Assessment Instruments for Twenty-First Century Skills

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Chapter 8
Assessment instruments for 21st century skills

It has been established in previous chapters that learning and teaching has significantly evolved over the past few decades, towards a greater emphasis on 21st century skills in the school curriculum. Twenty-first century skills are incorporated into national educational standards in many countries; assessments, however, have been less emphasized as integral components of these new models (Hilton, 2010). Inquiry- and project-based learning interventions involving research as well as technology require compatible methods of assessment to support learners' progress and development (Cachia et al., 2010). This chapter begins with an overview of previous literature on assessment of 21st century skills, then discusses the use of assessments in a variety of research studies conducted by the authors, and proposes an evidence-based approach for assessing different aspects of 21st century skills. Education practitioners and researchers should bear in mind that some of the 21st century skills such as life and career skills are not always easily measurable in quantitative terms. The chapter therefore focuses on skills that could be evaluated in relatively more concrete ways during an assessment.

8.1 Overview of assessment instruments for 21st century skills

The adapted P21 framework of 21st century skills in chapter 1 outlines three skill sets containing a total of twelve components that learners are said to need to possess. The skill sets are: learning and innovation, digital literacies, and life and career skills. The conceptual framework of the relationship between 21st century skills and teaching strategies (Chu et al., 2012b) shows assessment as a way of reflecting learning outcomes. Outcomes can be assessed in terms of product outcomes, based on the grades of learners' final output of their learning activities, and in terms of process outcomes, by evaluating their learning in the process and interactions while completing tasks. Researchers and education practitioners make use of various tools to evaluate learning outcomes in these two aspects.

The P21 report on assessment of 21st century skills (Honey et al., 2005) outlines the objectives that an ideal form of assessment should fulfil. Assessments should:

- Measure learners' knowledge, application and learning of 21st century skills, and identify where intervention is required
- Be applicable across a wide range of instructional programs
- Allow learners to demonstrate their proficiency in 21st century skills to educational institutions and prospective employers (Honey et al., 2005).

The report acknowledges that diverse assessment tools are needed as a single assessment instrument cannot meet all these objectives. In fact, assessment methods need to go beyond traditional standardized tests (Redecker & Johannessen, 2013) and various tools have been designed to support such methods. The convenience of having a wider range of assessment tools brings forth the challenge of choosing the most suitable ones. Designers of assessment tools should take into consideration the ease of administering the test, if a test is used, and how truly the test reflects learners' skills (Walsh, 2009).

Table 8.1 provides a snapshot of ways in which 21st century skills are currently being assessed by researchers around the world. Research projects are organized according to the dimension of the 21st century skills they assess. The assessment method employed in each project is summarized, along with relevant scholarly citations.

Table 8.1 Methods to assess 21st century skills

	Assessment method	**Reference**
Learning and innovation		
Core subjects	Programme for International Student Assessment (PISA): Multiple choice questions and open-ended questions on reading, mathematics and scientific literacy	OECD, 2012
	Progress in International Reading Literacy Test (PIRLS): Multiple choice questions and constructed response items, focusing on the reading purpose, process, behaviour and attitudes	Mullis et al., 2009
	Reading Battle: An online e-quiz bank to promote and assess students' reading interest and comprehension ability	Wu et al., 2014
Critical thinking and problem solving	Sternberg Triarchic Abilities Test (STAT): Multiple choice questions in verbal, quantitative and figural forms	Sternberg, 2006
Communication and collaboration	Ongoing observation of group work via a web-based collaboration tool	Chu, et al., 2012a; Reynolds, 2010
	Self-assessment of perceived social skills using questionnaires	Notari & Baumgartner, 2010
	Online portfolio assessment in which learners report and reflect on their project-based assignments, group activities and workplace projects	Koenig, 2011
Creativity and innovation	Torrance Test: written and drawn answers, yielding subject scores for each characteristic assessed, and a cumulative score for each individual	Torrance, 2000
Digital literacies		
Information literacy	Test made up of multiple choice questions, adapted from TRAILS	Chu, 2012; C. Chu et al., 2012
	Mixed method design involving tests, surveys, interviews and documentary analysis	C. Chu et al., 2012
	Direct assessment of researched term papers	Scharf et al., 2007
	Diagnostic inventory of students' perceived competence and motivation towards inquiry and research	Arnone et al., 2009; 2010

Media literacy	Questionnaire on media awareness and media use pattern, consisting of open-ended questions and statement evaluation of responses to the statements using the Likert scale	Chu et al., 2010
	Assessing learners' critical reading, listening and writing skills after receiving media literacy instruction	Hobbs & Frost, 2003
Information technology and communication literacy	Questionnaires and interviews asking about perceptions of learning progress	Chu et al., 2008; Chu, 2009; Chu et al., 2011b
	Content and IT literacy knowledge outcomes, as measured using content analysis methods to evaluate learners' final digital product creation, via application of a reliable evaluative coding scheme	Reynolds, 2010 Reynolds & Harel, 2009
	Test tools assessing knowledge on computer hardware and software operation and information processing	Cha et al., 2011
	Performance-based assessment in a virtual school or work situation	Claro et al., 2012

Note: Life and career skills are not included in the table as they are relatively difficult to be measured quantitatively.

8.2 Case studies on assessing 21st century skills

The following section captures the authors' experience in assessing students' 21st century skills. Five knowledge outcome dimensions are covered: *reading literacy*, *collaboration, information literacy, information technology literacy* and *media literacy*.

8.2.1 Assessing reading literacy through gamification

Reading is a vital skill for life-long learning and the development of 21st century skills. Strong readers have been shown to demonstrate more advanced critical thinking (Hawkins, 2012) and there is a positive and significant relationship between one's reading ability and information literacy (Sayed, 1998; Chu, 2012). Both the promotion of reading and assessment of reading progress have been found to be important to the development of students' reading abilities (Afflerbach, 2011; Wu et al., 2014; Chan, Chu, Mok, & Tam, 2015).

