
Practice characteristics that lead to “21st century learning outcomes”

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Abstract

The key research question for this study was to ask whether or not innovative teaching practices would lead to the development of learning outcomes essential for preparing the younger generation for the challenges of life in the knowledge society of the 21st century, and if so, how are the pedagogical features related to the different learning outcomes. Preliminary analyses of the case study data collected from the SITES M2 Study in Hong Kong reveal that where the development of more significant learning gains were observed, the cases possess characteristics additional to the criteria defined in the Study for selection of innovation: extended learning tasks, personal meaning and relevance of the learning tasks, involvement of significant others outside of the classroom in the learning process and the availability of suitable facilitation. More importantly, it was found that the impact of the pedagogical practices was not determined simply by the aggregation of pedagogical characteristics of the practices per se, nor on the technologies used, but on a rather more nebulous notion of “empowerment”. This pertains to whether the teachers and students had a sense of empowerment in the process and whether the learning outcomes targeted went beyond specific cognitive and metacognitive goals to include affective and socio-cognitive learning outcomes essential for empowering a learner in the information age. Further, this paper claims that these affective and socio-cognitive learning outcomes are more important as preparation for lifelong learning in the 21st century than “knowledge management competencies”.

Introduction

A main justification for the widespread introduction of ICT to support teaching and learning across the curriculum has been the development of a new set of competencies to
prepare the younger generation for life in the 21st century. The purpose of introducing ICT into the school curriculum can be various and the way this problem has captured the attention of policy makers and the education community as well as the general public at large has witnessed great changes in the last several decades. However, it is undeniable that there is a growing tendency for education policies on ICT in the curriculum to be linked to or made in the context of a wider educational renewal/reform at a national level (e.g. (PCAST, 1997), (Singapore Ministry of Education, 1997), (Ireland, 1999), (Korean Ministry of Education, 2000)). This orientation of conceptualizing studies of ICT in schools in the context of education reforms has also dominated the research literature (e.g. (Kozma, 1998)). It is also in this context that the Second International Information Technology in Education Study introduced the concept of emerging pedagogical paradigm for the study (Pelgrum, 1999). Furthermore, there has also been great consistency in the education reform goals of different countries: preparing students for lifelong learning. Lifelong learning ability is seen both as a demand made on the average citizen of the 21st century as well as what ICT could contribute most in preparing students for.

The purpose of this paper is to explore whether or not innovative teaching practices would lead to the development of learning outcomes essential for preparing the younger generation for the challenges of life in the knowledge society of the 21st century. In this sense, this paper also attempts to contribute towards connecting the study foci for the two phases of SITES\(^1\), M2\(^2\) and M3\(^3\).

**Preparation for lifelong learning requires paradigmatic changes in teaching practice**

If the goal of education is to prepare students for life in a fast changing world where the shelf life of knowledge is getting ever shorter and the ability to work collaboratively with others on new problems is essential for effective functioning in the workplace, the abilities to be cultivated through schooling becomes very different from those found in the traditional curriculum. Rather than ensuring that students master a set of core contents and skills, schools need to prepare students who are able to communicate, think and continue to learn throughout their lives and who can work productively and effectively with others through negotiations and compromises ((Gardner, 1991), (Sarason, 1990)). To bring about such learning requires new roles for teachers and new teaching strategies and practices. The general realities of current classrooms are designed for achieving the educational goals of the modern industrial age:

> “The traditional classroom …… is singularly ill suited to producing lifelong learners: “Right now, you’ve got 30 little workers who come into a room, sit in


\(^3\) SITES M3 Survey Module http://www.sitesm2.org/SITES_Research_Projects/sitesm3.html
The use of ICT to support teaching and learning across the curriculum may or may not support the development of lifelong learning abilities. In fact, it is anticipated that current usage of ICT in educational settings is more likely to be in the form of deploying new technology for the delivery of old pedagogical practices (Plomp, 1996). The development of new pedagogies need nurturing and encouragement. It is in recognition of the importance of identifying and studying such new pedagogies that uses ICT that the SITES M2 study was developed.

