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## Key competency development and students' use of digital learning objects

Garry Falloon

[falloong@waikato.ac.nz](mailto:falloong@waikato.ac.nz)

Faculty of Education, The University of Waikato, Hamilton, New Zealand.

### Abstract

*The inclusion of key competencies in the New Zealand Curriculum (2007) has presented challenges for teachers in their efforts to gather evidence and detail student progress for reporting purposes. Research identifies the need to adopt different evaluation processes and systems, as outcomes and progression in key competencies is fundamentally different from those associated with more conventional learning. It also suggests the use of digital tools may assist in this process, but offers few suggestions as to how this might take place.*

*This article introduces and describes a current research project utilising a thinking skills framework and screen-recording software to map students' interaction with digital learning objects, and explore the extent to which they provide opportunities to develop thinking and relating to others competencies. It suggests the approach offers potential to make explicit for reporting purposes the nature and quality of students' thinking, and how their interaction with others in groups, influences their ability to solve problems presented by the objects. However, it also suggests the approach may suffer from manageability challenges, and that student-led administration systems need to be developed to ensure its viability in whole class contexts.*

**Keywords:** competencies, digital, object, learning, reporting, recording.

## Introduction

The New Zealand Curriculum (NZC) of 2007 heralded the introduction of five key competencies, specifically focused on skills and capabilities to enable students to “live, learn, work and contribute as active members of their communities” (Ministry of Education, 2007, p. 12). These competencies are thinking (using cognitive processes to build knowledge from information); using language, symbols and texts (understanding the different forms of knowledge representation); managing self (self motivation and independent learner capability); relating to others (interacting effectively with a diversity of people); and participating and contributing (active involvement in communities). The framework identifies that developing these competencies should be seen as an integral component of all learning, rather than treated in isolation or taught as discrete entities, claiming them to be “the key to learning in every learning area” (p. 12). This perspective behoves teachers to identify opportunities to exercise and extend student capabilities in these five areas through the normal activities of the classroom, and requires them to develop systems by which development and progression in these can be made explicit.

This article explores the potential of student use of digital learning objects as a means of developing the key competencies of thinking and relating to others, and presents an approach, trialled in 2010, which enables student interaction with objects to be recorded and analysed for evidence of the application of these. It also introduces and outlines a current research project exploring use of this approach in a primary classroom, using portable netbooks and digital learning objects from the New Zealand Ministry of Education’s Digistore (see <http://digistore.tki.org.nz/ec/access>)

The research questions for this project are:

1. To what extent can working with digital learning objects provide opportunities for students to exercise thinking and relating to others competencies at year 5–6 level?

2. How can evidence of this be recorded for assessment or reporting purposes?

### **Digital learning objects**

Views of what constitutes a digital learning object vary. Early work by Wiley (2000) identifies it as “any digital resource that can be reused to support learning” (p. 7), while the American Learning Technology Standards Committee defines it as “any entity, digital or non-digital, which can be used, re-used or referenced during technology supported learning” (LTSC, 2002, standard 1484).

However, later work by McGreal (2004) claims that definitions need to be more focused than that, encompassing “a formal, expressed learning purpose ... as learners cannot always be expected to discern the learning possibilities of any accessed component” (p. 11). McGreal also differentiates between reusable digital objects *with an educational purpose* and those that have a *formal or specific educational purpose*. By that he refers to the importance of embedding use of objects within a specific lesson, series of lessons, or unit of learning. He comments that the addition of a learning context provided by such structures “changes information or knowledge objects into learning objects” (p. 11), enabling better evaluation of their performance for the specific purpose for which they were designed. McGreal’s perspective strongly emphasises the importance of linking lesson or unit learning intentions or outcomes, with strategic selection and use of learning objects. In the absence of this link, he comments that digital learning objects become little more than “information objects, that have no ostensible learning objective” (p. 11).