Traditionally, reading assessments include short quizzes, reading comprehension exercises or book reports. However, such assessments may exert pressure on readers, and it can be time-consuming for teachers to read, mark and provide feedback to students on their work. With the aim of cultivating reading and comprehension skills among students as well as facilitating effective monitoring and evaluation of student learning, Wu et al. (2014) devised a motivate-scaffold-monitor framework to gamify students' reading experience and provide a quick and easy platform for teachers to evaluate and monitor students' reading comprehension level through a program called "Reading Battle". Figure 8.1 below presents the program framework:
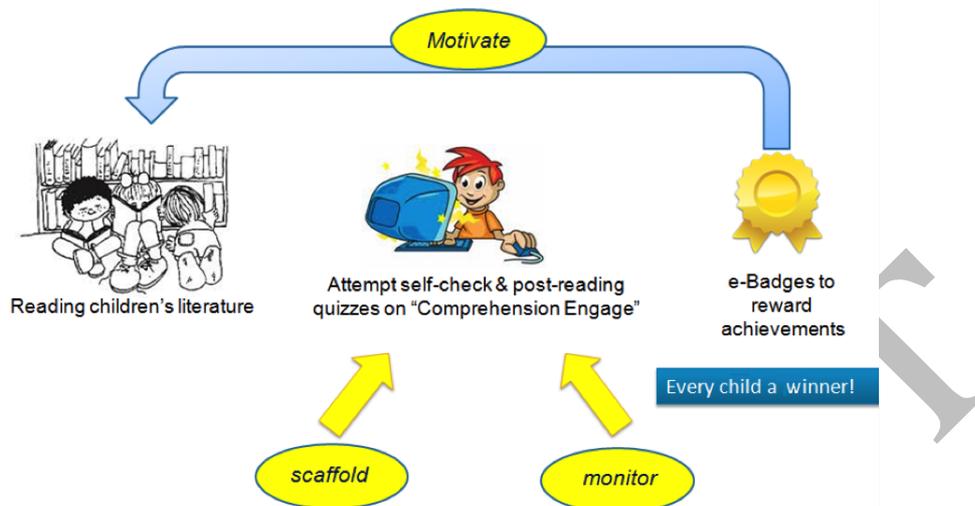
Figure 8.1 The motivate-scaffold-monitor framework in the project (Wu et al., 2014)

Reading Battle is an online e-quiz bank that houses more than 13,500 questions written based on 450 books (W. Wu, personal communication, April 8, 2015). Users can access the quizzes via a search using the title, author, book ID or ISBN, or select from the archive of books sorted into different genres. Once a book is chosen, users enter the test interface. Each test consists of 10 multiple-choice questions randomly drawn from a pool of 30 questions. With 180 books picked by the project team and an additional 270 school-based titles from each participating school, student-users have the flexibility of selecting books they like to read and browse the archive for further reading suggestions.

Questions in the quiz focus on the 4 processes of comprehension adapted from the PIRLS 2011 Assessment Framework: information retrieval, making inferences, interpretation and integration of ideas, and evaluation (Mullis, Martin, Kenndy, Trong, & Sainsbury, 2009). These four processes match the Bloom's Taxonomy of learning domains, for example, making inferences relates the domain of understanding, whereas interpreting and integrating ideas falls into the domain of applying and analyzing (Bloom, Engelhart, Furst, Hill, & Krathwohl, 1956). Aided by prompts and hints, students are guided in finding the right answer after an initial failure. For particularly challenging questions, an instant explanation is given for the correct answer. The system is designed to interact with users and provide immediate feedback. Upon completion of the test, the total score is shown. Participants earn points for every correct answer. E-badges of different levels are awarded as recognition of their achievement and encouragement to challenge them to reach a higher level and/or compete with others in the leaderboard. These gamified applications have the advantage of providing participants with a sense of challenge and curiosity (Deterding et al., 2011) as well as enhancing their experience and engagement (Dominguez et al., 2013). Logging in with a teacher account enables teachers to view their students' test scores and participation rate, thereby allowing them to evaluate the progress of students' reading abilities and offer support to and/or guide them towards the correct reading practices as appropriate.

Reading Battle was piloted in 9 primary schools in Hong Kong in 2014 involving student participants from primary 3 to 5 (aged 7-11). Students' reading abilities were benchmarked prior to the implementation of the program. Post-tests of individual students were administered 5 months after the implementation. Preliminary findings have shown that students who actively took part in Reading Battle achieved higher reading test scores in the post-test compared to those in the same age group who seldom or never joined Reading Battle. They also improved in their Chinese and English reading and writing skills, with over 70% citing the Reading Battle as a reason behind (Lu, Chu, & Wei, 2016). In the case of one of the participant, the improvement was as significant as a jump from 10 marks to 90 marks out of 100, in the English and General Studies subjects. Impact of Reading Battle is not limitied to academic performance – students' character developed as they read stories about essential virtues such as honesty, caring for others, and other interpersonal skills (Lu, Chu, & Wei, 2016).

In addition to students describing Reading Battle as "appealing", "exciting" and "fun", teachers was pleased to observe their students' growing motivation and confidence to read. Extrinsic motivation such as the e-badge system as well as students' intrinsic motivation to acquire more knowledge have also challenged students to do more reading and complete more quizzes (Chan et al., 2015; Lu, Chu, & Wai, 2016). In one school, students were so eager to join Reading Battle that a much higher book borrowing rate was recorded, with the school library reporting an average of more than a hundred books loaned out per week. Interviews with parents also revealed encouraging findings. One parent exclaimed in an interview that her son, a primary 4 student, after reading books of difficulty levels 1-4, could write compositions with better organization and had since then performed better in the school's writing assessments. Information gathered also showed that a primary 3 boy could read on his own rather than being read to by his mother which used to be the case. A primary 4 girl, who could not find the Reading Battle books she wanted to read from the school library nor afford to buy the books she liked, was found spending hours in commercial bookstores, trying to read and remember as much book content as she could so that she could be ready for the challenge in Reading Battle. Another primary 4 boy, who did not have a computer at home, was seen investing as much time as he could in the school library doing quizzes from Reading Battle. All 4 students performed very well in Reading Battle. The students' performance corroborates with the social cognitive theory, which suggests that participation in educational interventions in which students have a chance to "experience success" increases their self-efficacy in educational knowledge domains (e.g., Luzzo, Hasper, Albert, Bibby, & Martinelli, 1999).

The rapid advancement of computer facilities and mobile technology nowadays has opened up new doors not only for teaching and learning (Chu et al., 2015; Kwan, Chu, Hong, Tam, Lee, & Mellecker, 2015; Hew, Huang, Chu, & Chiu, in press), but also for student assessment (López, 2010). Reading Battle, a computer-graded e-quiz bank, can save a considerable amount of teachers' time evaluating students' comprehension abilities and grading their reading reports. Teachers can also trace students' reading skills development with ease while students enjoy the gamified reading experience, thereby fostering the engagement of both and boosting their motivation during the learning and assessment process.

8.2.2 Assessing collaboration

Two case studies on assessment of peer collaboration are discussed in this section. The first study (Chu et al., 2012a) was carried out in Hong Kong, focusing on assessing how

secondary school students worked together to complete a wiki-based writing project. The second study (Notari & Baumgartner, 2010) involved Swiss university students in a group project, and evaluated the degree of their collaboration by the students' self-assessment of their social skills. Although assessment of students in higher education is not the focus of this chapter, for the benefit of researchers and education practitioners, the study is included as the assessment method adopted is believed to be transferable to primary and secondary school contexts.

