FEATURE

ICT and learning

by **Paula Christophersen**, Information and Communications Technology (ICT) Curriculum Manager, Victorian Curriculum and Assessment Authority

The theme for *Compak* 2006 is information and communications technology (ICT) with approaches based on the model presented in the interdisciplinary ICT learning domain in the Victorian Essential Learning Standards. In this article Paula Christophersen provides an overview of the ICT domain and the three dimensions within this domain.

What is ICT?

Information and Communications Technology (ICT) is one of four learning domains in the Interdisciplinary Learning strand of the Victorian Essential Learning Standards (VELS). The domains within the Interdisciplinary strand are designed to equip students with the knowledge, skills and behaviours to act effectively in the world. These domains focus on preparing students to be active learners and problem-solvers so that they can make sense of the world around them. Interdisciplinary domains encapsulate how students should conceive and realise ideas, evaluate processes, and develop and express their understandings of key concepts and ideas articulated in all other areas of learning.

In technical terms, information and communications technology is the hardware and software that enables data to be digitally processed, stored and communicated. Hardware includes items such as computers, digital cameras, electronic whiteboards and mobile phones. Software includes applications such as word processors, spreadsheets, web authoring, databases, Internet browsers, image editors and graphic organisers.

In curriculum terms, the ICT domain focuses on providing students with the knowledge and skills to change how they learn and to enrich their learning environment. This learning transformation occurs when students use ICT tools for building their knowledge and understanding; it occurs when students are able to focus on the tasks to be accomplished rather than on the technology they are using to do the work. ICT should enable students to work more productively and creatively; to collaborate more effectively; to gather and evaluate information efficiently, and to share their knowledge with others locally and globally. These outcomes are possible because ICT fosters modelling of phenomena, risk taking, analysis, creativity, hypothesising, knowledge sharing and new thinking skills.

How does ICT differ from IT?

The study of information technology (IT), as illustrated in VCE IT, focuses on students learning about the capacities, scope and limitations of hardware and software and how they interact to carry out specific functions, such as creating mathematical models using spreadsheets and creating multimedia information using multimedia-authoring software. Contrast this with the ICT domain, which focuses on using ICT as a tool to assist with learning, recreation and in personal relationships. Ultimately ICT should be transparent; it becomes a secondary tool to the primary focus of enhancing learning in all areas. Gaining fluency with ICT requires

time, effort and for most students, a structured learning program that provides them with the opportunities to acquire and apply specific ICT knowledge and skills. See 'Developing learning programs' on page 12 for further details.

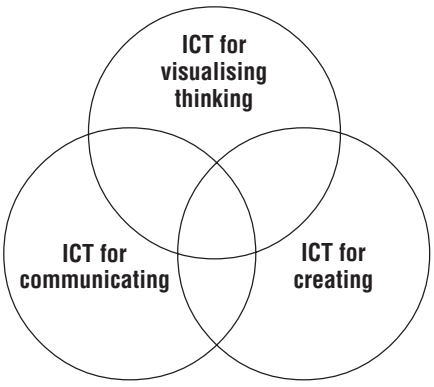
The ICT domain in a nutshell

The knowledge, skills and behaviours for this domain enable students to:

- develop new thinking and learning skills
- work productively
- create information and solutions
- express ideas in contemporary ways
- communicate to solve problems and share information
- act responsibly and critically when using ICT.

These outcomes are organised in three dimensions, as shown in Figure 1.

FIGURE 1: DIMENSIONS OF ICT DOMAIN



Standards for the ICT domain are organised in three dimensions.

For students this means applying ICT knowledge and skills to:

- *Develop* understanding of domain-specific knowledge and skills (focus of 'ICT for visualising thinking' dimension). The flexibility, speed and capacities of ICT supports the drafting, filtering, reorganising, refining and systematic assessment of ideas, content and concepts in order to structure thinking processes and construct knowledge.

