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E-Pedagogies in the Making: Case Studies from the National Institute of Education

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Abstract

The purpose of this paper is to describe the more recent conceptions of learning in the light of more traditional conceptions which we are familiar with. These recent conceptions differ from traditional conceptions of individualistic thinking to a more collaborative and social nature towards learning. From these recent notions of learning and cognition, we discuss how the National Institute of Education is currently formulating e-pedagogies along the vein of these conceptions.

Introduction

Traditional conceptions of learning are underpinned usually by the individual learner and the teacher whose aim is to impart or dispense knowledge into the student's head, connoting a seemingly passive learner. Such a mechanistic perspective of learning is predominated by the view that knowledge is abstracted out of its context, that is generalized, and disseminated to the learner, albeit passively. The student's duty is to seemingly memorize the facts and knowledge presented to him or her, discharge it at the examinations, and hopefully remember it after the examinations (which is usually not the case!).

Although not with ill-intentions, students develop their own explanations of learning and of subject domains, albeit not according to conceptions held by practitioners within communities of practitioners. Issues of promoting life-long learning are also inhibited due to negative experiences such as described above.

The purpose of this paper is to describe the more recent conceptions of learning in the light of more traditional conceptions. These recent conceptions are inclined towards a more collaborative and social nature towards learning. From these recent notions of learning and cognition, we discuss how the National Institute of Education is currently formulating e-pedagogies along the vein of these conceptions.

Recent Conceptions of Learning

More recent conceptions of learning deviate from the seemingly passive connotations of learning to the active learner. These recent conceptions emphasize the demand-drivenness of learning – that is, learning is goals driven. Students need to know why they have to learn what they learn, and what should be learned should be ideally needs-driven. This point can be illustrated in this case example taken from Palmer (1998). The problem arose in a medical school where trainee doctors did not seem to possess the disposition of practitioners (doctors in the field). These graduates did not seem to show care for patients! The dean of the medical school suggested that the problem arose because for the first 2 years, the students sit in an auditorium while a professor up on the stage, pointer in hand, goes through the bones of a skeleton hanging on a rack. The students' task was to memorize all that information, feed it back on tests, and use it in laboratory settings. Then, in the beginning of the third year, they meet their first live patient – and we wonder why they treat that patient like "a skeleton hanging from a rack." Thus the dean suggested a new approach. The students are to gather in small groups sitting around a live patient from day one. A mentor was always present to ensure that the patient was not harmed by a group of trainees.

A second conception of more recent notions of learning relates to the need for learning within subject domains to reflect the "ways of thinking" within that particular domain. For example, those trained to be doctors must reflect the kinds of thinking that practitioners in the field possess. Bruner (1996) claims that education is about transmitting beliefs and practices of culture. He points out that education should provide the balance between teaching specific beliefs and providing learners the "culture's toolkit" through enculturation – entering and picking up the values of a community or culture by practicing the "trade of the community." The toolkit includes a variety of tools a given culture uses to make sense of the world, such as culturally developed representational systems, technologies, and ways of thought.

A third and related conception of more recent notions of learning is that cognition is socially distributed. By socially distributed, we mean that cognition is embedded not just in others but in tools and artefacts. For example, in an aeroplane cockpit, the cognition required to drive the plane lies not just in the pilots but also in the complex controls of the cockpit. Not only is cognition distributed between pilot and cockpit, it is also distributed in artefacts, books, and other persons. Such a view is congruent to social cultural studies of the mind (Wertsch, 1985).

Thus, active learning (in contrast with passive learning) is made in the context of developing dispositions or ways of seeing based on real and authentic goals and demands. It requires an active construction of knowledge in order to develop the relevant dispositions of the trade and such dispositions are developed through an enculturation process with the real practice and with practitioners within the culture. Students must see the goals at hand – why they are engaged in what they are

doing – and develop explanations to phenomena (the why's). According to Schank (1999), students make explanations when they encounter results of their experimentations turning out against their expectations of what is to take place. Schank calls these expectation failures. Learners engage in the essence of learning when they make explanations for expectation failures. Thus, students need to learn to develop expectations, plan to execute these expectations through socially constructed experimentations, and develop explanations (according to current practices in domains of knowledge) for expectation failures.