8.2.2.1 Assessing collaboration in wiki-based collaborative writing

Assessing collaboration has always been deemed a particularly challenging task for teachers, due to the inherent difficulty in obtaining information about individual students' contributions. For instance, one or two members in a group may take up a large proportion of work during the process without the teacher noticing. The use of wikis nonetheless provides teachers with access to an imprint of their students' collaboration process. A wiki offers users a platform to directly create and edit the content of one or more webpages through web browsers (Leuf & Cunningham, 2001). It can show, to a certain extent, users' level of collaboration and how they work together. The following section explores how wikis support the evaluation of student collaboration. Chu et al. (2012a) discussed how this was assessed through observing students' work on wikis using data generated by wiki pages, while Chu et al. (2011a) shed light on affordances that wikis have for assessing collaboration from the teacher's perspective.

The aim of Chu et al.'s (2012a) study was to investigate the patterns of activities of twenty-five secondary one students (aged 12-13) in their inquiry-based project, their level and frequency of participation, as well as the distribution of work and the degree of collaboration among group members. Assessment began with extracting data, both qualitative and quantitative, from the students' wiki-based group reports covering topics on media, education, religion, sports, art, information and communication technology, etc. Students in a class were divided into five groups and their contribution was categorized as either content input in the compilation of the report or comments posted on wikis. The built-in functions of Google Sites enabled both types of data to be recorded. Input from individual students was made visible using the revision history function, which allowed direct access to all previous versions of a page. Details of each change were logged, including the name of the student who made the change, the date and time of the change, and the specific change in the content. Quantification of data revealed how much and how often students made a contribution to the content, and enabled categorization of changes to identify the types of action commonly performed. The categorization of changes was based on a modified version of the action taxonomy developed by Meishar-Tal and Gorsky (2010). The taxonomy classifies students' actions on the wiki content by, for example, adding, deleting and moving texts, and editing of format and grammar.

Comments made by students, the second type of contribution on wiki, were retrieved from the comprehensive records of messages and replies. By analysing the records, researchers could understand the degree of collaboration among the students. The comments were organized using an adapted content analysis coding scheme following the work of Judd, Kennedy and Cropper (2010). Their scheme placed the comments into six non-exclusive categories: content, form, work, individual, group and reply.

Drawing on the findings of Chu et al.'s (2012a) study, uneven work distribution was

observed, with considerable disparity among group members in terms of the amount of actions each member performed and the proportion of work done. Generally, two to three members out of 5-6 in a group took charge of most of the actions and contributed to a large part of the writing up of the project. The unequal share was, as the researchers explained, a result of students' collaborative writing strategy. The report-writing task was split into discrete units and group members were assigned to work on separate units. Students might also have participated in pre-writing work like questionnaires, interviews and presentations but this was not recorded.

Students displayed a certain degree of collaboration, as evidenced by the comments they left on their wikis. Comments concerning content and those addressing the whole group made up more than half of all the comments, with a similar distribution pattern across groups. Both types of comments indicated engagement in online communication and exchange of ideas. Students, however, might not have communicated exclusively using the commenting function, limiting the extent to which the comments painted a complete picture of their collaboration. Their assessed level of collaboration shown on wikis was thus treated with caution.

Interviews with teachers in Chu et al. (2011a) revealed that teachers were generally satisfied with Google Sites (a wiki variant) promoting collaboration. Using the function "history review" and "version comparison", teachers could track changes made by each individual throughout the project. Teachers were then able to grade students' performances fairly and objectively after examining their personal contributions. The tracking function also enabled teachers to identify high and low achievers, and in turn offer support to the less capable students. In addition, teachers noted that the commenting function allowed them to leave comments without restriction of time, space and even text, since videos, photos and quotes can be embedded in the comments. Teachers found that guidance could easily be given to help students understand relevant concepts and amend their work in progress, thereby lending itself to assessment for learning.

In the light of the above study, when using wiki-based platforms for collaborative group projects, teachers are advised to trace the edit histories in order to identify and assess individual students' contribution. Contributions to wiki content may take the form of posts and comments, which can be further coded as content/meaning related, surface level, and management-focused/other contributions (Woo et al., 2013). Examining these posts and comments during project execution helps the teacher decide on the type of support required and offer the right form of intervention by leaving comments on the wiki page. Tracing such edits after the project further makes it possible for the teacher to collect information on students' collaboration process and evaluate their performances accordingly.

8.2.2.2 Assessing collaboration through self-assessment of social skills

This section documents a project led by one of the book's authors investigating how social skills configuration within groups of university students collaborating on projects affect their communication, satisfaction with group performance, and quality of collaboration (Notari & Baumgartner, 2010; Notari et al., 2014). The social skills analyzed are cooperation/compromising, prosocial behaviour/openness, social initiative, leadership and assertiveness. Fifty-nine students took part in the study. They freely formed groups of 2-3, and the groups were described as comprising a combination of students with heterogeneous or homogeneous abilities, as well as high and low levels of various social skills. A

questionnaire was administered both at the beginning and end of the project. The pre-questionnaire consisted of 16 statements that assess individual students' social skills including exchange orientation, empathy, initiative, leadership and assertiveness, which students were required to rate on a scale of 1- 4 (totally disagree: 1 – totally agree: 4). In the post-questionnaire, students evaluated their own level of satisfaction and quality of cooperation using the same scale as in the pre-questionnaire. The questionnaire contained six statements, as shown below:

1. I am satisfied with the level of team work achieved.
2. The group worked together in an efficient way.
3. The responsibilities were clearly distributed among the group members.
4. There was a group leader.
5. We got along well within the group.
6. We supported and/or complemented one another well in the group.

Data analysis showed that examination of social skills on a group level yielded more meaningful findings than that on an individual level. A homogeneous and/or high-level of social skill configuration in a group tended to be more conductive to effective collaboration than groups with heterogeneous and/or low-level social skills. This relationship was especially significant for social skills that focused on communal goals such as compromising, in which students perceived a higher degree of group efficiency and clearer division of labour. The same correlation was observed in prosocial behaviour/openness, where heterogeneity decreased reciprocity and equity among group-mates, leading to dissatisfaction with performance, and a felt lack of efficiency in collaboration and division of responsibilities.

Given the aforementioned findings, teachers are encouraged to teach students relevant social skills before engaging them in collaborative group work. A good starting point would be to strengthen their ability to cooperate and come to a compromise, foster prosocial behaviours and boost their leadership skills. Compromising can be achieved by a clear share of responsibilities and identifying specific roles of individuals within the group. Teachers should however be aware that a high level of compromise may diminish the group's permissibility for members to put forward their own ideas (Zurita et al., 2005). In order to promote prosocial behaviour, it is vital that students respect the equity and reciprocity among group members (Hatfield et al., 1978) so that organizational agreements may be reached more efficiently. As for leadership, teachers may create room for students to take charge of tasks, since it was shown from the project that a higher average leadership level in the group results in more efficient collaboration.