  Using visualising thinking tools focuses students on integrating current and past knowledge, and on identifying essential information. Visualising thinking engages students to create tools for understanding content and these understandings are usually more easily recalled when presented in a non-linguistic way.
- *Demonstrate* understanding of domain-specific content and concepts (focus of 'ICT for creating' dimension). It is important that students are confident users of ICT so that they can take risks when problem-solving; that they are encouraged to refine, reconsider and experiment with alternative ways of solving problems, and that they can apply appropriate formats and conventions to best represent their understandings. This dimension also equips students with the knowledge and skills to manage their files and to manage time and resources, particularly when working on collaborative problem-solving tasks.
- *Share* understanding of domain-specific knowledge and skills with known and unknown people (focus of 'ICT for communicating' dimension). Students acquire knowledge and skills in order to:
  - present ideas and understandings to audiences, for example developing a PowerPoint file to support an oral presentation to an audience
  - communicate with known and unknown participants. This also includes developing and applying protocols for effective communication and for understanding associated legal responsibilities and ethical considerations when using this ICT application
  - support knowledge building among teams.

Dimension details: ICT for visualising thinking

In this dimension students use ICT to assist their thinking processes and they reflect on the suitability of their visualising thinking strategies for different learning situations. It's the dimension that should lever real changes in how students learn.

> Students use software applications to assist in developing their understandings of concepts, ideas and relationships. Any software application may be used to visualise different types of thinking and as students progress through the levels of schooling they should use a range of ICT tools so that they may eventually develop the knowledge to determine the most appropriate software for a particular purpose. The value of using ICT compared with using pen and paper, includes the immediacy of results (as the effects of changes in a thinking strategy are seen almost instantly), and the greater impact of onscreen visuals (through the use of colour, different fonts, symbols and animation) which encourages persistence and deeper thinking. (Source: unpublished VCAA document)

When using ICT in this way David Jonassen said ('Computers as Mindtools for engaging learners in critical thinking', *TechTrends*, 1998) '… learners function as designers, and the computers function as Mindtools (ICT tools) for interpreting and organizing their personal knowledge. Mindtools scaffold different forms of reasoning about content. That is, they require students to think about what they know in different, meaningful

About the author

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ways'. For further reading access <www.coe.missouri.edu/~jonassen/Mindtools.pdf>

These visualising thinking strategies are classified in a variety of ways by different educational writers, but essentially they fall into three categories:

- graphic organisers
- simulations and dynamic models
- controlled models.

Graphic organisers

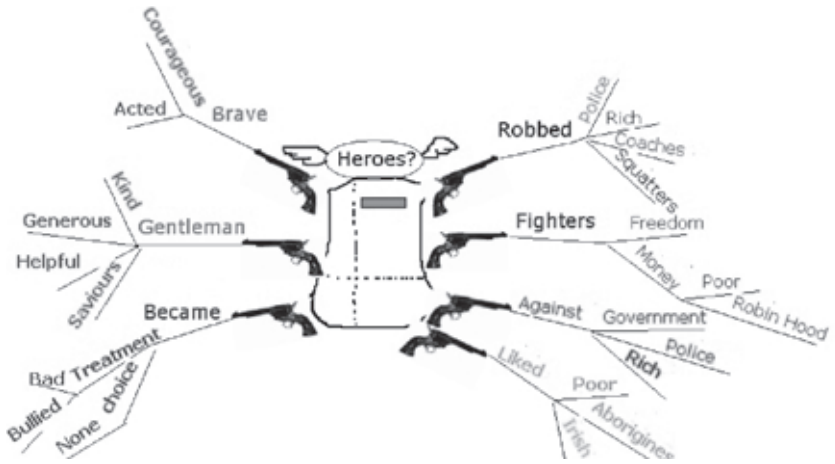
Graphic organisers such as mind maps, fishbone diagrams, spider maps, double bubble diagrams, memory nodes diagrams (see page 36 for an explanation), brace maps and Venn diagrams are created using any ICT tool that enables students to link symbols (such as words, shapes and images) in such a way that constructs a visual representation of the thoughts, ideas, patterns and associations they are forming in their mind. These might range from simple diagrams to sophisticated multimedia documents containing hyperlinks that open up more and more associations for complex ideas.

Many students already use hand-prepared graphic organisers, hence it is expected that in the early implementation stages of VELS, this category of ICT visualising thinking tools will be the most commonly applied. Consequently, in this article, most emphasis will be placed on them.

Typically these tools are used by students to make links between what they know and what they need to know. They are bridging tools that help them construct understandings of new situations. They are thinking tools; not the means by which students demonstrate understanding, but rather how they gain an understanding. Students can then build on key findings represented in these organisers. They can copy key findings, using them as scaffolds for further development. They can save these organisers, and add to them as new situations arise. They can be annotated by students and teachers to assist in the learning process.