In summary, we reiterate that learning should be goals-driven, an active construction towards developing ways of seeing, and that cognition can be distributed in tools and in others. In this increasingly complex society, we can no longer consider learning to be merely an individualistic activity but a collaborative one. To illustrate how these recent conceptions of learning can be translated into practice, we describe two instructional design frameworks or approaches: Anchored Instruction and Constructivist Learning Environment.

Anchored Instruction

Anchored Instruction situates classroom learning in real-life problem-solving scenarios in order to engage students in problem solving. By anchoring learning in real-life contexts, we are encouraging students to apply the knowledge they learn in classrooms to solve real-world problems, thus linking the "school knowledge" with everyday applications. An example of anchored instruction is the series of video-based programmes called *The Adventures of Jasper Woodbury Mathematical Problem Solving Series* developed by the Cognition and Technology Group at Vanderbilt (http://peabody.vanderbilt.edu/ctrs/lsi/team.htm).

Unlike traditional instructional videos that record "talking heads" to emulate lectures, each Jasper video contains a short realistic story that represents sufficiently complex problems. Since learning is demand-driven, the detective-like adventures help to motivate the students to engage in problem-solving tasks. Using the "embedded data design" principle, the videos contain all the data necessary to solve the adventure with purposeful inclusion of irrelevant data to simulate the complexity of real-life problems. Jasper adventures also contain "embedded teaching" episodes that model expert's approaches to solving problems. Leveraging on digital video technology, the video can be viewed and revisited as the learners solve the problems. While traditional mathematics teaching focuses on teaching of heuristics and problem solving steps, followed by "practice questions" that have a single correct answer and one best method of getting the solution, the Jasper videos challenge the students to identify the problems, generate sub-goals, source for relevant information, cooperate with peers in planning and problem solving, compare perspectives, present possible solutions, select the best solution and justify the final solution. By taking up the challenge, the students apply their mathematics knowledge and concepts, critical thinking, and communication skills.

Since Anchored Instruction stresses contextualized problem solving, our students may not relate to the stories presented in the Jasper videos. A good local example can be found on the website of Canberra Primary School (http://schools.moe.edu.sg/canps/, May 2002). In this example, a group of Primary 5 pupils is assigned the task of organizing a cycling trip at East Coast Park. The pupils have to work out a budget proposal for the class outing, including the cost for transportation and food. The story centred around a form teacher who engages her class in planning for an outing. A committee was formed to look for quotations on transportation. To enhance the authenticity, the video crew engaged real school staff, including the teachers and principals, as actors and actresses to present the story scenario.

Jonassen's Constructivist Learning Environment (CLE)

David Jonassen proposes a model of CLE that aims to engage learners in active and meaningful learning. The kernel of the constructivist learning environment is the issue, problem, or project that serves as the focus of the learning episode. Jonassen believes in using interesting and authentic problems to motivate the learners towards the learning goal. He proposes using ill-structured problems arising out of real-life contexts, which usually contain some emergent aspects that are definable by the learners. One major difference between expert and novice problem solvers lies in their experience in domain-specific problem solving. Experts possess knowledge and past experiences that are often encoded as stories; when met with a new situation or problem, they can readily search their memories for related cases. Jonassen proposes using related cases to supplant student experience and to provide multiple representations of content that reflect the complexity of the domain knowledge. One of the common criticisms of constructivist learning is the lack of "content learning". Jonassen, however, argues that information makes most sense in the context of its application, thus information banks and repositories should be provided in a just-in-time and learner-selectable way. In a CLE, relevant and appropriate information, including web-based materials, could be made accessible as embedded hyperlinks at the appropriate juncture.