8.2.3 Assessing information literacy (IL) using IL assessment tools

Two case studies assessing IL are presented in this section, one targeting upper primary students (aged 9-11) (Chu, 2012) and the other junior secondary students (aged 12 – 15) (C. Chu et al., 2012).

IL instruction is in great demand in Hong Kong. In secondary schools, inquiry project-based learning has been integrated into the formal curriculum, and Liberal Studies is one of the core subjects (Curriculum Development Council [CDC], 2000). In primary schools, information literacy education is spaced out in two stages: primary one to three for Stage I (aged 6-8), and primary four to six for Stage II (aged 9-11). Guidelines for each stage are provided on the

skill types that students are expected to acquire, in terms of learning targets, knowledge, skills and attitude (Education and Manpower Bureau [EMB], 2005). Nevertheless, no standardized territory-wide assessment for information literacy exists, limiting educators from assessing students' IL abilities. Both studies featured in this section evaluate IL of students of different levels, aiming to provide empirical evidence for further research on ways to enhance students' IL competence.

8.2.3.1 A case study of primary five students

The study conducted by Chu (2012) made use of the Tool for Real-time Assessment of Information Literacy Skills (TRAILS) to evaluate the IL of 199 primary five students (aged 10 -11) from four schools in Hong Kong. The IL assessment tool consisted of fourteen items (see Appendix 8.1) which matches well with the IL framework set by the Hong Kong government. As such, the IL assessment instrument has the potential to be generally applicable to Hong Kong primary school students. Modifications to the assessment were made to suit students' comprehension ability and to place questions in a more familiar context, since TRAILS was originally designed for American students. The contextualized test was then translated into Chinese, the students' first language, for their ease of understanding, but specific English terms were retained to avoid misinterpretation. All questions were close-ended, with two to four options each. Each correct answer was worth 1 point, and the maximum score was 14. Students' responses in the IL assessment were collected through SurveyMonkey, an online survey tool administered by students' IT teacher during regular class hours.

With the descriptive statistics of the participants' test scores calculated, the results were analyzed. The mean correct number of questions was 8.12 (SD = 2.56). No significant difference in mean score was noted among the four schools. The assessment questions were then categorized according to relevant American Association of School Librarians (AASL) and Association for Educational Communications and Technology (AECT) IL standards. Seven questions correspond to standard one, the ability to access information efficiently and effectively, and five questions to standard two, the ability to evaluate information critically and competently. The overall results showed that students possessed some but inadequate IL competency. The mean score for standard one and two were 4.63 and 3.29 respectively. The percentage of correctness for each answer was compared to the expected percentage based solely on guessing, and the sufficiently higher observed percentages indicated that students, in most cases, performed better than wild guessing. Still, they could only correctly answer half of the questions related to each standard, and this suggested that there was much room for improvement and that a systematic IL curriculum was urgently needed (Crawford & Irving, 2013; Sandars, 2012).

8.2.3.2 A case study of secondary one students

In the study carried out by C. Chu et al. (2012), the IL level of 176 secondary one students (aged 12-13) was assessed. A mixed-method research design was adopted, combining quantitative and qualitative research tools like surveys, interviews, documentary analysis of students' group projects, and a test made up of multiple-choice questions. First, in order to evaluate students' IL skills, a test comprising 15 multiple-choice questions set according to TRAILS was administered. Their IL skills concerning proper and ethical use of information sources were analyzed through examination of their group projects. Before further investigation by the researchers, an online free plagiarism checker was employed to look into

whether students' citations resembled any form of plagiarism. Interviews were then conducted to better capture students' and teachers' knowledge and attitude towards IL in their completion of the group project.

Based on the test results, content analysis of the interviews and the projects, students' learning outcomes were mapped using indicators provided by the IL framework (EMB, 2005). The framework categorizes learning outcomes into four dimensions: cognitive, metacognitive, affective and socio-cultural. The number of indicators on a particular level shows students' performance in that dimension. The secondary one students were found to possess IL skills primarily at Level II, the stage of primary four to six, but they demonstrated progress in the cognitive dimension. A breakdown of students' performance in the IL multiple-choice test revealed their strengths and weaknesses. The test results shed light on students' ability to identify potential sources, but they were weak in using information sources in a responsible and ethical manner.

According to the findings, the researchers were able to denote aspects of students' IL that required enhancement. Overall, their poor understanding of plagiarism called for more education and training to raise their awareness of and knowledge on the issue.

8.2.4 Assessing IL and IT literacy by perceived learning progress

Apart from assessing IL and IT literacy through particular assessment tools as referred to in section 8.2.3, IL and IT literacy is sometimes assessed by students', parents' and teachers' perceptions of learning progress. In the following section, a study which illustrates the role of perception in evaluating one's IL and IT skills is introduced. Although assessment on the basis of perception may not be the most direct method of reflecting students' competency, it contributes greatly to portraying their strengths and weaknesses, and this helps educators locate areas in need of intervention, support and improvement.

8.2.4.1 Assessing student development of IL and IT literacy through student and parent perspectives

Primary four (aged 9-10) students from a school in Hong Kong joined a project examining the effect of combining collaborative teaching and inquiry project-based learning (Chu et al., 2008; Chu, 2009). Over a six-month period, students carried out two General Studies projects on two different topics, in which they were required to perform various IL and IT skills oriented tasks. Teachers of three subjects (General Studies, Chinese and IT) and school librarians assisted in the process and provided guidance to students when needs arose. Upon completion of the projects, students and parents were invited to articulate the difficulties they encountered and the students' improvement in their IL and IT skills.

Telephone interviews with parents were conducted. Parents were told to rate the difficulty of the project on a 5-point ordinal scale, in which 1 meant very difficult and 5 very easy. They were then asked about their child's improvement in aspects such as their ability to locate information, and competency in computer-related skills like the use of PowerPoint and Chinese word processing. Students were asked the same questions in a questionnaire administered in class by their teachers. In-depth information regarding teachers' perception of the projects was obtained through interviews.

Results suggested that both students and parents considered the tasks easy, while teachers had

a relatively neutral stance, rating the tasks in the middle of the scale. The difference in their ratings were, however, not significant. In particular, conducting online searches was one of the difficulties more commonly reported by students, as stressed by General Studies and Chinese language teachers. The results showed that the level of difficulty was linked to perceived improvements in certain dimensions of learning. Participants who gave higher ratings on the ease of the project rated advancement in reading and writing ability, IT skills and presentation skills more positively, implying that improvement may be induced by students' perceptions that the project was not too difficult.

