TECHNOLOGY PROGRAMME DESIGN

Discussion ideas for future programme development

ABSTRACT

Technology programmes are at the level of school curriculum development and as such provide a school specific framework to work from for all teachers involved in teaching technology. This paper provides some ideas and examples for discussion to support technology programme development during the 2008-2010 transition period as schools move from technology programmes based on technology in *The New Zealand Curriculum* (1995) to those based on technology curriculum in *The New Zealand Curriculum* (2007).

INTRODUCTION

A technology programme should provide opportunity for the incorporation of *The New Zealand Curriculum* (2007) principles, values, and key competencies alongside the opportunities to address the requirements of the technology learning area statement and achievement objectives. The foci for contexts chosen as suitable for the programme should reflect the school's resources. This includes the knowledge and skills of the teachers, physical and consumable resources, and the available community resources. As a compulsory learning area for all students from year 1 to the end of year 10, every school in New Zealand should be developing their own technology programmes. The nature of existing technology programmes being delivered to address the *Technology in the New Zealand Curriculum* (1995) will need to undergo a shift to align with the technology curricullum in *The New Zealand Curriculum* (2007). A transition time is being provided until 2010 to enable schools to develop teacher understanding of *The New Zealand Curriculum* (2007) and bring these into their technology programmes. During this time, it is recommended teachers focus on ensuring their technology programmes support and report on progression of student learning in terms of the three components of Technological Practice. This strand pulls together the three previous strands of *Technology in the New Zealand Curriculum* (1995). Over this transition time teachers are also encouraged to begin to explore the five components within the two new strands (Technological Knowledge and the Nature of Technology) but will not be expected to formally assess or report on student progression of these before 2010.

Section One focuses on programme duration and the role of achievement objectives and assessment to support and report student progression. Section Two focuses on classroom programmes. Section Three provides possible ideas of what programmes might look like as they transition towards supporting a technological literacy based on all three strands of the technology curriculum in *The New Zealand Curriculum* (2007). Further information will be gathered from future classroom research with regards to pedagogical strategies and resources that best support learning within these two additional strands. As this information becomes available further papers will be written to communicate this to all teachers and case study resources will be produced using student data to illustrate different levels of student achievement in terms of the Technological Knowledge and Nature of Technology achievement objectives.

SECTION ONE

PROGRAMME FOCUS AND DURATION

The duration of a technology programme should be determined by wider school structures in order to maximise the opportunity to plan for and monitor student progression. From 2010 this progression will be focused on developing student technological literacy as evidenced by their achievement across all three strands (and therefore eight components) of technology. For 2008 and 2009 however, teachers are encouraged to develop programmes that focus on formally assessing and reporting on students' progression within Technological Practice as evidenced through their achievement in terms of Brief Development, Planning for Practice and Outcome Development and Evaluation.

Contexts should be identified at the school programme level to provide coherent and comprehensive opportunities to meet the purpose of the programme focus. The selection of contexts rests on a balance between providing students with variety and interest, and providing enough richness to sustain progression of learning both within and across components. Teacher interest, teacher and others' expertise and classroom resourcing should also be key factors in context selection to ensure learning experiences are informed and manageable.

Currently it is common for programmes in technology to be planned to cover a one or two-year time period. For example, in primary school a technology programme may be planned separately by syndicates – that is, the junior syndicate may plan to cover years 1 and 2, the middle syndicate to cover years 3 and 4, and the senior syndicate to cover year 5 and 6. Similarly, intermediate schools often plan a programme for their year 7 and 8 students, and junior secondary for their year 9 and 10 students. Senior secondary tend then to plan one-year programmes for year 11, year 12 and year 13. Recent work in technology suggests such planning is not helping students' overall progression in technology as the transition points within and between schools tend to be particularly disruptive to seamless learning in technology.

To address this, it is suggested that schools begin to increase the scope of their programmes to cover more year groups and to link to programmes that provide entry and exit points. For example, primary schools could look to plan a programme of learning that has a duration of six years (or eight in schools that cater for year 1-8). Secondary schools could look to plan their technology programme to cover five years (or seven in schools that cater for year 7-13) with multiple exit points for students from year 10 onwards to reflect the optional nature of technology at years 11, 12 and 13. Intermediate schools will continue to be bound to a two-year programme, however these programmes should be seen to link with programmes from both contributing and destination schools. Those schools who cater for students from years 1-13 could work towards a coherent 13-year programme.