Nurmi and Jaakkola (2006) further highlight the importance of context to the effectiveness of learning object use, but comment that understandings of what this means need to be broadened to encompass more than simply a ‘match’ between object content and intended learning outcomes. They claim that the notion of object adaptability and reusability across learning contexts is problematic, “because of the myths of context and pedagogical independence” (p. 277). By this they refer to the unavoidable embedding of particular pedagogical and epistemological assumptions

within the design and content of objects, making seamless transference from one learning context to another difficult. They further comment that these difficulties can compound when objects are presented in large, 'pre-packaged' formats. They indicate that most effective use is likely when smaller objects are assembled into flexible, multi-object arrangements by teachers. In this way, close attention can be given to the design and construction of the learning environment (including making decisions about pedagogical alignment), compatible with the selection and organisation of objects and purpose for use, so that optimal learning benefits can accrue. In relation to object design, they describe this as the need for "pedagogy to surround the object" (p. 272), rather than be embedded within it.

The importance of this flexibility is recognised in the supporting material provided on the NZ Ministry of Education's Digistore learning object repository. This repository, developed in conjunction with the Learning Federation of Australia, hosts a huge array of digital learning content loosely organised around the learning areas of the curriculum framework, and offers a variety of ways to coordinate objects to form 'learning pathways' comprising multiple objects and related activities teachers can assemble and use with their students. Generating pathways enables teachers to organise objects in ways that focus on particular knowledge or concepts, and adopt desired pedagogical approaches using individual objects and supporting materials as 'building blocks' towards planned goals and outcomes. Research into Australian and New Zealand teachers' use of the repository with students reports significant improvements in levels of learner motivation, engagement, concentration and enthusiasm, and an ability to bring to the classroom learning resources and experiences that would otherwise have been difficult to secure (Schibeci, Lake, Phillips, Lowe, Cummings & Miller, 2008). Furthermore, Schibeci et al. argue that interactive objects of flexible design that contain 'self-help' systems were better able to "respond individually and patiently to student needs, and were found to have a significant impact on student enjoyment of curriculum areas" (p. 279). They linked this to notions of choice and control afforded by particular object designs, commenting that where students were able to regulate their pace of interaction with objects, were given regular and formative feedback on progress and strategies, and were provided with options on how they could respond to problems or

challenges the object presented, work engagement and motivation could be sustained for considerable periods. They also noted that some qualitative data suggested objects could be valuable for promoting higher order thinking and metacognition, although this was based on self-reported student accounts.

### **Key competencies and digital learning objects**

The key competency framework of the New Zealand Curriculum has its origins in the OECD's Definition and Selection of Key Competencies (DeSeCo) project (1999–2003). This project sought to identify the “psychosocial resources – including skills and attitudes” (OECD, 2003, p. 4) required by individuals facing the demands of the rapidly changing, globalised and interconnected world of the 21<sup>st</sup> century. The competencies identified by this project were more than simply knowledge or skills, but included dispositional elements such as an individual's ability and willingness to think reflectively, use tools interactively to solve problems and meet changing needs, interact in heterogeneous groups, and act independently and autonomously. According to Hipkins (2007), the adaptation of this framework included in the New Zealand Curriculum presents significant challenges for assessment, as key competencies focus on “different sorts of learning outcomes” (p. 1) from those to which traditional assessment methods have been applied. She adds that these challenges stem from difficulties in *making explicit* the nature and extent of students' development in each of the competencies, and the need for teachers to develop authentic and relevant learning tasks which “not only provide opportunities for demonstrating competencies, but also invite and foster students' inclinations to show what they know and can do” (Hipkins, 2007, p. 6). To this end, Hipkins draws upon Delandshere's (2002) work in describing the need to view competencies as context-dependent, “complex performance(s)” (p. 6) which, over time and with practice, are able to progress and develop in quality and complexity. She comments that evaluating these performances demands different approaches to assessment, ones that must acknowledge the capabilities of the individual and their contributions as team members. The development of assessment methods that allow dispositions to be demonstrated “in action and of the moment” (p. 9) is seen as one way of achieving this.