Students' perception of their IL and IT skill gains was also checked in a slightly different way (Chu, et al., 2011b). Using questionnaires, students were required to rate their familiarity with various information sources, searching skills and IT skills before and after participating in the project (see Appendix 8.2). Dependent t-tests were used to compare their ratings of familiarity in each aspect. Increased familiarity in a certain aspect was found to correlate with improvement in the corresponding skills.

After the project, students considered themselves more familiar with all the dimensions of IL and IT skills in focus. It was also discovered that as the accessibility of searching tools and computer software increased, greater improvement was noted in students' familiarity with the use of the corresponding tools/information services. For instance, students did not have free access to Wisenews (a news database) in the past, resulting in a substantially lower familiarity prior to intervention and the biggest improvement in the IL domain.

8.2.4.2 Learning analytics measures of student in-progress digital behaviors

Around the world people are now taking pride in an increasing availability of e-learning management systems and other digital environments provided by educational technology developers and entrepreneurs, and in parallel, more widespread adoption of such platforms by educators, school districts and other organizations aiming to educate learners. With the development and deployment of these new platforms comes a growing proliferation of digital trace log data (educational "big data") generated by the systems themselves that produce an imprint of learner behaviors and actions in the environment. Many inter-disciplinary parties are pursuing the use of "learning analytics" (Siemens & Baker, 2012) to aid the cultivation of intelligent digital settings that aggregate, measure and report upon user actions, and that are moving towards offering predictive and diagnostic evaluative models and agents that can support the learner – in some of which the system itself scaffolds the learning intelligently, while also providing teachers with diagnostic and moderation tools (Wu et al., 2014).

The field of learning analytics (LA) addresses the collection and analysis of such data about learners and their engagement in such environments. The field also involves the design of new digital evaluative systems that are responsive to user actions. The community now has its own conference and journal to further drive this agenda item (LAK conference; Journal of Learning Analytics). Cooper (2012) identifies several research and organizational communities out of which LA approaches are derived, including:

- Statistics
- Business intelligence
- Web analytics
- Operational research

- Data mining and artificial intelligence
- Social network analysis
- Information visualization

In the context of inquiry- and project-based learning interventions, an LA approach might be utilized to investigate ways in which students are using an e-learning management system in conjunction with their inquiry and project creation. A teacher may decide to design and deploy such an environment to support the inquiry and collaborative endeavors of students. Wikis have also been discussed as coordinating representations for student inquiry engagement. Such a system creates trace log data and site metrics that in some cases can be accessed and juxtaposed at the student and team levels of analysis for assessment purposes (Chu et al., 2011a).

Such data are made available via the wiki-based learning management system in the Globaloria project, which is a focus in Chapter 6 of this book. In Globaloria, a blended e-learning program involving project-based game design, students in the 2012/2013 school year used a Learning Management System (LMS) developed by an organization in NYC to develop individual online identities, engage in teamwork and collaboration, and for project management of the game development process. The LMS supported tasks and activities including:

- Game project file sharing (which in 2012/2013 included Flash and other software files, programming code, image files such as JPGs, and design documents)
- Ongoing documentation and archiving of the product management process
- Updating of a schedule logging students' daily tasks completed
- Communication and feedback among team and class members
- Information-seeking for tutorial resources on programming help
- Assignment completion (Reynolds, 2016)

The system generates trace logs of wiki page edits and file uploads to the LMS. These data can be used to measure frequency of student engagement in a variety of page types.

To investigate whether student processes such as uses of the wiki contribute their learning outcomes, Reynolds and Chiu (2012) used this page edit and file upload log file data to aggregate frequencies and statistically measure their relationships to the scored game evaluations. To measure game outcomes, the authors used a rubric coding scheme that had achieved inter-coder reliability (2012). Findings indicated that the larger the number of constructive page edits and uploads to the wiki made by students, the more advanced were their game design learning outcomes. This result suggested that page editing (for instance, adding code to the site to share with peers) and uploading (for instance, archiving a Flash project .FLA file on the site so others could access it later) served to support, coordinate and organize their game design efforts. This result adds validity to the claim that learning analytics process data such as log file frequencies for student uses of particular learning management system pages and resource types can be indicative of their success in achieving learning objectives. Such a result needs to be tested further, though, considering variety in instructional context factors.

Another LA data source that LMS environments may generate includes page read and site visitation data (also called "click stream data"). In the case of Globaloria, page reads and site

visitation were logged by Google Analytics, and these data were also accessible to the researchers. Google Analytics recorded page reads for non-editable information resource pages such as tutorials, that students were expected to access to help them problem solve programming challenges. Similar to page edits and uploads, findings for page *reads* also supported ways in which student information resource uses of the LMS contribute to learning outcomes (e.g., Reynolds, 2016).

Overall, these data can be used by teachers and researchers as well as an organization such as Globaloria which develops a curriculum and/or web-based learning platform, to monitor and evaluate how students are using varied resources, and how such uses contribute to their learning (Reynolds, 2014, 2016). Such a use of LA data can help teachers in assessment of individuals (e.g., some students are not using the resources enough or effectively, thus they may need greater information literacy support). LA data can also help teachers evaluate quality of a given curriculum (e.g., if they are piloting 2 solutions, and observe that student uses of one platform yields higher outcomes than uses of another platform, they may opt to use the higher yielding solution instead). LA data can also help organizations involved in curriculum and learning platform design to optimize particular features (e.g., if students are not using a particular resource in a suite of affordances, or if a particular resource is not linked to outcomes, then that resource's design might need to be improved). Educators are encouraged to empower themselves for data-driven decision-making, drawing on LA data when available. This is an up-and-coming domain of innovation within education, to watch.

8.2.5 *Assessing media awareness of primary four students*

Media education in Hong Kong has been gaining importance since the turn of the century. Dissatisfaction with media performance and the undergoing education reforms are the major forces propelling the change. Media education was officially mentioned in the agenda of the Curriculum Development Council in 2000 (CDC, 2000), hoping to equip students with sufficient media literacy to judge the credibility of news from the media (Lee & Mok, 2007), meeting the goals of the education reforms to enhance students' critical and independent thinking skills (Education Commission, 2000). However, it was unclear then how media education was to be incorporated into the curriculum framework. Research studies in media education were limited too.

This section discusses a project investigating media use and media awareness of primary four students (aged 9 -10) from four schools in Hong Kong (Chu et al., 2010; Chu, Lau, Chu, Lee, & Chan, 2014). In the era of information explosion, the media has established its central status in knowledge and information circulation, and newer media is casting increasing influence alongside traditional media such as newspapers, television and the radio. Little research has nonetheless been done on media education of young children, and stakeholders have shown themselves to be anxious about the impact of the media on children. The project thus attempted to fill the gap by exploring children's access to media, their media awareness and use patterns, and how well teachers know about children's media consumption.