It is important that students become skilled in selecting and using organisers that best suit the task at hand. Figures 2–5 illustrate some popular organisers and their applicability.

FIGURE 2: CONCEPT MAP USED TO EXPLORE CONNECTIONS RELATING TO NED KELLY



Source: VCAA

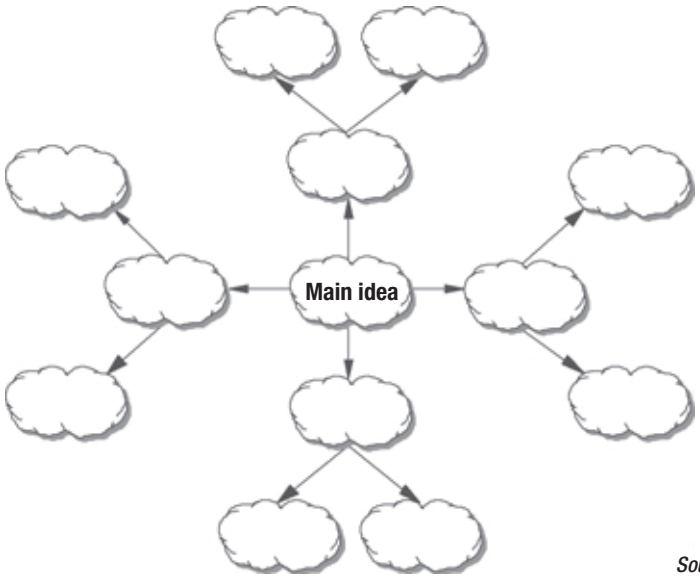
Concept map/bubble map

These organisers are used to describe attributes and connections between key ideas. Software such as Inspiration can be used or templates can be created containing callouts or text boxes. See Figures 2 and 3.

Double bubble/Venn diagram

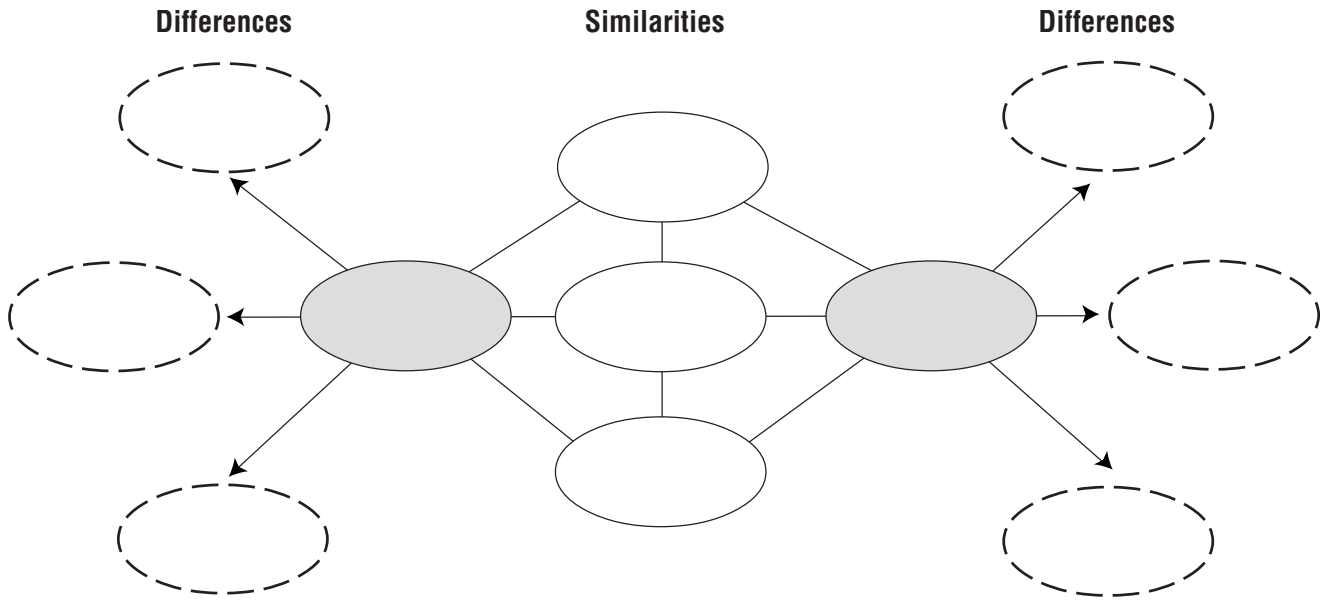
These organisers are used to identify the similarities and differences between two concepts/ideas/issues. Students can insert hyperlinks to add further depth to their ideas, including links to other files they have created or to websites. For example, in Level 6 of Humanities–Economics, students are required to analyse the role and significance of trade in influencing Australia's standard of living. A double bubble organiser could be used by students to establish the similarities and differences between absolute and comparative advantage of trading nations. Links could be inserted to relevant businesses or countries. In Level 6 of Civics and Citizenship, students are required to learn about the differences between various types of laws. A double bubble organiser or a Venn diagram could be used to identify similarities and differences between common law and statute law. See Figure 4.