To help engage the learners in higher order thinking, Jonassen suggests the use of cognitive tools, including visualization tools, knowledge modelling tools, performance support tools, and information gathering tools. These tools help to facilitate cognitive processes and support learners in performing problem solving tasks. Premised on the notion of social constructivism, which emphasizes learning through collaborative construction of socially shared knowledge, Jonassen suggests using computer-mediated communication tools to support dialogue and collaboration within communities of learners, who share similar knowledge and values and are pursuing similar learning goals. Collaborative tools include simple discussion forum and scaffolded environments such as Knowledge Forum. Besides devoting our effort to the design of a CLE, Jonassen argues that a crucial factor

for successful implementation of the learning activities is the social and contextual support. Without social and contextual support, which includes the physical infrastructure readiness and training to instructors and learners, the learning activities may be rendered ineffective.

In addition to the above components, Jonassen suggests three supporting strategies – modelling, coaching, and scaffolding. Modelling involves the demonstration of overt performance as well as cognitive modelling of covert intellectual processes. Coaching, on the other hand, focuses on the learner's performance. It involves motivating learners, analysing their performances for feedback and advice and provoking reflection. Scaffolding refers to the systemic approach to support the learners, which includes providing frameworks to support performance and adjusting task difficulty. Examples of CLE can be found at Jonassen's home page http://www.coe.missouri.edu/ jonassen/courses/CLE/index.html (May 2002).

In the sections below, we illustrate case examples of "e-pedagogies in the making" in the context of applications developed by the National Institute of Education.

Online Learning at the National Institute of Education (NIE)

The National Institute of Education (NIE) is the sole teacher-training institute in Singapore. As a philosophy of the institute, IT integration through e-learning is not perceived as a stand-alone initiative but rather as an integral part of the curriculum, instruction, and assessment process. We note at this point that we are not casting e-learning in terms of mere information delivery, but rather as a mechanism for constructivist-oriented problem-centred activities which our trainee-teachers can be engaged in.

In particular, IT is an integral part of the NIE's philosophy of active, problem-focused teaching and learning processes where content is applied to authentic practices – thus, the need for integrated content areas. An emphasis is also targeted towards an assessment where the processes of thinking and communication are emphasized. Problem-based learning (PBL) is one pedagogical approach that adopts problems and real-life cases as a starting point in instruction at NIE. Thus, pedagogy is a focus, rather than technology *per se*. In this regard, the design of problems and their scenarios are as important as the technologies (e.g. video-based Jasper series) that represent the problems.

A gradual redesign of the curriculum is being looked into in order to more effectively employ IT tools and online learning environments in PBL contexts throughout the modules in NIE. PBL starts primarily with a focus on problems, that is, real-life problems and activities, rather than intense disciplinary knowledge (Boud, 1995; Savery & Duffy, 1995). The approach attempts to move learners towards the acquisition of knowledge and skills through a staged sequence (serving as a scaffolding process) of problems presented in context, together with associated learning materials and support from necessary sources (e.g. teachers and experts).

Current forms of technology, for example, web-based tools, have been adopted in relation to curriculum and pedagogy integration. The following are ways in which IT tools are used in NIE:

IT as an information resource, for example, web resources. As an information resource, IT can be used as a tool to access relevant information and resources when engaged in project work and other forms of problem-oriented activities. However, students need to develop information literacy skills and the skill of validating the kinds of information found from the WWW. Information resources should be provided in a just-in-time and learner-selectable way. An example of such a mechanism is when our trainee-teachers make use of video footages (posted on CD-ROMs or on the Web) of real-life classroom misbehaviour and engage in an online discussion over these issues (see Fig. 1).