In the project, teachers and students were given identical questionnaires on media awareness and media use patterns to be completed. A total of 332 questionnaires were collected, including 248 questionnaires from students and 84 from their teachers. Teachers from the four participating schools received the questionnaire before their students did to ensure that they could facilitate the students' understanding of the questions there. Teachers were invited to imagine how their primary four students would answer the questions, and to fill out the

questionnaire from the perspectives of the students. During class time, the same questionnaire was administered on the students.

Questionnaire on media awareness and media use patterns

1. Please list three Chinese newspapers from Hong Kong:
    i.   _____
    ii. _____
    iii. _____

2. Which of the above newspapers do you read most often? _____
   Why? _____

3. Please list two free TV stations in Hong Kong:
    i. _____
    ii. _____

4. Which of the above TV stations do you watch more often? _____
   Why? _____

5. Please list one paid TV service: _____

6. Does your family have a subscription to paid TV service at home? Yes/No
   If yes, which one?

7. Please list two radio stations:
   _____
   _____

8. Which radio channel from the above radio stations do you listen to more often?
   _____
   Why? _____

9. Do you surf the Internet? Yes/No
   If yes, how many hours do you spend online every day? _____

10. When you get connected to the Internet, which website will you first visit?
    _____

11. Do you agree with the following statements? (1 for strongly disagree, 5 for strongly agree)
     i.   Generally speaking, news in the newspapers is reliable.
     ii. Generally speaking, news on TV is reliable.
     iii. Generally speaking, news from the radio is reliable.
     iv. Generally speaking, information on the Internet is reliable.
     v.   I think it is important to read about the news every day.
     vi. I like knowing about the latest news.
     vii. I know how to distinguish true from unreliable news.

Fig 8.3 Questionnaire on media awareness and media use patterns (Chu et al., 2010)

The questionnaire (see Figure 8.3) was drafted in Chinese, the students' first language, for their ease of understanding. Organized in two sections, the first part contained open-ended questions concerning media use and awareness, in which students had to freely recall the names of different media while the second part required them to evaluate statements regarding media credibility on a Likert scale of 1 to 5.

The research questions focused on the following two aspects: 1) the media awareness and media use patterns of primary four students, and 2) the extent to which their teachers understand their media use and awareness patterns. The former was studied by identifying possible trends within students' answers, and the latter by comparing students' and teachers' answers.

Students were told to list their most frequently read newspaper. The top three listed ones were *Apple Daily, Sing Tao Daily* and *Oriental Daily*, with the first two papers concurring with their teachers' choices. Despite this, teachers were unable to spot the popularity of other newspapers like *The Sun* and *Mingpao*. Students' awareness of free television channels was also assessed. Most were able to name two channels: *TVB* (which offers several free channels such as *TVB J2* and *TVB-interactive news channel* and other paid channels) and *ATV*[1]. Teachers were capable of pointing out the popularity of TVB over ATV, but were less successful in naming the TVB channel with the greatest popularity among students. There were also noticeable discrepancies between teachers' and students' answers about paid TV and radio services. The wide range of media forms mentioned further indicated that primary students in Hong Kong demonstrated a considerable level of media literacy, especially in their awareness of what there was on television.

Students were prompted to give reasons for choosing a particular newspaper, TV channel and radio channel. For newspapers, rich content was the leading factor, followed by interesting information. The influence of parents and teachers on their choice was not as huge as what the teachers expected. Similar results for TV channels were obtained. The results revealed that students were more content-oriented than what their teachers thought. They were able to make independent judgements on media consumption. Nevertheless, tabloids were more popular among students' choices of newspapers, including *Apple Daily* and *Oriental Daily*, which both featured on the top three. This is worth noting as the results showed that students selected which newspaper to read based on its content. But a large proportion of the respondents provided no answer to the question asking for their choice of radio channel.

Results denoted that around 85% of the students had Internet surfing habits, with an average of 1.87 hours spent on the Internet per day. Teachers were able to predict the first website that students visited (Yahoo!) but overestimated the frequency of their visits to online game-related websites. The popularity of the Internet may account for students' lack of familiarity with radio channels, since the Internet offers an alternative to radio programs (e.g. podcasts), and also substitutes radio channels to a certain extent.

Students were asked to comment on the reliability of the media. They considered the television to be the most reliable form of media, followed by the radio, newspapers and the Internet, as expected by their teachers. They were also more cautious about the content of the media, especially the newer media, than their teachers thought. This suggested that traditional media is still regarded by them as important sources of information.

The study concluded that the students were autonomous in deciding on their choice of media, and did not rely merely on the new media, thereby demonstrating a considerable level of media literacy. Results of the study also indicated that teachers did not seem to fully understand their students' perspectives towards media use. Assessing students' media use

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[1] ATV is no longer in operation from April 2016.

patterns had implications for how media education models should be developed to maximize the benefits of media education on them. Findings pointed to the need for teachers to deepen their own understanding of students' media consumption habits in order to devise an effective, tailor-made media education curriculum for their students. Both under- and over-estimating students' access to, knowledge of and consumption of the media may lead to ineffective use of classroom time and implementation of teaching strategies.

8.2.6 *Measuring knowledge outcomes by evaluating product artifacts*

The products of student inquiry-based learning projects often comprise not only research papers but also digitally produced texts such as audio- and video-files, games, presentations and various multimedia artifacts. Such artifacts represent the culmination of student knowledge building during inquiry-project-based learning. While their measurement and assessment does not span the entire breadth of the learning that occurs, the products of knowledge-building offer another useful object for observation and evaluation.

Teachers are generally accustomed to grading student papers, where a standard research outcome is a text-based report. It now becomes imperative to also prepare them for the evaluation of digital projects in inquiry-based contexts. In one study, Reynolds (2010) and Reynolds and Chiu (2012) adopted a content analysis approach in evaluating student game design artifacts in the Globaloria project discussed in Chapter 6. The approach is described as follows.

Game quality. To develop a variable of game quality for use in research, the authors conducted content analysis of all teams' final games. Neuendorf (2002) defines content analysis "as the systematic, objective, quantitative analysis of message characteristics" (p. 1). The purpose for evaluating games is to better understand the range of game mechanics (programming expertise), design attributes (aesthetics) and messages students achieved (the results of their inquiry on a topic of interest, e.g., climate change, or social/cultural themes resident to their local environments).

Coding Scheme Development. The authors matched the definition of a "game" to a file that goes beyond a mere image to include some level of interactivity in which, at minimum, the file provides a response to the player, based on a player action. Defining a "game" at this minimal level of interactivity allowed the authors to code the full range of game files created by students from basic to advanced. The format of the game files students posted online included both .SWF (Small Web Format / Shockwave Flash) and .FLA project file formats.