FIGURE 3: CALLOUTS USED TO CREATE A TEMPLATE FOR A CONCEPT MAP/BUBBLE MAP



Source: VCAA

FIGURE 4: DOUBLE BUBBLE ORGANISER



Double bubble organisers can be created using AutoShapes in Word.

Cause-and-effect organisers

Many different organisers can be used to tease out the causes of a particular event and their ramifications. A tree diagram is one such organiser, as illustrated in Figure 5.

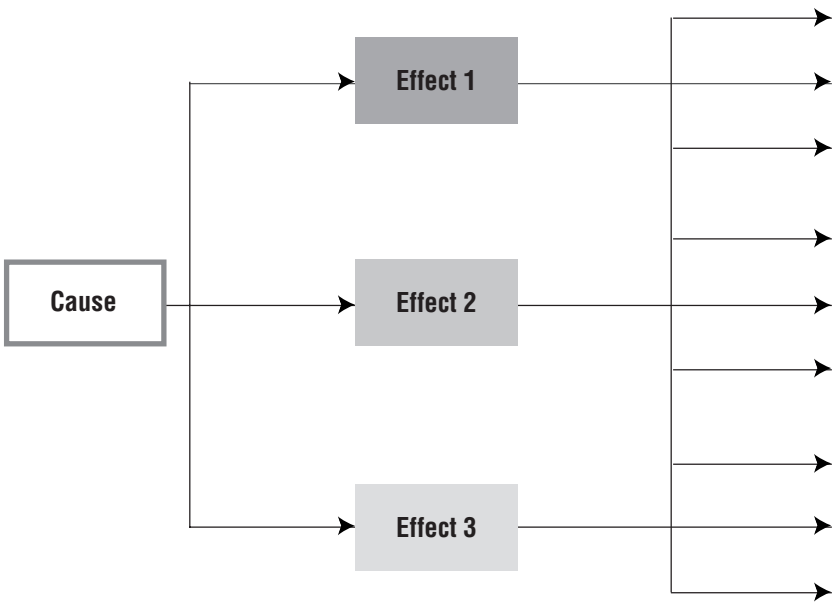
Tree diagrams can also be used for forecasting and selecting by substituting problem for cause; options for effects; and then listing outcomes arising from each option.

The computer company Intel produces a range of software tools to support visualising thinking. Seeing Reason is a very useful tool for describing the relationships between a cause and an effect. Through the use of symbols, lines and comment boxes, students are able to visually represent relationships. Their visual representations are posted to a Web space set up by their teacher, who is then able to electronically comment on students' work. This tool is available free from the Intel website at <www97.intel.com/en/thinkingtools/seeingreason>.

There are many websites featuring templates and articles on graphic organisers including:

- www.eduplace.com
  Click on → *Graphic Organizers*
- www.graphic.org
- vels.vcaa.vic.edu.au
  Click on → *Support Materials* → *Teaching and Learning Resource*.

FIGURE 5: TREE DIAGRAM ORGANISER



A tree diagram organiser documents the cause and effects of an event or episode. Note the use of 'colour' in visually linking an effect with further effects. Text boxes can be added or removed, depending on the situation being investigated. (Source: VCAA)

Simulations and dynamic models

This category of visualising thinking tools assists students to develop an understanding of dynamic relationships. For example, by using software such as spreadsheets and domain-specific modelling software, it is possible for students to visualise the effect of changing the value of a variable component on other fixed components. Figure 6 shows how spreadsheet software can be used by students to develop their understanding of financial factors that influence consumer decisions (Economics, Level 5).