Within this module, trainee teachers access relevant information resources, watch realistic videos (similar to the Jasper series) of what is happening in classrooms, and engage in discussions with supervisors and peers when they are attached to the schools. In this regard, these videos are also used as a *problem-representation tool.*

IT as a communicative tool, for example, discussion forums and other collaborative tools such as *Knowledge Forum* (see Scardamalia & Bereiter, 1994). As a communication tool, students are able to engage in a constructive dialogue with other peers and with experts on issues of particular concern. Scardamalia and Bereiter (1994) conceive such a discourse as knowledge building. Technology has been used to facilitate the process of tele-mentoring between real practitioners and the trainee teachers. Multi-point desktop video conferencing (MDVC, see Fig. 2) is one such system that allows the various parties from the institute to communicate

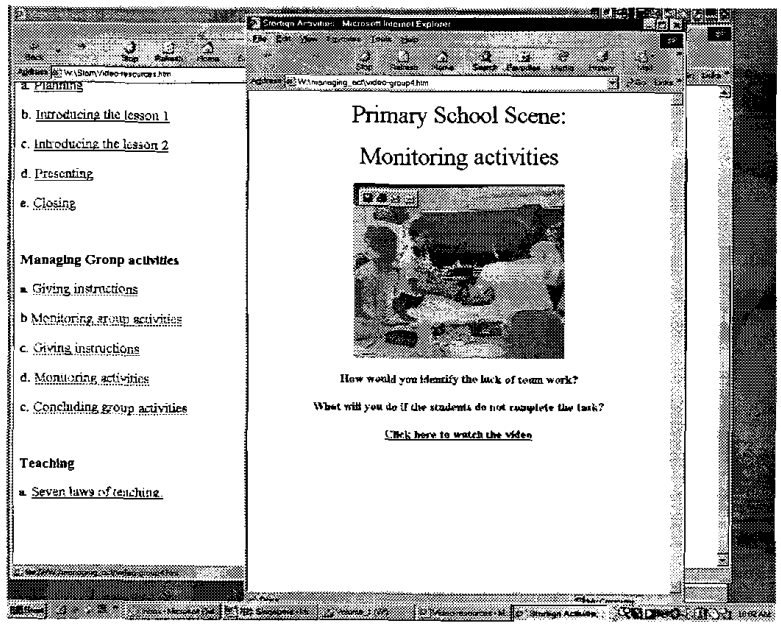

Fig. 1. Classroom management module with online component.

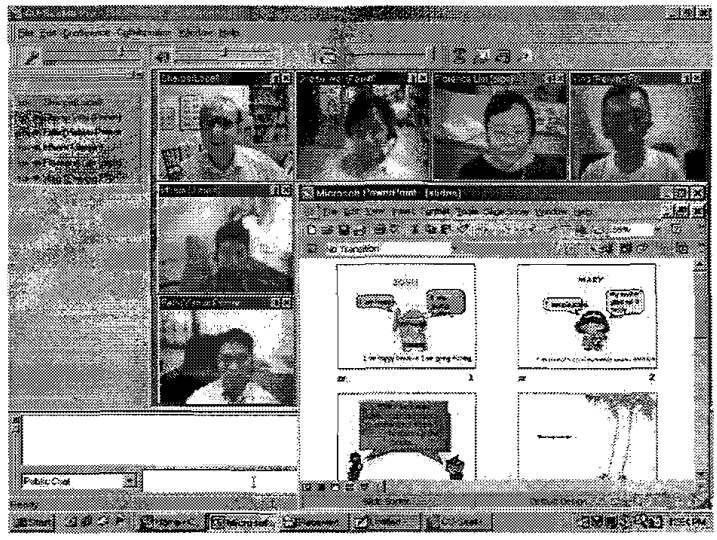

Fig. 2. Multi-point desktop video conferencing (courtesy of the MDVC project).