The final coding scheme, presented in Appendix 8.3, included dichotomous variables for Actionscript programming codes that could reasonably be expected from introductory game design students which are measured for their presence or absence by a simple review of the .FLA and .SWF files (1 = present; 0 = absent). Furthermore, games were more subjectively evaluated for their design attributes built into the game, involving the following categories: visual and sound design elements, game play experience, concept development and genre. Games were judged on a 3-point scale: 1 = Not present / insufficient representation; 2 = basic/introductory representation; 3 = well-developed representation.

To test inter-rater reliability, Reynolds and Chiu (2012) computed the kappas for each section of the coding scheme among a set of 3 coders who coded 10% of the dataset with the following results: Actionscript programming evaluation, 0.85; visual and sound design

evaluation, 0.81; game play experience evaluation, 0.87; concept development evaluation, 0.75. Appendix 8.3 presents this content analysis approach, which was used for research purposes but can be adapted as a rubric for practitioner use.

The resulting score for each game measures the quality of the game at the team level of analysis, and the team scores ranged from 16 to 61. The team score is interpreted to be the maximum extent of student expertise any one individual on that particular team may have reached. Note that this team approach to evaluation of a team-based artefact is quite different from the traditional school practice of individualized assessment as team-oriented evaluation is found to be able to incentivize more effective team collaboration and cooperation. Overall, such an outcome measure, if created and tested for reliability, can be used in educational evaluation and social science research.

Although inter-coder reliability assessment may not be feasible for the practitioner and rubrics are commonly utilized in education, such schemes for digital products are expected to become more widely available. The scheme approach shown in Appendix 8.2 can be adapted for educators who need to develop their own assessment of their students' inquiry-project based learning artefacts, considering the learning goals and objectives in one's own given context.

8.3 Conclusion

Various instruments for assessing 21st century skills and a sketch on what has been done worldwide to assess different skill components in the P21 framework have been introduced in the first part of this chapter. While an assessment tool may be well suited for the evaluation of more than one component of 21st century skills, multiple tools are often applied in assessing one particular component. Appropriate assessment methods need to be carefully chosen and adapted for both teachers' and students' benefits and needs.

It is the authors' goal to suggest an assessment approach based on empirical evidence drawn from different ways of monitoring students' work. Therefore, in the second part of the chapter, research projects conducted by them are presented. In all the case studies included, the researchers assess the respective skill components using evidence-based methods, including extracting data from records of student performance and collaboration during the intervention, self-assessments, custom-made assessment tools, application of learning analytics, questionnaires, and content analysis of artifacts produced by students. These assessment tools enable students to demonstrate their proficiency in various skills in a low-risk environment in comparison to standardized tests; they are also tailored to best reflect students' competency in the area under investigation, as one specific skill may need to be assessed in a different way than the next (Redecker & Johannessen, 2013). With a suitable assessment method, students' competency can be effectively activated, and with quality assessment, teaching and learning is promoted to the students' advantage.

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Appendix 8.1 Back-translated version of the IL assessment tool (Adopted from Chu, 2012)

IL assessment tool

Question 1 (TRAILS, Sixth Grade General Assessment 1, Q1)
Your teacher wants you to choose one religion and create a handout on that religion to introduce it. Which of the following subtopics below would you not include in the handout?
    A. World population
    B. Countries where the religion is found
    C. Customs and holidays
    D. Religious symbols

Question 2 (TRAILS, Sixth Grade General Assessment 1, Q2)
When you are assigned a research project, the topic of the project is often too broad. You will have to narrow it down. In each pair of the topics below, select the topic that is narrower.
    A. Outer space
    B. Planets

Question 3 (TRAILS, Sixth Grade General Assessment 1, Q22)
Which of the following is not a reason why you should cite your sources?
    A. Citing gives credit to the author or the first person of the idea.
    B. Citing shows that you have researched the idea.
    C. Citing allows another person to identify the complete work that you used.
    D. Citing tells readers where to purchase the complete work that you used.

Question 4 (TRAILS, Sixth Grade General Assessment 1, Q6)
The assignment for a health class is to find facts about childhood obesity. You want to save time. Before typing "childhood obesity" into the Google search engine, which website should you check first?
    A. "Healthy Adults"—www.healthyliving.org—health information for adults
    B. "Lose Weight Now"—www.dietnow.com—several diet plans are explained
    C. "Kid's Health"—www.kidshealth.org—children's health topics are discussed
    D. "Food For Life"—www.foodgoodforyou—healthy food choices

Question 5 (TRAILS, Sixth Grade General Assessment 1, Q9)
If you wish to find books by Cha Leung Yung, what kind of catalogue search should you try?
    A. Title search
    B. Author search
    C. Subject search

Question 6 (TRAILS, Sixth Grade General Assessment 1, Q12)
Your friend tells you about a website where you can download the latest songs that you hear on the radio for free. If you use this website for this purpose, which of the following will you violate?
    A. Right of privacy
    B. Copyright
    C. Freedom of information

Question 7 (TRAILS, Sixth General Assessment 1, Q10)
You are told to create an informational pamphlet on animals. Your topic is giraffes. Select from the following websites one with the most credible information about giraffes.
   A. www.ourgiraffes.org – A site created by scientists studying mammals
   B. www.sunnyschool.p6.hk/chan -- A site about zoo animals created by Mr. Chan's sixth grade students
   C. www.visitanddiegozoo.org -- A site created by supporters of the San Diego Zoo
   D. www.safaripictures.com -- A site created by a tourist who visited Africa

Question 8 (TRAILS, Sixth General Assessment 1, Q14)
If you wish to find Joanne Kathleen Rowling's "Harry Potter", which library resource would you use?
   A. library catalogue or online catalogue
   B. video collection
   C. reference tool
   D. periodical database

Question 9 (TRAILS, Sixth General Assessment 1, Q16)
Read the following sentence and decide whether the sentence is a Fact or an Opinion.
"Smoking is bad for health."
   A. Fact
   B. Opinion

Question 10 (TRAILS, Sixth General Assessment 1 Q16)
Read the sentence and decide whether the sentence is a Fact or an Opinion.
"Smoking should be banned."
   A. Fact
   B. Opinion

Question 11 (TRAILS, Sixth General Assessment 1, Q18)
On a recent hike you saw an unfamiliar bird. You want to hear what sound this bird produces. Which library source would allow you to identify the bird and also hear the bird's sound?
   A. a bird identification DVD
   B. a printed field guide on birds
   C. a general encyclopaedia

Question 12 (TRAILS, Sixth General Assessment 1, Q15)
You have used a search engine to locate websites on the negative effects of drugs on teenagers. Below are some websites that your search retrieved. Read the site description and choose the one that would best meet your information needs.
   A. www.addictionscare.com – a 24-hour hotline regarding drug addiction in your community
   B. www.teendrugabuse.org – describes how illegal drugs affect teenagers' brains
   C. www.teenscenezeen.org – explains how to say "no" to drugs at a party
   D. www.teendrugabusers.us – provides assistance to parents with troubled teens

Question 13 (TRAILS, Sixth General Assessment 1, Q23)

You are unsure about how to check out materials from the school library. Which source would not provide information on the library's checkout procedures?