The transition to planning programmes that are more conducive to providing students with a seamless technology education will need to be well supported by the development of shared teacher understandings of technology education, and the development of robust assessment and reporting mechanisms. Some strategies that can support the development of shared understandings include teachers being involved in ongoing discussions about technology generally, joint planning and team teaching, and internal moderation of student work. The development of professional learning communities within and across schools has many benefits including the establishment of common reporting mechanisms for student achievement that are effective and manageable.

An example of a school that has been exploring programme planning of lengthier duration Is available on Techlink at Programme Planning.

ACHIEVEMENT OBJECTIVES AND REPORTING

Achievement objectives in technology have been developed for each component to provide a focus for progression within the programme. They also provide guidance to teachers for the development of a series of coherent learning experiences that could sit within the programme and may be organised into interlinking units of work. Achievement objectives require interpretation by teachers to plan for and deliver multiple-level teaching to address student learning needs within their technology programme. Levelled achievement objectives are not specific learning intentions. Achievement objectives are statements that need to be broken down by teachers into learning intentions to support the planning and delivery of learning experiences, formative assessment and for reporting purposes.

Formative assessment information gained by teachers throughout the learning experiences should provide a picture of student achievement in terms of the achievements objectives. As teachers develop a shared understanding of what student achievement looks like at each level, reporting mechanisms can be effectively developed to ensure this information, along with suggested next steps in learning, is communicated to students, caregivers and subsequent teachers within or across schools. Communicating this level of information is critical to ensure student learning is not disrupted by a change in school and/or teacher.

SECTION TWO

LEARNING INTENTIONS

Programmes of learning may include a varying number and range of contexts within which a series of coherent learning experiences will be developed. These may be organised as units and/or projects, however care should be taken to ensure such organisational structures are clearly interlinked to support the programme as a whole. The time allocated to learning experiences is determined by both the intended learning planned by the teacher, and student learning needs in relation to this learning focus. For example, a series of lessons may be planned whereby students disassemble a product developed locally, visit or are visited by a technologist involved in the product's development, and review their initial analysis in order to develop an understanding of brief development prior to developing their own brief for as part of their own technological practice.

When planning for 2008 and 2009, teachers are encouraged to develop learning experiences focused on one or more of the components from the technological practice strand, as well as any other knowledge and skills identified as 'key' to student learning. The identification of other knowledge and skills will be determined by the specific context selected and the nature of the student's technological practice. While some of these will be common across all students, others may vary between students as dependent on their needs.

Learning intentions can therefore be pre-determined by the teacher prior to the delivery of the learning experiences to ensure students have access to generic knowledge and practice that takes into account students' prior learning. However, during the delivery of learning experiences, opportunity should be left to develop negotiated learning intentions that are responsive to student technological practice, and additional specific contextualised learning needs and/or their interests that arise from the experiences offered.

As learning intentions represent the learning that the teacher has determined to be 'key' within the context, they provide the main focus for teacher interactions within the classroom. However, they do not represent all the learning experiences the context will provide. For example, when students are undertaking technological practice within a specific context they will clearly be increasing their capability and knowledge of all three of the components of technological practice. However, the 'focus' for teacher interaction, and therefore assessment and monitoring of student learning, may be on only one or two of these components. This will increasingly be the case as the five new components from the two additional strands become part of the school technology programme.

PEDAGOGICAL STRATEGIES

All teaching in technology should be based on an understanding of students' current level of achievement and interest and an awareness of what their next learning steps should be. Pedagogical strategies that have been found to be particularly useful in supporting technological practice include:

- Explanation and demonstration of skills and techniques followed by scaffolded opportunities for students to develop these themselves.
- Exploration of and free 'playing' with a wide range of materials.
- Demonstration of equipment use, followed by multiple opportunities for students to use the equipment safely for a range of appropriate purposes.
- Investigation of multiple perspectives underlying own and others' decision making.
- Research into current understandings of how things work.
- Analysis of past and contemporary technological developments.
- Technological product and system analysis.
- Open debate of personal ideas and contentious issues.
- Questioning (from teacher, peer and self) to encourage justification for decisions made.
- Introducing and revisiting concepts, skills and practices across a range of contexts to aid students develop more generic understandings.
- Explicit discussion of similarities and differences across contexts.