Controlled models

These tools typically use physical objects, such as robots, to demonstrate responses to different sets of inputs. These provide a concrete way for students to experiment with their ideas and build their understandings.

Dimension details: ICT for creating

In this dimension, students use ICT to demonstrate their understandings. This entails students learning to:

- process data to create solutions to problems and to produce information products, such as reports, brochures, websites and charts
- manage their stored files
- manage their time and resources by creating project plans using ICT.

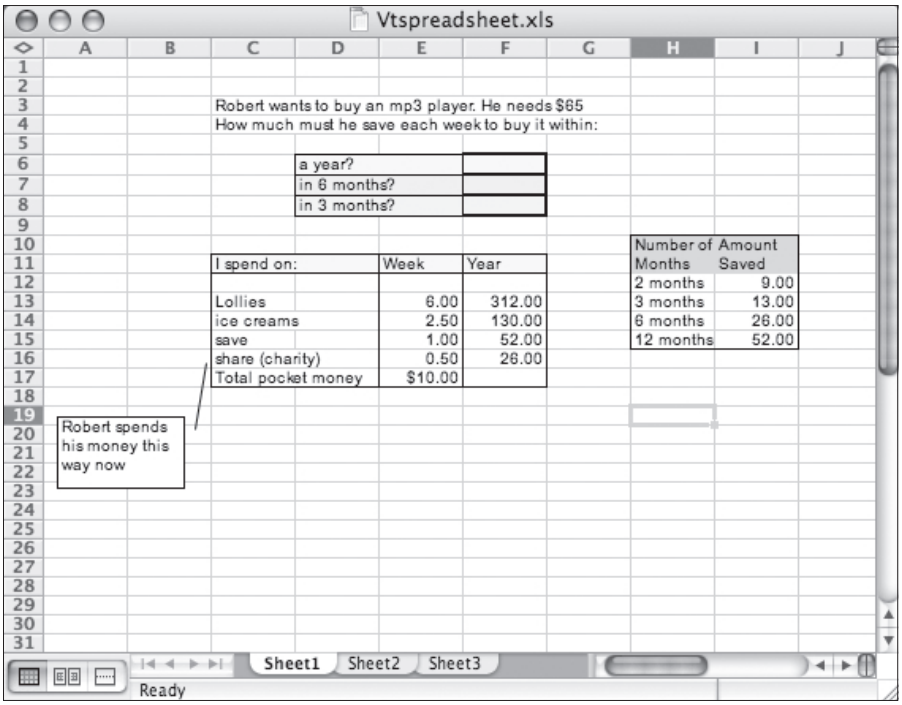
Most teachers and students are very familiar with the content of this dimension.

Students use software to present the results of investigations, their considered views about an issue, and their understanding of a topic. Basic software tools like word processing and spreadsheets can produce effective information products such as reports, charts and newsletters (see Figure 7). And students can use a combination of ICT tools to create their products.

FIGURE 7: THE USE OF ICT TO CREATE A REPORT

Software tools like word processing can produce effective information products such as reports.

FIGURE 6: THE USE OF SPREADSHEET SOFTWARE AS A DYNAMIC MODELLING TOOL



Source: VCAA

Students learn the functions of some software relatively quickly but the skill to apply those functions to design an effective product requires practice. Effective design occurs when students apply the accepted ICT formatting styles (for example, statistics are formatted in tables or graphs as these are easier to read than prose) and ICT conventions/rules for the layout of the information (for example, graphs should have a title, axis labels and a key) along with appropriate graphic elements and imagination. The more frequently students use ICT tools to create information products the more efficiently they will create them. To develop effective products they need to learn the ICT formats and presentation conventions for designing products for different purposes and audiences. (Source: unpublished VCAA document)

A new VCAA resource, *Student Learning DVD February 2006*, is now available. The DVD provides design advice when using ICT. It includes the validated Standards, material from the Office of Learning and Teaching (DE&T), and the *Design Awareness in Schools* resource. Its target audience is teachers, and the associated activities and units are geared to Level 6.