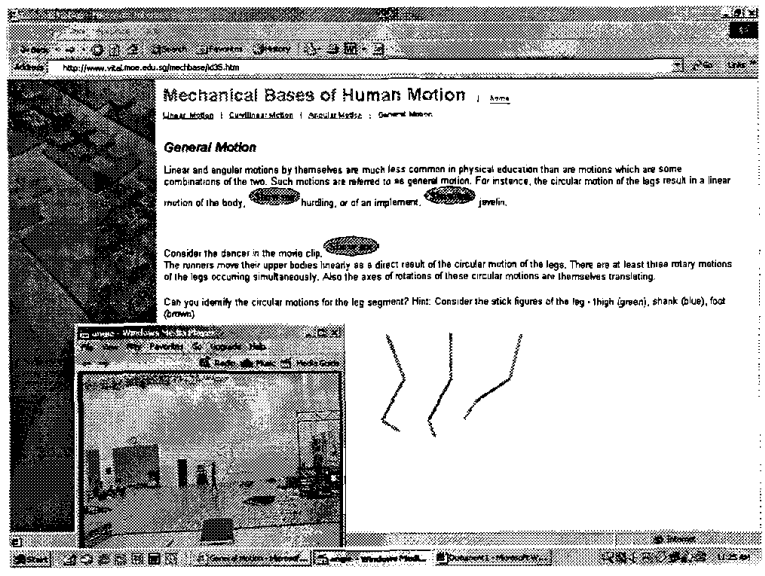

Fig. 3. Visualization of concepts (courtesy of the Vital biomechanics module).

with one another and also with in-service teachers in the schools. Due to the logistical convenience, such an environment affords, dialogue between various parties (both within and outside of the institute) has been improved.

IT as a visualization tool, for example, the use of simulations such as Java applets. Through simulating principles and concepts through animation, IT tools of such nature can foster understanding of difficult to visualize concepts. See Fig. 3 for an example of a physical sports module on the concept of biomechanics. Other examples include visualizing chemical or molecular structures and simulations that can be controlled via the manipulation of variables in order to observe certain phenomena.

IT as a data management tool, for example, MCQ or Survey questions on *Black-Board* (web-based management system) and all results are automatically tallied.

Data management tools are taught to trainee teachers for various tasks, including item banking, item analysis, item calibration, test construction, test administration, test scoring and test reporting, and their applications for school-based testing.

IT as a cognitive tool. IT tools, for example concept-mapping tools, which facilitate higher order thinking are adopted in some of the modules in NIE. Thinking templates, for example, compare and contrast structures and other epistemic forms have been practiced among the trainee teachers.

IT as a constructive tool. As an example, trainee teachers were required to design a web-based project task using the PBL framework. To make learning experiences more authentic, experienced teachers from the schools are also invited to share their successful experiences, for example, on the *WebQuest* project (see San Diego State University, 1998) approaches from their K-12 schools. Trainee teachers are also required to construct their understanding of pedagogical principles in relation to a topic in any content area. They also create an IT-based task that would span a curriculum time frame of 2–3 weeks for a target group of K-12 students. During class presentations, trainee teachers defend the effectiveness of their IT-based products (e.g. WebQuest projects) as a pedagogical tool in meeting learners' needs in classrooms and catering to individual differences. Self and peer evaluation are also required. There is the dual focus on *processes* (with an emphasis on thinking and reflection at levels of analysis, synthesis, and evaluation) as well as on *products* of learning.

In the near future, the concepts of Jonassen's constructivist learning environments would be incorporated into the PBL framework. The current formulations of text-based PBL scenarios can be translated into constructivist-type learning environments. Figure 4 represents our conceptualizations.

Discussion: E-Pedagogies in the Making

The IT tools framework as described in the above section (by no means exhaustive) can be framed within the PBL and CLE context. Within the notions of demand-driven and goals directed learning, *problems* are a concrete means through which demands and goals can be created and engineered. IT serves as tools that mediate between learners and the problems which they have to solve (see Fig. 5).

Not only can tools mediate the process of demand-driven learning, IT tools also share in the cognitive distribution between people and technology (refer to our earlier principles of learning). Based on the above IT tools framework, Jonassen's CLEs, PBL and the elements of anchored instruction, the following are design guidelines for learning (see Table 1).