Learning environments which provide students with authentic tasks and the opportunity to interact with a range of people (for example, team teaching situations, outside 'experts', clients) have also been shown to increase motivation and raise the standard of the outcomes produced.

SECTION THREE

EXAMPLES OF PROGRAMME CHANGE

The following examples illustrate possible ideas for a year 3/4 and 9/10 programme. Figures 1a and 2a reflect how programmes may currently look as based on technological practice alone. Figures 1b and 2b reflect how these may change over the next two years of transition time. Figures 1c and 2c reflect possible future programmes once all three strands of the technology curriculum in *The New Zealand Curriculum* (2007) become features of the technology programme. These examples represent the shift to include the additional five components from the nature of technology and technological knowledge. As indicated earlier, teachers would also be encouraged to extend the programme duration to include year groups before and/or after as part of a more coherent programme that supports seamless learning in technology.

In these examples, the component-related learning intentions sit on the brown horizontal line. These represent the generic knowledge and practices inherent in the achievement objectives for technology that need to be progressed for all students as they develop their technological practice initially (as shown in Figures 1a, 1b, 2a and 2b), and later, their technological literacy (as shown in Figures 1c and 2c). In an attempt to keep the diagrams simple, Figures 1c and 2c show each of the components only once ('on the line'). However, it is expected these would be revisited in a range of contexts to support the progression of understandings and capabilities.

Those aspects that appear 'off the line' represent context specific knowledge and skills that might be identified as essential for students to know and/or be able to do in order to fully engage in the context. For the transition period the additional components are also shown 'off the line' to show they may be explored during this time but need not be focused on for progression and reporting purposes.

The context-specific knowledge and skills show a mix of technological knowledge and skills, as well as additional knowledge and skill that may come from other disciplines such as science, social science, mathematics. These will range in number according to the time available for each context and will be determined by the decisions teachers make about what they consider to be 'key' and the resources they have available. Therefore the examples provided are indicative suggestions only.