Dimension details: ICT for communicating

As with the 'ICT for creating' dimension, students are very familiar with using ICT for communicating with people they know and don't know. Students use contemporary communication tools, such as text messaging, blogs, forums and chat sites to facilitate the development of interpersonal skills as well as building knowledge about a topic/theme and ICT. For example, a student who drafts a message and edits it before sending it in an email or posting it on a website will learn to reflect about message content, purpose and the impact on the known and unknown audience. Contemporary real-time communication tools, such as netmeeting and videoconferencing, further facilitate the development of interpersonal skills while building group knowledge and providing students with real-world experience of collaborating as a virtual team—a common method of working in the world today.

An important aspect of this dimension is the ability to locate and filter information efficiently and effectively from websites. Far too often students use ill-defined search

strategies to locate information. For Level 6, students are expected to be able to '… locate more precise information from websites, including searching general and specialised directories, and apply proximity operators'.

Teachers are urged to visit the VELS website <http://vels.vcaa.vic.edu.au> to access the validated standards. The extent of change from the original standards varies from domain to domain.

Developing learning programs

Not every learning program must include a domain from each strand, but in a student-focused curriculum, programs that focus only on domains from the Discipline-based Learning strand are not capable of fulfilling the purposes of VELS (discipline-based learning; physical, personal and social learning; and interdisciplinary learning). Schools must plan so that the 16 domains are blended or woven into a coherent program.

Schools are not being pushed to blend multiple discipline domains into their learning programs. What is being promoted is the combining of domains that foster deeper learning, and that enable students to achieve the three purposes of VELS.

If schools choose to blend multiple domains, it is critically important that they identify the commonality between these domains, in order to construct coherent programs, but also respect their differences. Without these territorial boundaries being acknowledged, what is 'essential' about each domain can get lost if the program is too diverse. Connectivity between different domains certainly fosters effective learning, but these connections must be real—not contrived ones.

Regardless of the composition of learning programs, teachers must be constructing learning environments that challenge students to make sense of the plethora of information available to them. Teachers must exploit the capabilities of the technology to foster risk taking, and to accept the learning journey that students will take when experimenting with different ways of problem-solving. Embedding ICT within all areas of learning should be accompanied by a shift from teacher-controlled, didactic learning to a more open-ended, pupil-centred learning environment.

TABLE 1: USING GRAPHIC ORGANISERS IN VCE BUSINESS STUDIES

Visualising thinking tools such as concept maps and double bubble diagrams can be used to assist student thinking when posed with specific questions or topics for discussion, as illustrated below.

VCE study	Topic/key question	Concept map	Double bubble
Accounting	'Straight-line depreciation is the simplest and fairest method of accounting for the declining value of assets.' Discuss.	Depreciation	Straight-line and reducing method
Business Management	Is the financial performance of a business a reliable indicator of success?	Financial indicators	Financial and non-financial indicators
Economics	'Only with protection will Australia's economy continue to thrive.' Discuss.	Trade liberalisation	Trade liberalisation and protection
Legal Studies	'The bicameral system of parliament inevitably results in conflict and frustration of the will of the people.' Explain why you support or refute this statement.	Commonwealth Parliament	Senate and House of Representatives
Industry and Enterprise	'Enterprise skills prepare you for work, but not life.' Discuss.	Lifelong and work-related skills	Employability skills and key competencies

VELS and VCE: What's the connection?

In the compulsory years of schooling students use ICT as a tool for transforming learning and enriching the learning environment. This purpose does not stop during the post-compulsory years. Students should still be using ICT to assist with their thinking processes, for example within VCE Accounting, using a double bubble graphic organiser to identify the essential differences and similarities between straight-line depreciation and the reducing method. See Table 1 for further suggestions on how visualising thinking tools can be used in VCE Accounting, Business Management, Economics, Legal Studies, and Industry and Enterprise.

In the majority of VCE studies, recommended assessment task types include ones created using ICT, for example websites and presentation files, such as PowerPoint ones. These products require the application of knowledge and skills identified in the 'ICT for creating' dimension.

Knowledge building, supported by communications technology, such as blogs, websites, email and netmeeting facilities, is fundamental to success at school and at work. The ability to access, scrutinise and share ideas and information with known and unknown people can only enrich learning in all VCE studies. These attributes form the basis of the ICT for communicating dimension.