In order to make learning even more authentic or real-life, problem situations should be the actual kinds of problems that take place in the community of practices. For example, if we are conducting a classroom management module (in NIE), then the problem scenarios ought to be the real kinds of problems that occur in the classrooms. To further enhance the authenticity of the learning experiences, we should

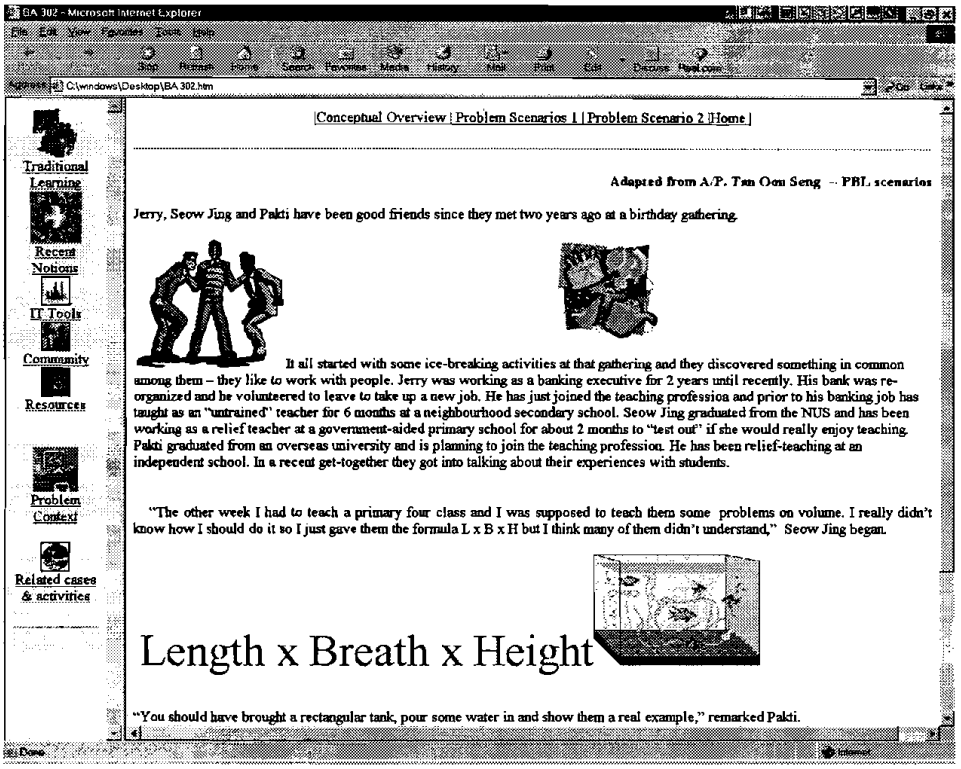

Fig. 4. Constructivist Learning Environments and PBL scenarios.

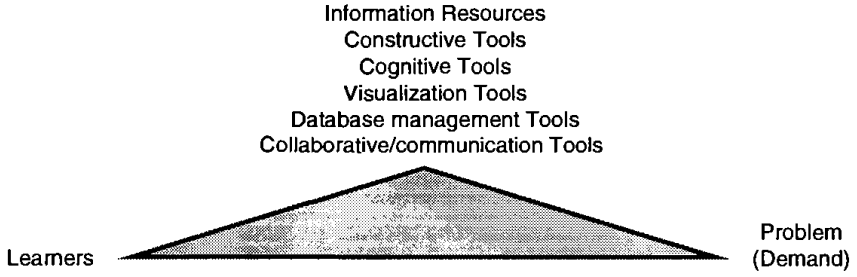

Fig. 5. IT tools mediate between learner and problem.

also use communicative tools to include in-service teachers in the pre-service teachers' learning processes (see Fig. 2). Tighter integrations can be accorded to the learning loops or cycles between NIE lecturers, in-service teachers, and pre-service teacher trainees. Technologies can enrich such a process. Only by enriched interactions between learners and the community of practitioners would one be able to be enculturated and acquire or appropriate dispositions (way of seeing), for example, as teacher professionals (refer to our earlier conceptualizations of learning). These steps are currently underway in modules such as "classroom management" where attempts are made to integrate assessments with practicum requirements.