Figure 1: Example of a Year 3-4 Programme

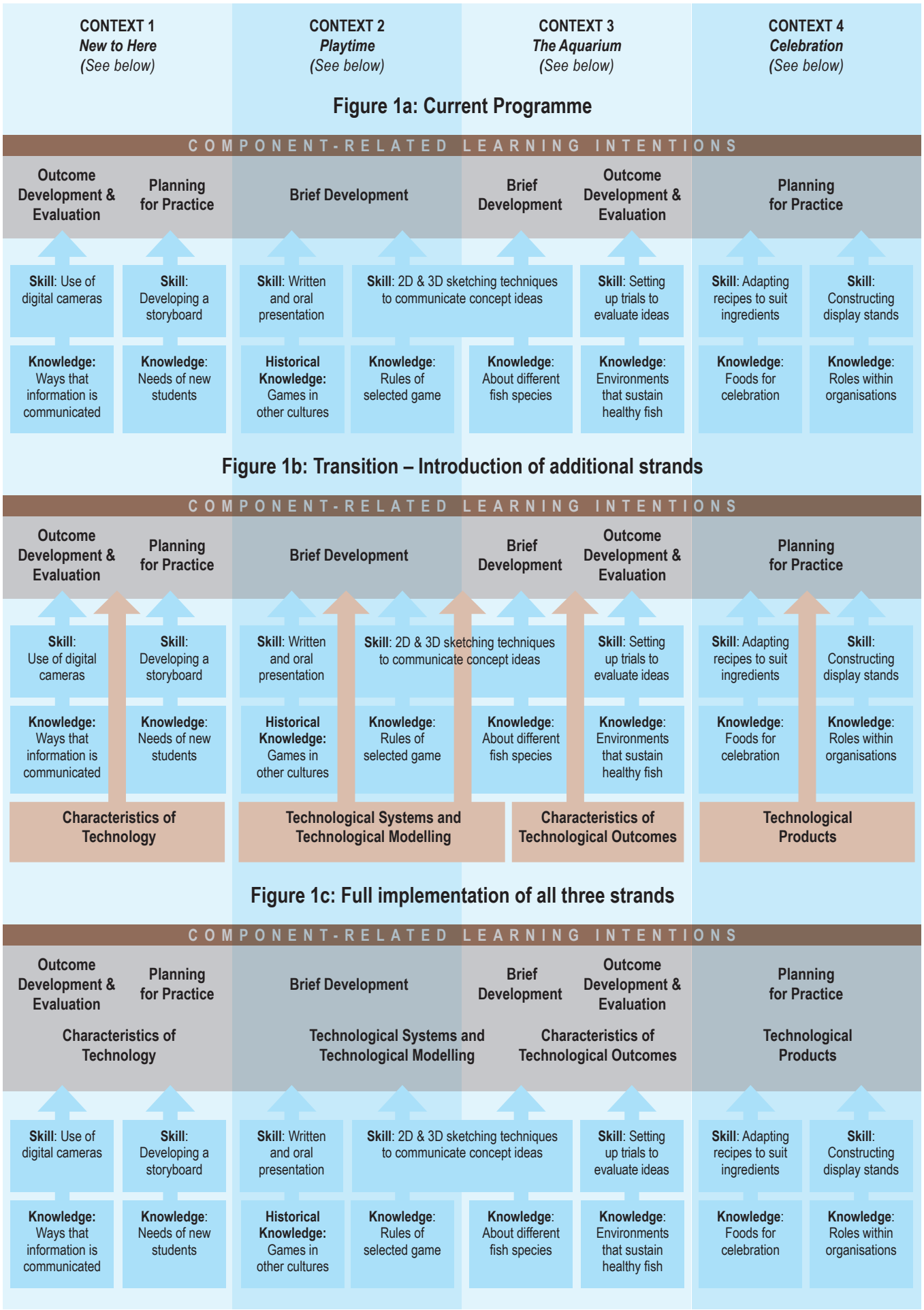
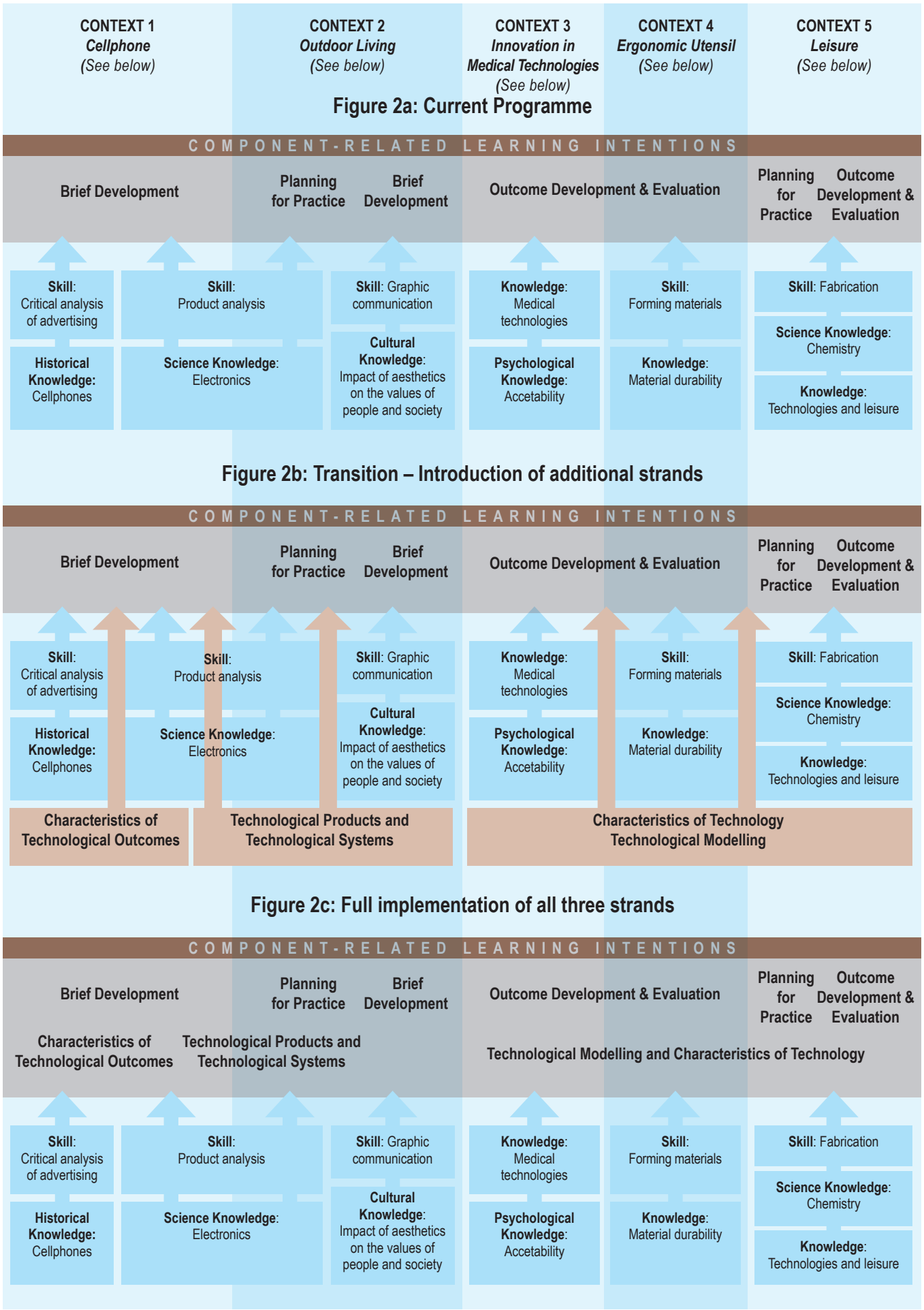