While research generally indicates that digital learning objects can add value to students' learning, apart from arguments related to enhanced motivation and engagement, little evidence exists as to any affect they may have on cognitive processes, or problem-solving strategy development. Although objects are not specifically designed for assessment purposes, the potential exists to use them to make explicit student thinking processes and learning interactions (relating to others) as described in the key competency framework. Presently there are significant challenges for teachers to provide assessment evidence of progress in these aspects of student development, as concrete and 'visible' data are difficult to record and present. Screen-capturing students' working with carefully selected objects, and then analysing these recordings for the exercise of thinking skills and formative interactions, offers a way of capturing visible evidence supporting assessment judgements relating to student performance and progression in these competencies. The digital format of this evidence is also compatible with current moves by many schools towards the use of student online and e-folios, and could assist during reporting events such as parent–student conferences. The following describes an approach that may assist teachers in these areas.

### **Recording students' learning pathways**

In 2009, data were collected from a group of year 7 and 8 students in Hamilton, exploring the efficacy of using digital learning objects to support the development of higher order thinking skills. The purpose of this original trial was to support learning object design work being undertaken by Microsoft as part of a wider education-support initiative known as Partners in Learning (see

<http://www.microsoft.com/education/en-nz/leadership/partnerships/pil/Pages/index.aspx>).

In the trial, 35 intermediate-level students used a single 'off-the-shelf' learning object from Digistore as part of an integrated environmental/sustainability topic they were working on. The three-week topic integrated multiple curriculum areas, and included a visit to the city council to discuss town planning processes and learn about council decision-making. Full details of the trial have been published elsewhere, so will not be

repeated here (see Falloon, Janson & Janson, 2010). The object used in the trial was called ‘Cartown’, and was a simulation focused on decision-making about the impact that the imposition of traffic congestion toll would have on a community. It required students to gather information and perspectives from a range of stakeholders before making a recommendation about the toll to council.

During the trial, an approach was developed that combined the screen capture software SnagIt (see <http://www.techsmith.com/Snagit>) and a learning journey framework to map and record the incidents and levels of student thinking while they were collaborating to solve problems presented by the object. This framework was based on Anderson and Krathwohl’s (2001) adaptation of Benjamin Bloom’s Taxonomy of Learning in the cognitive domain, and identified six ‘types’ or levels of thinking the students were engaged in while interacting with each other and the object. A description of these types corresponding to the levels represented in the adaption is provided in Figure 1.

Use of the objects in pairs was recorded using SnagIt, which was activated prior to students commencing work. SnagIt captured as digital video all on-screen activity and associated student audio discourse, saving these data automatically to computer hard drives for later retrieval and analysis. After each recorded session, data were transferred to an external storage device for reviewing and coding.

	<b>Level</b>	<b>Description</b>
Higher Order Thinking	6. Creating	Synthesising or building a structure or pattern from diverse elements. Putting parts together to form a whole, with emphasis on creating new meaning or structure.
	5. Evaluating	Checking and critiquing using standards. Making judgments about the value of ideas or materials.

	4. Analysing	Separating material or concepts into component parts so that its organisational structure may be understood. Distinguishing between facts and inferences.
Lower Order Thinking	3. Applying	Using a concept in a new situation or unprompted use of an abstraction. Applying what was learned (or other knowledge) to novel situations.
	2. Understanding	Comprehending the meaning, translating, interpolating, and interpreting instructions and problems. Stating a problem in one's own words.
	1. Remembering	Recognising and recalling data or knowledge.

Figure 1. The thinking levels framework (from Anderson and Krathwohl, 2001)

### Mapping student interaction with the object

Following recording, student interaction with the object was plotted against a 'relative percentage timeline' as indicated in the example (Figure 2). As students worked through the object at different speeds, the total time taken for each pair to complete the object was noted (eg., 30 minutes). For each pair this was recorded as 100% on the timeline of the student learning journey graph (i.e. total *working time* from start to finish = 100%, regardless of how long this was). During coding, the research team plotted occurrences when there were 'spikes' in thinking levels and student interaction. Spikes were plotted according to their occurrence during the total working time the particular group of students' took to complete their DO task. The learning journey for students H and L (pseudonyms) can be seen in Figure 2.