Selection Criteria for innovative pedagogical practice in SITES M2

SITES M2 is a cross-national comparative case study of innovative pedagogical practices using technology (IPPUTs). To qualify for selection as an innovative practice for international comparison, the pedagogical practice must be one:

- In which technology plays a substantial role,
- That shows evidence of significant changes in roles of teachers and students, the goals of the curriculum, assessment practices, and/or the educational materials or infrastructure,
- That shows evidence of measurable positive student outcomes,
- That is sustainable and transferable,
- And innovative, as locally defined,

as specified in the case selection criteria according to the SITES M2 Study Prospectus.

The study design recognizes the difficulty in specifying and operationalizing the notion of “innovative” and that this is often dependent on the cultural and historical context within which it is observed. However, in the context of the study, a common frame of reference has been provided for this term for the purpose of international comparison - the practices must contribute towards preparing students for lifelong learning in the information society. Examples given in the SITES M2 Study Prospectus included practices that:

- Promote active and independent learning in which students take responsibility for their own learning, set their own learning goals, create their own learning activities, and/or assess their own progress and/or the progress of other students.
- Provide students with competencies and technological skills that allow them to search for, organize, and analyze information, and communicate and express their ideas in a variety of media forms.
- Engage students in collaborative, project-based learning in which students work with others on complex, extended, real-world-like problems or projects.

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4 SITES M2 Study prospectus. 
♦ Provide students with individualized instruction, customized to meet the needs of students with different entry levels, interests, or conceptual difficulties.
♦ Address issues of equity for students of different genders or ethnic or social groups and/or provide access to instruction or information for students who would not have access otherwise because of geographic or socioeconomic reasons.
♦ “Break down the walls” of the classroom—for example, by extending the school day, changing the organization of the class, or involving other people (such as parents, scientists, or business professionals) in the education process.
♦ Improve social cohesiveness and understanding by having students interact with groups and cultures that they would not interact with otherwise.

Knowledge management competencies and knowledge management pedagogical practice categories

The focus on innovative pedagogical practices was very much motivated by the expectation that such practices would lead to the development of learning outcomes essential for preparing the younger generation for the challenges of life in the knowledge society of the 21st century, such as the ability and readiness to engage in lifelong learning, to access and evaluate information, to communicate effectively and to collaborate with others in solving complex open-ended problems, with the appropriate use of technology. Specifically, in the draft plan submitted to IEA for SITES M3, (Anderson, 2000) identified seven ICT knowledge management competencies, which was the term used to refer to the skills and abilities to manage knowledge and to deal with information using ICT:

♦ retrieve and organize knowledge
♦ solve complex problems
♦ collaborate; exchange knowledge; work with experts
♦ communicate; give persuasive presentation
♦ construct knowledge products;
♦ integrate and critically evaluate knowledge
♦ identify and evaluate secondary effects

The same document, offered a model for linking up the knowledge management competencies as learning outcomes with the pedagogical practice characteristics that are present in schools. Thus, there is a tacit, and perhaps rather persuasive assumption that certain pedagogical features in teaching and learning will lead to the development of particular competencies. A preliminary analysis of the SITES M2 case data collected in Hong Kong indicates that neither the above list of learning outcomes nor the SITES M2 characterization for innovative practices were able to capture the most important learning outcomes or the pedagogical characteristics of the practices that are most valuable for bringing about the development of 21st century learning outcomes. Further, there is indication that the relationship between pedagogical practice characteristics and learning outcome is a holistic rather than an atomistic one.
In the remainder of this paper, an attempt will be made to first describe the perceived complexities that distinguish the pedagogical practices in important ways beyond the specified innovation characteristics. This will be followed by a description of the observed learning outcomes that go beyond the knowledge management competencies listed above. Finally, this paper will conclude with some suggestions for the design of studies that attempt to link up “21st century” pedagogies with “21st century” learning outcomes.

