royal Society Scholarships/Funds: e.g., Teacher fellowships, CREST, Bayer Scholarships, FREESTA, Student Travel Awards				
Fonterra Science Roadshow (Science Technology Roadshow Trust)				
Virtual fieldtrips (e.g., Learnz)				
Parents/whanau with expertise relevant to topic				

4. Are there any other ways you or your students have been engaged with/supported by the "science community"? [Brief description only]

Your use of ICT for science learning

ICT here includes, but is not limited to, using: the Internet, learning platforms like Moodle, videoconferencing or Skype, blogging, data loggers, and Web 2.0 technologies.

5. How often do you use ICT to do the following things *to support science learning*?

	Often (at least once a week)	Sometimes (every couple of weeks)	Don't but would like to	Never
Update your own science knowledge				
Find resources for your students, like images or articles				
Find student activities to download				
Demonstrate a concept or provide an example in class, e.g., using a video clip				
Have students use computers during class to search for information for a topic or project				
Set science homework which requires students to access the Internet				
Have students collect and/or analyse scientific data, e.g., from an Internet site or using a digital data logging device				
Support students to collaborate/share their learning with students in other classes or in other schools				
Have students communicate with someone beyond the school who is involved in a scientific activity				
Have students publish on the Internet (e.g., building Web pages, blogging, putting stories or videos online)				

Your ease of access to resources and curriculum support *for science*

6. How easily can you access the following types of resources?

	Ready access	With time to plan	Limited access	No access
On-line science resources during class				
Scientist(s) who can support student inquiry				
Scientist(s) who can talk about their science/what they do etc				
Professional advice and support for implementing NOS strand				
A network of peer support (e.g., local science teacher group)				
Learning Media print resources (e.g., Building Science Concepts, Connected/Applications journals)				
A science museum or similar EOTC initiative				
E-tools that support science inquiries (e.g., data loggers, science databases)				

Your confidence with the different parts of science in NZC

7. Overall, how well do you feel you can put into practice each of the following parts of the NZC?

	Very well	Moderately well	Not very well	Not at all well
Understanding about science (NOS strand)	○	○	○	○
Investigating in science (NOS strand)	○	○	○	○
Communicating in science (NOS strand)	○	○	○	○
Participating and contributing (NOS strand)	○	○	○	○
Living World strand	○	○	○	○
Planet Earth and Beyond strand	○	○	○	○
Physical world strand	○	○	○	○
Material world strand	○	○	○	○
Learning area ("essence") statement	○	○	○	○

Your views on NZC and science learning

8. Please indicate your level of agreement with the following statements:

	Strongly agree	Agree	Neutral/not sure	Disagree	Strongly disagree
At my school the teachers have good processes for learning and changing pedagogy together	○	○	○	○	○
New ideas are hard to put into practice at my school	○	○	○	○	○
The NOS strand of NZC adds content that is difficult/too abstract for students	○	○	○	○	○
NCEA is a barrier to changing *science* learning in the secondary school	○	○	○	○	○
The NOS strand of NZC is changing the way I teach *science*	○	○	○	○	○
Engagement with people from the science community is essential for a 21st century science education programme	○	○	○	○	○
Science is the same for everyone: we do not need a specific emphasis on Māori or Pasifika students	○	○	○	○	○
It is important to use ICTs as part of a 21st century science education programme	○	○	○	○	○
I have good access to personal networks for science teaching ideas and support	○	○	○	○	○
There is too much emphasis on student voice and similar ideas nowadays	○	○	○	○	○

The best resources for specific uses

9. Thinking about all the resources mentioned in Questions 1–3 — and any other favourite resources — which would you be *most likely* to use for each of the following purposes?

Complete as many as you want and feel free to add brief comments

Integrating literacy and science learning	
Making science more engaging for **all** students	
Increasing students' awareness of what scientists do/science careers	
Supporting student inquiry in a science context	
Increasing your own knowledge of NOS	
Getting good teaching ideas generally	
Integrating e-learning and science	
Helping students experience science learning in a real world context	
Engaging Māori or Pasifika learners *in science*	
Working with special needs students *in science*	
Updating your own science content knowledge and/or practical skills	
Helping students make decisions about secondary and tertiary *science* study	
Extending students who are talented in science	

10. Any further comments on resources?

About your school

11. What is your school's decile rating?

- 1
- 2
- 3
- 4
- 5
- 6
- 7
- 8
- 9
- 10
- NA

12. How many students are on the roll?

- Under 100
- 100–199
- 200–399
- 400–599
- 600–799
- 800–999
- 1000–1499
- 1500 +

13. The location of your schools is:

- Urban
- Rural

14. In your school, about what percentage of the students identify as:

	0–7%	8–14%	15–30%	31%+
Māori				
Pasifika				

15. Which would be your nearest MOE office?

And now a few questions about you:

16. Are you:

- Male
- Female

17. How many years have you been teaching?

- Under 2 years (PRT still)
- 3–5 years
- 6–10 years
- 11 years or more

18. At which year levels do you teach?

Select as many as are relevant: secondary teachers please think only about your science teaching

- 0–3
- 4–6
- 7–8
- 9–10
- 11–13

19. Which best describes your role(s)

- ☐ Senior management (principal, AP or DP)
- ☐ Middle management (syndicate or faculty leader)
- ☐ Predominantly a science teacher
- ☐ General classroom teacher
- ☐ In charge of science in the school (primary)

One last request:

20. Would you like to participate in a teleconference or focus group to explore the ideas and challenges raised by this survey?

- ○ Yes
- ○ No

21. If you would like to participate in a teleconference or focus group to explore the ideas and challenges raised by this survey, please include your:

Name

e-mail address

22. Which part of the project would you like to discuss?

- ☐ e-learning in science
- ☐ Science education-science community interactions
- ☐ NOS resources to support NZC

Thanks