The learning journey maps logged students’ progress as they complete tasks embedded within the object, using the oral data from the videos to rank the complexity of their thinking processes (using the 1–6 descriptors in Figure 1), and oral and visual cues indicating problem-solving interactions between group members (relating to others). Evidence of the exercise of thinking processes of ranked levels of complexity (indicated on the y axis) were entered onto the x axis as vertical bars, while the downwards arrows at the top of the timeline indicate interactions between group members contributing to the solving of problems presented within the objects (see Figure 2).

As is the case generally with the coding of qualitative data, researcher interpretations and subsequent decision-making about what constitutes evidence of student thinking at particular levels is a subjective exercise. In the trial, the researcher and two colleagues independently coded student video data. During this process, each kept a log of examples from the videos they ranked at each thinking level, and where student interactions were judged to be contributing to problem solving. Descriptions and relative times for these were recorded (Figure 3), and were subsequently used when coders met to discuss and debate their interpretations, and settle on a single interpretation of each group’s learning journey against the thinking-skills framework.

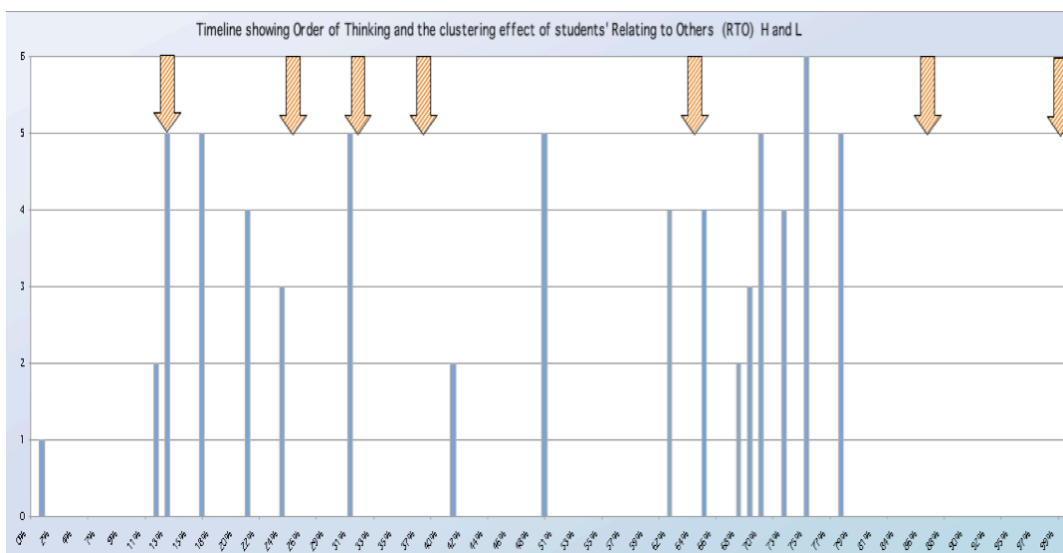


Figure 2. A sample learning journey mapped against the relative percentage timeline and thinking levels for students H and L

Participating teachers were called upon to input to this process, however this was restricted to providing verbal feedback on particular students’ work practices as shown in the videos, after the final coding decisions had been made. Students were not shown any video data, nor interviewed to ascertain possible strategies used or reasons for decisions they made while navigating the object.


Framework Categorisation	Example – what students did	Screenshot of clip
<p><b>6. Creating:</b> Designing a media clip to effectively convey their message to a target audience, by analysing and integrating data of several types from different sources. Revising initial draft to improve the communication of perspectives. Reorganising elements into a new output.</p>	<p>Construct and plan a newspaper layout – students record, summarise and blend different media and content to create a layout appropriate to their target audience and key messages. Pairs effectively discuss, interact and decision-make to reach a negotiated and agreed to outcome. (J&amp;M: 12.00-13.09/14.30-15.30)</p>	

Figure 3. A data sample and descriptor rated at level 6 of the thinking framework for students J and M.