Pedagogical characteristics of innovative practices

The case studies selected in Hong Kong met most, if not all, of the seven characteristics of innovative practices. In examining the characteristics of the practices, several prominent features that were not included in the original selection criteria stood out to have strong impact on the possible learning outcomes. First, where the practice involved an extended learning task extending over a period of months appear to provide more scope for the students to be deeply engaged personally in the learning process, creating much better conditions for significant learning. Another important feature was that the learning tasks themselves have to be personally meaningful and relevant to the students. Further enabling factors include the involvement of significant others outside of the classroom in the learning process and availability of suitable facilitation.

Besides the more tangible characteristics of the classroom practice, closer inspection of the SITES M2 case study data reveal finer, less tangible differences across the practices that have yet more important impacts on the learning outcomes of students. These differences relate to the teachers’ ability and focus on enhancing reflection and sharing of ideas among students throughout the project process, thus increasing the interdependence and interaction among students.

A good illustration of these less tangible, teacher related characteristics can be found in CN001, one of the Hong Kong M2 cases. This is an innovative practice at the primary school level involving the use of ICT in project-based learning. The school started to implement project-based learning in the 1998-1999 academic year. At this initial stage, the ICT team members acted as pioneers to facilitate students (grade 4 to 6) to complete projects in groups on a self-selected topic as their extra-curricular activities. When the research team contacted the school to finalize on the specific practice to focus on for data collection in early 2001, two projects, "My Pocket Money" and "Understanding Myself" were underway as part of the formal curriculum in Grade 5 and Grade 4 respectively. Both projects had been designed and implemented by Teacher A (the Panel Head of the Information Technology Implementation Team as well as an ICT team member) as the first implementation of project-based learning in the formal curriculum in the previous academic year, 1999-2000. Later, she passed on her experience to Teachers B and C, who modified and implemented her project plans in their classes in the 2000-2001 academic year. Thus both projects were part of the school’s efforts to scale up good practices through extending these to a wider group of teachers in order to ensure the sustainability of project-based learning. After finding out about the details of both projects, the research
team decided to focus on teacher B and his project "My Pocket Money" as it had a more comprehensive task structure that included a wider range of activities and skills, including conducting research, fund-raising and a service day in a neighborhood elderly centre, but maintained contact with teacher C’s class when time allowed. However, as the weekly sessions evolved, the research team found teacher C’s classes to be more stimulating and finally followed through both projects to roughly the same level of detail. Figure 2 below presents an outline of the activity flow for the two classroom practices.

Figure 2. A diagrammatic representation of the activity flow for the two classroom practices involving project based learning.

**A task structure and process focus**

Teacher B considered his own role to be mainly that of a facilitator whom students could consult when they encountered difficulties, and he would avoid making decisions for his students. In describing the perceived gain for the students through this classroom practice, teacher B said,

"Usually their (the students’) role is that of listening to the teacher’s talk. But in this project, they have to ask questions and listen to the advice from others. They have to give feedback to one another at appropriate time. So the one who offers advice is not the only one who can improve. The other groups’ members can make improvements too. I think the students become more mature and learn how to solve problems."

Teacher B’s students also commented that they recognized the importance of teamwork through participating in this project. They found that it was enjoyable to learn on their own, as they could express their ideas and learn beyond the confines of the knowledge obtainable from textbooks.
While Teacher B explicitly acknowledged the importance of his role as a facilitator, an inspection of his pedagogical focus and attention was on the practical, task level, organizing students through the different stages of the activities. He said:

"My main task is to ensure that the whole project runs smoothly."

The activity flow shown in Figure 2 indicates that each of the groups in Teacher B’s class work independently of each other, going through the various stages of the project development processes such as searching for information and further refining their problem, collect data, analyze and develop presentations entirely within each task group. The focus of the students’ interactions was on accomplishing the tasks assigned to them. This task level focus though helped students to gain experience and understanding of project-based learning and improved on the various skills involved, there was a noticeable absence of guidance in reflecting on the experience through the process, when compared with Teacher C’s class.