- A. The school newspaper
- B. A pamphlet describing the library's rules and procedures
- C. The librarian
- D. Information signs at the checkout desk

Question 14 (TRAILS, Sixth General Assessment 1, Q24)

Your teacher wants you to write a report about Dr. Sun Yat Sen. Read the paragraph below and find the information that would help you answer this question: What did Dr. Sun Yat Sen accomplish during his presidency?

Dr. Sun Yat Sen was an important figure in modern Chinese history. He was the first provisional president of the People's Republic of China. He played an instrumental role in inspiring the overthrow of the Qing Dynasty and established the People's Republic of China, which makes him a world-renowned revolutionist. In 1925, Sun passed away because of liver cancer.

- A. Sun passed away because of liver cancer.
- B. Sun was the first provisional president of the People's Republic of China.
- C. Sun played an instrumental role in inspiring the overthrow of the Qing Dynasty and established the People's Republic of China.
- D. Sun is a world-renowned revolutionist.

Appendix 8.2 Questionnaire on students' familiarity with IL and IT skills (taken from Chu et al., 2011)

	Before the inquiry-based learning projects	After the inquiry-based learning projects	Perceived level of importance
	Level of familiarity 1 = Not familiar 5 = Very familiar	*Level of familiarity* 1 = Not familiar 5 = Very familiar	1 = Not important 5 = Very important
A. Sources/databases:			
The use of the school library	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
School library's online catalog	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
The use of public libraries	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Public libraries' online catalog	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
WiseNews	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Google	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Yahoo	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
School/Library suggested websites	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Others, please specify			
B. Search skills & knowledge:			
Dewey classifications	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Reference books	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Newspapers	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Keyword search	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Boolean operator ―And‖	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Boolean operator ―Or‖	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Boolean operator ―Not‖	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Others, please specify:			
C. IT skills and knowledge:	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Jiufang input method	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Canjie input method	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Writing pad	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
PowerPoint	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Excel	1 2 3 4 5	1 2 3 4 5	1 2 3 4 5
Others, please specify:			

Appendix 8.3 Coding protocol for a digital literacy intervention involving student inquiry-based learning and construction of digital artifacts

1	**Game Design Programming Features, Basic (0=not present; 1=present)**	**How it looks in the Flash .SWF game file**	**.FLA Actionscript Code to search in Flash project file**	**SCORE**
1.1	roll over/roll out	When you place the mouse over or move the mouse off an object without pressing it, does something happen?	Symbol.**onRollOver** **or** Symbol.**onRollOut**	
1.2	Button presses	When you click a button on the screen, does something happen?	**onRelease**	
1.3	hit test/collision detection	When two objects on the screen overlap or collide, does something happen (such as points gained/lost, color change)?	Symbol.**hitTest**(otherSymbol)	
1.4	key press	Does something happen when you press the keys on the keyboard (like the arrow keys)?	if **Key.isDown**(Key.NAMEOFKEY) {effect of key press}	
1.5	on enter frame *	(You will have to check the FLA and code.)	**onEnterFrame** = function() { continuous looping code }	
1.6	timer *	Does this game have a time limit or do certain things happen at timed intervals? (You will have to check in FLA for the latter.)	**setInterval**	
2	**Game Design Programming Features, Advanced (0=not present;**	**How it looks in the game design .SWF game file**	**.FLA Actionscript Code to search in Flash project file**	**SCORE**

		1=present)		
2.1	drag and drop	Can you click and drag a symbol to move it and release the mouse button to drop it?	Symbol.**startDrag**(this); ***or*** Symbol.**stopDra**g();	
2.2	dynamic text or input text	Dynamic Text (e.g., score counter): the text changes depending on your actions -- might have to find in Actionscript to ensure its dynamic text. Input Text: you can type text into a text field.	Dynamic Text: **textBox.text** = "Your Text Here"; || Input Text: output = input; or **.htmlText**	
2.3	preloader	Is there a preloader before the game appears?	var total = this.getBytesTotal(); this.onEnterFrame = function(){ loaded = **this.getBytesLoaded**();	
2.4	load sound	Does the game have sound?	my_sound.**attachSound**("soundIdentifier")	
2.5	Physics engine	Do characters accelerate (as opposed to moving at a fixed rate)? Can they jump?	anything mentioning "**isJumping**", "**velocity**", "**landspeed**" or "**gravity**" will denote presence of a physics engine, generally	
2.6	variables*	You will have to look in the code	**var** name = value;	
3	**Design, Content Evaluation:** Evaluate on a scale of 1 to 3.	1 = Not present / insufficient representation; 2 = basic / introductory representation; 3 = well-developed representation		
3	**Visual and sound design elements**			
3.1	The visual design of the game creatively reflects the concept of the game (e.g., the designer uses color, shapes and patterns so that the visuals and design reinforce the ideas in the game design plan)			
3.2	The visual / graphic style is consistent throughout the game (e.g., elements of color-scheme, character design and game-play objects are held consistent throughout the game)			
3.3	Sound is used to enhance game-play (e.g., no sound = 1; if certain objects have sound embedded = 2; if sound is used to enhance experience overall = 3)			
3.4	Non-player moving characters and animated objects make the game dynamic (e.g., graphic animation elements are created and included as files)			
3.5	The game feels immersive, e.g., includes perspective-taking features in the artwork and player characters such as a first-person viewpoint for the avatar			

4	**Game play experience**	
4.1	The game instructions are clear and helpful to the viewer	
4.2	The game provides helpful feedback when the player advances or fails to advance through the game (e.g., quiz game provides feedback on a response; when a character dies, a life is lost or a message appears)	
4.3	The game is navigable and intuitive to use	
4.4	Game mechanics are simple to understand and learn, but offer increasing levels of challenge	
4.5	Based on their game design plan on the wiki, students have a clear idea of their "audience", and their game design as executed is appropriate for this audience	
5	**Concept development**	
5.1	The object / purpose of the game is clear from the beginning (the game provides context for the gameplay up front)	
5.2	The subject of the game is integrated throughout, not fragmented. See whether there is a message storyline or content present in the game. Is the topic / material complex and presented through the game?	
5.3	Any facts included are presented accurately and reflect research	
5.4	The educational material / game concept is not just presented as a quiz but is represented in a creative way in the gameplay. See whether game concept / storyline is coherently integrated with the mechanics and game play (e.g., challenge questions offered in an educational game are related to the action and game play)	
5.5	The game has an ending / conclusion that provides closure to the player	
5.6	The game design document on the wiki is thorough, clear and understandable	
5.7	The paper prototype video is present and thorough in its initial outline and scope	