**Key learning from the trial**

Detailed outcomes from the trial have been published elsewhere (Falloon, Janson & Janson, 2010), but are worthy of brief note here as background information. Firstly, the trial identified the value of using digital learning objects as environments to support interaction and discourse contributing to the exercise of higher level thinking processes, and screen capture provided visual and oral evidence of these processes in action. Feedback from participant teachers indicated they valued such evidence and considered it to be useful for reporting purposes, particularly for discussing during parent interviews and as data for inclusion in student e-folios which at the time the school was implementing.

The trial also highlighted particular object design features and content that promoted the use of these processes in some students, and identified clearly the role of oral interaction prompted by the problems embedded in object, for scaffolding students' thinking performances. While not universal, loose patterns did exist between different student groups and 'spikes' in the levels of thinking stimulated by particular features of the object, providing tentative clues as to the types of object content and activities that encourage interaction and higher level thinking. Such information would be useful to learning object designers who wish to build objects specific to these purposes.

However, while generally successful, the trial did have limitations. Perhaps the most significant of these was that no data were collected directly from the students themselves. To fully explore design and content aspects of the objects and better understand how these prompted particular actions and responses from students, there was a need to share the videos and researcher interpretations with the students, and get feedback on reasons for their actions and choice of strategies at identified points (particularly the 'thinking spikes') during their learning journeys. Doing this would enable a more complete picture to be generated of strategies such as students' use of knowledge from different sources to solve problems, make decisions, or negotiate a point of view; how group interaction supported or hindered these processes; and how information within and beyond the object was reviewed and combined in formulating responses to embedded tasks.

Secondly, the trial involved all students using a single object for a defined learning purpose. It did not trial other objects, nor did it explore their use or performance for supporting thinking or interaction in other curriculum areas.

Thirdly, while teachers tentatively indicated they saw potential in using the visual and oral data for reporting purposes and for including in student e-folios, as such use fell outside of the scope of the trial, this was not attempted. More information is needed on the efficacy and practical logistics of doing this, to determine whether or not the approach offers a viable means of recording and reporting on student progress in these areas.

The research described below and presently being implemented, seeks to build on the earlier trial by applying the learning journey framework to map the interactions of a larger number of students at a different level of the school, with a wider array of learning objects. This will be combined with visual recount interviews to discover what elements of objects prompt the exercise of different levels of thinking, and unearth more information about strategies students applied when working through these. It will also investigate the practical considerations of using data gathered through this process for assessment purposes, by including samples in students' e-folios and as evidence to be used in reporting to parents.

### **The present research context**

The current study is being carried out at year 5 and 6 level, and involves 31 students and their teacher. The class has continual access to 16 netbook computers that are extensively used for all aspects of class work. The netbooks are connected to the school's wireless network, which enables managed but reasonably open access to the internet. Students are encouraged to use the netbooks extensively for research activities integral to the thinking skills/inquiry learning model used in the classroom, for monitoring class blogs and wikis, and for maintaining their e-folios which serve as an important communication and reporting channel to parents.

The digital learning objects have been selected to support classwork in Language and Reading. They focus on written language skill development (recount and improving descriptive language), reading comprehension (understanding written and visual clues to help a policewoman solve a simulated crime) and oral and visual language (a 'whodunit' simulation about apprehending an art thief by assembling oral and visual clues). They have been organised by the teacher into learning pathways (groups of related objects) which students have paired access to, via the netbooks.