**Focusing on enhancing reflection and interdependence**

Teacher C, on the other hand, saw her main role as one of helping students to think and develop, putting the tasks and stages of project work as the contexts for helping students to develop their ability and understanding

"(The teacher) has to lead students to discuss. The teacher has to do much preparation and think of many leading questions to prompt discussion. In the discussion, it is possible that many things that are out of the teacher’s expectation occur. This is because the scope of project work is quite broad. The teacher cannot entirely predict what the students will say and what will happen. Therefore, the teacher has to do much preparation work. The teacher has to possess many skills, as the students may ask the teachers what are genes."

The differences in their own personal emphasis also led to differences in perceived personal gains through engaging in the project-based work. While Teacher B was very positive about having gained experience in organizing this kind of projects, Teacher C had different views on her own personal gain:

"I did not think there was a great improvement in my professional knowledge [in terms of curriculum planning]. However, I know more about my students. For example, I know who are more active; who needs more motivation or who are more responsible."

Thus Teacher C put a much greater focus on supporting the students on their own basis. There was a great deal of emphasis on training the research and collaborative skills of her students. This motivated her to provide intensive facilitation for individual groups and she taught them the skills of handling and analyzing research data during these sessions. The groups had to comment and integrate their work and ideas frequently. The
organization and flow of the project work activities in this class are thus distinctly different as indicated in figure 2. There was a lot more interactions amongst the groups during the project development process where the whole class made decisions on all aspects of the project such that there is much greater interdependence among the students. Consequently, though both classes have organized the project work as collaborative group-based activities, the level and intensity of interaction among the students was quite different.

Teacher C was very much intent on providing detailed formative comments to students, encouraging them to reflect and continuously improve on their work throughout the whole project process. There was frequent use of formative peer assessment, usually conducted at the end of each stage of the project process. Teacher C remarked:

“I used to assess students in terms of the marks that they got. Sometimes I assess them in terms of their responses to my questions. However, for this practice, they will not be given any marks. Rather, I assess them in terms of their development of skills of cooperating with others, presenting their findings, and commitment to the projects.”

**Fostering a knowledge community through developing learning conversations**

Reflection is an important process for learning through practice (Schon, 1983). It is interesting to note that Teacher C’s focus on enhancing mutual engagement coincides with what has been preached as effective ways of fostering knowledge communities in the knowledge management literature concerned with the challenge of harnessing the tacit dimension of knowledge (e.g. (Wenger, 2000)). The tacit knowledge refers to what (Sallis, 2002) describes as “knowledge that is felt”: hunches, insights, intuitions, feelings, imagery and emotions, personal knowledge that are “developed through social interactions, power plays, teamwork, friendship and corporate politics”. Teacher C’s focus also coincides with the findings on features of effective facilitation of collaborative project based learning reported in (Law, Yuen, & Ma, 2000).

**Learning outcomes gained**

The SITES M2 case study data were also analyzed to look for evidence of learning outcomes gained through the innovative practices, which are important to citizens of the 21st century. Our analysis reveal that while the knowledge management competencies detailed in the SITES M3 design document were observable through the task performance of the students, there is evidence for the learning outcome to be gained in a more holistic manner and that the affective and socio-cognitive dimensions of the learning outcome may possibly be more important than the individual competencies. As the evidence for such learning outcomes are more readily available in the form of students’ direct comments for practices at the secondary school level, illustrations in this section thus come from CN05 where students were engaged in two practices: the use of a bulletin board to support project-based learning on some Physics topics, and the use of a
multi-age discussion forum, which included the participation of current students as well as past graduates, to support the learning of the three science subjects through discussion and sharing.

It is not surprising to note that the features most appreciated by students in these two practices were those associated with breaking down the confinement of the traditional classroom. Students could carry on with their project work or learning of the science topics at home, communicate with their classmates, consult the teachers and other schoolmates through the Internet at any time.