Figure 2: Example of a Year 9-10 Programme



CONTEXTS FOR FIGURES 1 AND 2

Taken from Discussion Document: Design Ideas for Future Technology Programmes by Compton and Harwood, available at www.tki.org.nz/r/nzcurriculum/draft-curriculum/technology_e.php

Figure 1: Example of Ideas for a Possible Year 3-4 Programme

The first context, New to Here, provides opportunity for teachers to focus on two components as students undertake technological practice to develop an intranet page for students new to the school. The focus on outcome development and evaluation allows learning experiences to centre on students finding out what people new to their school need to know, and developing content (suggestions/pictures/maps) that can be put up in a user-friendly way for students with a range of reading abilities and English literacy capabilities. Exploring the use of multimedia as a means of effectively communicating to others also allows students to gain an understanding of how technology both reflects and changes society, as part of the characteristics of technology component.

The second context, Playtime, also relates to characteristics of technology by looking specifically at games – and how and why different games have developed in different cultures. The other component focused on in the second context is brief development. The inclusion of this component ensures students explore a range of ideas for an area outside their building, which has in the past been used for different ball games but is currently under-utilised. By accessing the views of the students in the middle school (for whom the area is designated), the students are able to develop an outline of the attributes any solution would need to have, taking into account resources available (including money and time), and issues such as safety and pedestrian flow. The outcome of this technological practice may not necessarily result in the completion of the area given time and money constraints. However, it should allow for future completion through an oral and written presentation of a collective brief to the Parent Teacher Association (PTA) as based on the students experimenting with materials and trialing of ideas. This may include the use of a range of modelling techniques, for example, scale 3D models, computer simulations, perspective landscape drawings etc.

The third context picks up on a newly acquired aquarium for the classroom, and includes a focus on three components. The students focus on technological systems as they explore the relationship between the inputs, transformation, and outputs of the water filtration system needed to keep their fish healthy. As part of this context the students will develop science understandings in order to identify fish that can co-habit and that will survive best in a simple cold water aquarium. The students are encouraged to explore the characteristics of technological outcomes in general, and select appropriate 'toys' for the selected fish as based on an understanding of their material and functional nature. A focus on technological modelling is also included whereby students explore functional modelling to evaluate the potential impact of adding different 'toys' and other non-technological additions (rocks/plants) to the aquarium before physically adding them – thereby addressing ethical concerns with regards to care of their fish. Once satisfied that their selected toys for the aquarium will not impact on the health of the fish, the students explore how the selected products can be trialed in the aquarium to see how the fish interact with them as part of their overall environment, and how they serve to enhance the aesthetic value of the aquarium. From this basis, the students can then set up their new aquarium in the classroom from an informed basis and make plans to ensure it is maintained as a suitable environment for their fish.

The final context, Celebration, recognises the importance of valuing achievement and provides opportunity for students to plan an afternoon to share their achievements over the year with parents. A focus on planning for practice provides opportunity for the students to plan the event efficiently, allocating roles to themselves and helpers as appropriate. The event also provides opportunity for students to work to a set deadline. A key part of the celebration will be the inclusion of a display of work and an afternoon tea. Gaining an understanding of this context's second component, technological products (in terms of both food products and display stands), will aid the students in ensuring their planning identifies appropriate resources to make the afternoon a safe, enjoyable, and successful occasion.