### **Research method and data coding**

Data is being collected using a combination of SnagIt screen recordings, semi-structured interviews in which students view their recordings and are prompted to describe and explain the interactions and strategies they use, and analysis of work samples resulting from, or related to, their use of the objects. Pairs have been organised according to existing social relationships or already established working partnerships. Earlier work by the author indicates this to be an effective organisational system when students have frequent or continuous access to technology on a ‘whole class’ basis, as less time is needed to establish working ‘ground rules’ or efficient work practices (Falloon, 2004). As it is not the purpose of the study to *compare* one pair with another in terms of the quality or level of their thinking or ability to relate and work together to solve problems, adopting this system is appropriate, as it should be the most effective means of gaining data on how objects might support these processes, *unique to each pair*.

### **Screen recording**

Due to restrictions in the licencing arrangements for SnagIt, of the 16 netbooks, six have had the application installed, and these have been marked with a coloured sticker. Consistent with ethics requirements, students were informed beforehand of the purpose of the research and the procedures by which data is being collected. Only those students who completed and returned signed consent forms are able to access marked machines, and participate in follow-up interviews. While data collection is still in progress, to date four separate recording sessions have taken place with a total of nearly 10 hours of video data recorded and stored on an external hard drive for analysis. The researcher and a postgraduate research student will initially code this independently before interpretations are discussed and compared, resulting in a final learning journey analysis ‘map’ being generated for each pair.

### **Follow-up interviews**

Following recording, students will be shown their screen capture, and using the learning journey analysis map as a guide, the researcher will explore their:

- approaches to solving problems presented in the object;
- discussions while working together on the object;
- difficulties or challenges experienced when using the object;
- perceptions of how the object assisted them (or not) in their learning;
- ideas about working in pairs and if (and how) this helped them work through the object;
- views of features of the object that appealed to them (or not) and why;
- ideas of changes they could recommend to the design or content of the object;
- views of whether use of the objects was worthwhile, and why.

Analysis of these data will be written up and combined with each pair's learning journey analysis to form a comprehensive account of their working processes, thinking strategies and interactions, as supported through use of the objects. Excerpts from this, combined with selected sections of the screen capture video, will be reprocessed and incorporated into students' secure online e-folios.

### **Implications of using this approach for assessing key competencies**

While the approach described in this article is an attempt to meet Hipkins' challenge of 'making visible' the nature and quality of thinking processes students apply when engaging with learning objects, and how group interactions may influence those performances, it faces challenges on several fronts. For an assessment measure to be credible, it must yield data that are valid and reliable, and it should be administratively manageable. In a school situation, it would be highly desirable, if using this approach, for more than one teacher to be involved in making judgements about individual or group performances, to enhance interpretation validity. It seems unlikely that busy teachers would have the time to engage in the level of analysis required on a single

student basis, at best undertaking this process in small groups and then, if necessary, ‘unpacking’ individual performances as described by Hipkins (2007).

Teachers would also need to be conversant with and have consistent interpretations of the thinking levels as described in the framework, and index data against these from students’ videos. While screen recording data is relatively straightforward, unless specific time could be freed up in a teacher’s workload, or a system found where students self- or peer-assess and record their or their classmate’s performance against the thinking levels and skill descriptors, then manageability of this approach is questionable. Promoting more active student involvement in assessment decision-making has been identified by Hipkins (2007) as an important means of fostering lifelong learning skills, enhancing self-management and developing what she terms, “meta-knowing” (p. 4). Designing a student-led and managed system based on the approaches detailed in this article would provide an ideal opportunity to support such outcomes.

With recent moves in schools towards using digital means for collecting assessment data and recording and reporting students’ achievement using e- or online folios, digital learning stories, reflective journals and logs, and other online systems (eg: e-asTTle), the use of screen-capture video to illustrate student performance in specific key competencies has potential. Including edited video clips and brief descriptors illustrating students’ work strategies in electronic folios would undoubtedly enable a richer and more detailed account to be presented of students’ capabilities. The use of digital multimedia for reporting purposes is still in its early stages, but its capacity to capture and illustrate aspects of student performance unable to be accurately reflected in more conventional paper-based reporting formats, is worthy of further exploration. The approach outlined in this article should be viewed as ‘work in progress’ – an initial attempt to explore this potential.

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