**Mastering information literacy skills**
As is expected, many students reported gains in information literacy skills through the learning process. This includes using Internet search for locating relevant information, editing reports with WORD and preparing presentations using PowerPoint. Some students even learnt how to apply for a URL and to design a Web Page for presenting their projects. The following are some abstracts from the student interviews:

‘At the beginning all the members in our group did not know how to put things on the internet and the WebPages design. We learnt these skills in this project.’

‘We went to the public library and found some books on web page design we do learnt a lot from this.’

‘We also learnt the presentation skills which I think is crucial for my adult life.’

**Developing critical thinking abilities**
Besides the mastery of new skills, students also reported having sharpened their ability to critically evaluate information and arguments through being confronted by different viewpoints expressed on the forums.

‘…participating in the forum help me to see things more in-depth and clearly. In the past when I was confronted with different points of view, I will be in a chaotic situation. But now I will think more in-depth before I post the questions and be more rational in considering other points of view.’

Student interview_224 (Student A)

‘…yes, we need to think before posing the message. As this forum is not a synchronized discussion, it is better for us to sharpen our arguments beforehand. For example, you need to think what kinds of counterarguments people will point out and how you would respond to it. This is a kind of critical and logical thinking…to a great extent, participating in the discussion forum does help me in developing my logical and critical thinking.’

Student interview_230(Student B)
Empowered to learn about the new and unknown
However, even more impressive, and closely related to the learning of specific skills and abilities were the students’ gains along the socio-emotional and socio-cognitive dimensions. Learning how to learn is not just a matter of cognitive ability, but also the self-confidence to face the challenge of knowing about something new, and the belief in learning as an incremental process (Seltzer, 2001). It is this kind of learning that is being reported by the students:

‘At the beginning I did not think the topic which we are going to investigate was related to Physics. But now I know more about the Butterfly effect.’

Student interview1_10

‘Compared with other projects that we had done before, we would have some background on the topic. However, the topic in this project was a brand new one; we have not learnt this topic before so we learnt much more in doing this project.’

Student interview2_86

Empowered to learn from various others
Another important socio-emotional intelligence involved in effective functioning in a knowledge society is to appreciate and seek knowledge from various others, including subordinates, and not feel threatened. Here, in this practice, the teachers exhibited this kind of learning, which was also echoed by the students.

‘Sometimes they will suggest which books are good in certain topics. Some students who went to the USA to continue their studies will share their experiences and pointed out the pedagogical differences between the two places.’

Teacher interview_66

‘There was a student asking something in the medical field which I’m not familiar with. However, one of our alumni who is now a doctor gave an answer to this student.’

Teacher interview_24

‘It has definitely had a positive impact on us. It is not easy to find a teacher to help you to solve problems immediately and you can only consult one person at a time. But through the forum, very often you can receive advice from different experts and teachers who can respond to your questions when they are free. It only takes about half an hour or a couple of hours for you to get the response. I think it is really good.’

Student interview_107(student B)

Empowered to contribute as a member of a learning community
Members of a learning community need to be not only confident about learning from others, but should also be confident and ready to contribute their views and ideas to the
community. Both the teachers’ observations and the students’ reflections revealed that this was indeed among the learning gains experienced by the students.

‘…you can observe that students are more attentive in this class and they will ask questions when their classmate present their work’

Teacher interview

‘Sometimes when I know there is something wrong in some of the posted messages, I will pointed it out and let them know which is the right direction. …It is because we are studying in the same school. We are in the same big family.’

Student interview_124(Student B)

‘Sometime you get lots of responses. It [the discussion forum] creates a brotherhood culture that encourages us to help each other.’

Student interview_126 (Student B)

In fact, as a contributing member of a learning community, students are not just presenting their own view, but also become intellectually engaged and cognitively challenged in relation to the issues being discussed, a sign of learning taking place:

‘When you see people discussing things and posing ideas on the forum, sometimes it seems that there is something wrong with their arguments. But actually I do not know what’s wrong with it and I do want to find out. Therefore, it motivates me to read books on that topic.’