Figure 2: Example of Ideas for a Possible Year 9-10 Programme

The first context, the Cell phone, provides opportunity for teachers to focus on three components. The characteristics of technological outcomes focus allows students to explore the concept of malfunction and develop their understanding that technological outcomes are 'fit for purpose' in terms of time and context. The context provides opportunity for students to gain technological knowledge about the component technological products, specifically about how technological products can be recognised by the relationship between their material and functional properties. The context also allows for an exploration of technological systems – both those internal to the cell phone as a product, and the wider communicative technological system of which the cell phone is a system 'component'. The rapidly changing nature of the cell phone makes this a rich context for such learning, as does the marketing aspects (for example, when do 'opportunities' become perceived as 'needs'), which are also explored as part of developing skills of critical analysis of advertising. All these understandings will provide a good basis for the students as they undertake their own technological practice within the next learning context.

The second context, Outdoor Living, includes a focus on two components. Focusing on brief development provides students with an opportunity to design and develop conceptual ideas for outdoor lighting to address a specific stakeholder need. To ensure that students possess knowledge that will enable them to effectively address this need and develop appropriate specifications, the component of technological systems is revisited, with a specific emphasis on the science knowledge underpinning lighting systems. The context also allows for negotiated learning experiences that centre on students' development and awareness of how the culture of a community both influences and validates what is aesthetically and functionally acceptable.

In order to enable students to communicate and test their conceptual ideas for lighting, a learning experience that focuses on skills in graphic communication has also been identified as essential for this group of students. This will enable them to gain effective feedback from stakeholders to further develop their brief, and undertake the subsequent development work to create an appropriate outdoor living environment for their stakeholder.

The third context, Innovation in Medical Technologies, allows teachers to focus learning on the component characteristics of technology. Such learning experiences enable students to develop an understanding of how technological developments enable human possibilities to be expanded, and why technology must draw knowledge from a wide range of disciplines. Psychological knowledge of people's views of risk and its link to acceptability is identified as a 'key' knowledge to assist students to work in this context, along with the need for students to develop skills in identifying all stakeholders (direct and indirect, current and future) associated with innovations. Students will draw from these understandings in order to generate their own designs for new or modified utensils, as they develop these for trialing in context four.

Context four, Ergonomic Utensils, provides opportunity for students to gain an understanding of technological modelling as they undertake technological practice to develop an ergonomic utensil for an identified purpose. Learning experiences supporting this component focus on developing student knowledge about how functional modelling contributes to the development of design concepts, through enabling evidence to be gathered to inform decision making specifically around feasibility. Exploring a wide range of similar products will provide key experiences for students, with prototyping being focused on in this exploration. This will allow students to explore the success or otherwise of pre-realisation predictions that were formed as a result of earlier functional modelling, and to analyse if prototype modelling of the utensils resulted in the need for subsequent changes. This will in turn inform their own trialing of prototype utensils when evaluating their utensils ergonomic features. A focus on the skills of forming materials will provide students with the opportunity to extend their knowledge of how materials can be shaped and allow them to develop a range of techniques for shaping different materials. Knowledge of material durability as linked to repetitive use and environmental factors is also identified as a focus key within this context. Both this knowledge, and the previous skills focus, will allow students to make informed selections of materials and techniques in the development of their own utensil.

The final context, Leisure, contains two components – planning for practice and outcome development and evaluation. The inclusion of these two components provides teachers with the opportunity to focus learning experiences on ensuring students develop an outcome that addresses an identified need or opportunity to do with a leisure activity. Learning experiences for the planning for practice component focus on students analysing

their own and others' planning practices so that they are informed in the selection and use of planning tools. This will support them to justify the technological practice they undertake to address the need/opportunity, and demonstrate they can use planning tools to make decisions about resources needed – for example, materials, equipment, tools, time and money. Outcome development and evaluation will provide a focus on ensuring that students develop an ability to justify the nature of their intended outcome based on relevant codes of practice and from their own exploration of materials.

To ensure that students have a broad basis from which to effectively address the identified need or opportunity, a focus on developing historical understandings of technologies associated with leisure, the impact of 'new' innovations (for example, smart materials), and the chemistry of materials is included. Learning experiences focused on skills of fabrication are also provided to ensure capability issues are addressed.