Student interview_246 (Student C)

**Empowered to appreciate different viewpoints**

Various parties in the school, from students to the school supervisor (the title used in Hong Kong for the chairman of the school board), also reported witnessing a change in students’ attitudes towards different opinions.

‘It is interesting to see different opinions in the forum. You can see just the opposite opinions on the web. You can compare and think about it. It is fun.’

Student interview_82(student B)

‘There are different points of view in the forum. It provides an environment for nourishing the democratic spirit and the attitude to respect one another even though they have the opposite opinions.’

Supervisor interview_4

The learning exhibited above involves a level of understanding of knowledge as socially constructed, as an artifact dissociated from the person generating those views. This level of understanding of level is a sophisticated one, and one which needs to be fostered for effective participation in a knowledge society (Bereiter, 1999).
Empowered through participating in the creation of a learning community

Responses from the students also reveal the kind of awareness and appreciation developed through experiencing the growth and establishment of a learning community as they participate in the knowledge forum. There is a strong sense of community exuberating from their descriptions of what the forum means for them.

‘If there is no discussion forum, it is more difficult for students at different levels to communicate. With the use of forum, messages and news will be delivered in a more effective way. It is just like reading the newspaper and knowing what is happening in the world. You just browse the forum and you know what is happening within the school.’

Student interview_184 (Student A)

This sense of community is exhibited not only during instances when the forum was used for exchanges of views in support of learning, or as a platform for social exchanges. The opportunity for as well as challenge to the maturity of a learning community and the socio-cognitive growth of its members arise when the integrity of the community is threatened by the irresponsible acts of some of its members. Not long after the establishment of the forum, some disturbing messages appeared on the forum: some students posted irresponsible messages and accusations, including attacks on the school principal; some students posted some erotic web sites on the forum. There erupted a lot of debates on how this should be handled. Should the forum be closed? Should students who posted those messages be banned from the forum?

With a school culture that is strongly value mutual respect and trust, the school decided the incident should not lead to the closure of the discussion forum, but rather as an opportunity for educating the whole school on responsible behavior in a cyber community. Teachers and students started posting messages on the forum to express why they found those irresponsible behaviors unacceptable. Even non-science teachers who were not involved in participating in the forum participated in the debate on how the matter should be dealt with.

‘It is better for us to find out why students were doing such things. Closing the forum would not help. You need to teach them what the result would be if they talk irresponsibly.’

(Non-practice) Teacher interview_50

As one of the students reported, a more mature school culture, which embraces the school community in cyber space, emerged through the discussion and debate process, moving the school a step further as a learning community in the information age:

‘If there are new comers who talk irresponsibly and maliciously, teachers, the principal and upper form students will tell those students that they are abusing the discussion forum and it is very impolite. Eventually, a web culture is established and students know what they should and should not do in the forum.’

Student interview_177 (Student A)
Later, the school gave the students the responsibility of moderating the forum. The right to delete inappropriate messages rested with the student moderators. The rationale given by the school was that the goals of establishing the forum was mainly to enhance communication for the student community, it would be better for the students to take up this duty rather than the teachers.

**Learning conversations and 21st century learning outcomes**

In reviewing our findings in terms of the prominent learning outcomes and the pedagogical characteristics of the innovative classroom practices using technology that appear to be related to the development of lifelong learning abilities of students for participation in a learning community, we come to the conclusion that it is important to not just gauge the task characteristics and the cognitive learning outcomes of these practices. More importantly, attempts should be made to gauge the perception of the key features of the characteristics, in particular whether the teacher has a focus on supporting the reflective approach to the learning tasks and to develop an empowering learning culture. For the evaluation of learning outcome, there are strong arguments for assessing the affective and attitudinal dimensions of learning as a socio-cognitive activity. These are probably more critical to the longer-term ability of the learner to cope with the demands of lifelong learning in a knowledge society.

**Reference:**