Learning is in essence fundamentally *in situ* or dynamic and connected with and constitutive of the environmental particulars, including other people, through which it is actualized (Barab, Hay & Yamagata-Lynch, 2001). *In other words, learning lies in the dynamic relations and interactions between learners and practitioners, and not so much in the problem, task, or environment.* In addition, Barab argues that authenticity

Table 1.
Design considerations for learning.

	Design considerations
Goal setting	There is a need to provide a problem or cover story to set a meaningful setting for learning; goals must be related to real-life cases
Motivation	The problem(s) must be interesting to the learner (extrinsic motivation); learners should have a function in influencing the problem to be solved (intrinsic motivation)
Context	The cases should be situated in a real-life situation or community setting
Roles of the learner	The roles must enable the learners to achieve the broad instructional objectives or goals in the curriculum
Facilitating tools	There is a need to provide mediating tools such as cognitive or mind tools and social constructivist/collaborative tools
Resources	There is a need to provide information resources which can include other forms of problems or cases
Learning activity	There should be plenty of opportunity for learners to operate within such a learning environment
Feedback	Students should receive appropriate feedback either from the human teacher or the simulated learning environment via coaching or situated responses

lies in the "learner-perceived relations between the practices they carry out and the use value of these practices" (Barab, Squire & Dueber, 2000, p. 38). In addition, it is necessary to "deny the legitimacy of preauthentication and, instead, conceive authenticity as an emergent process that occurs as individuals engage in practices of value to themselves and to a community of practice." (Barab, Squire & Dueber, 2000, p. 38). Translated into design environments, Barab has thus far advocated environments that facilitate *interactions* between learners and real communities of practice. Barab and his colleagues argue that authenticity (for instance, task or problem authenticity) is a co-emergent phenomenon and thus should not be pre-authentified. For example, what may be an authentic task to teachers or instructional designers may not necessarily be authentic to the learner or vice versa. On the other hand, what the learners or teachers decide as authentic may not be authentic in terms of real practitioners at the respective communities. We expand on the notions of the co-evolving emergence of authenticity (Barab, Squire & Dueber, 2000) by appropriating Barab's notions that practitioners be involved throughout the learning process – beyond problem authenticity. From the above conceptions, we adopt the following tenets (in addition to Table 1):

- *There is a need to facilitate and co-formulate problems (or goals) between learners, teachers, and experts from the community of practices; and*
- *There is a need to engage practitioners and teachers throughout the learning process in order to address the dynamic processes of authenticity beyond the problem-formulation phase.*

A "classroom of the future" was also designed and implemented at the NIE for the experimentations of the above described concepts. To further our example of the kinds of teaching practicum (teaching practice in the schools for pre-service teachers) efforts, we illustrate how our students are engaged in real-world practitioners' concerns while at the Institute. One of the greatest concerns for teachers is classroom management. While we can teach the principles of classroom management at the Institute, the essence lies in the skills and ability of experienced teachers to manage real classrooms. Trainee teachers are given the opportunities to manage real-world classrooms when they are attached to schools for their teaching practice for periods of approximately 8–10 weeks for two such occasions. But before they stand in the presence of real students, the module provides problems and scenarios (video-based) where these trainee teachers experience the classroom management problems, see Fig. 6.

The course is conducted in a PBL fashion within a learning environment. A series of video footages (likened to the Jasper Series) are presented to trainee teachers with an increasing degree (complexity and diversity) of classroom misbehaviour in the schools (see Cognitive Apprenticeship Methods: Collins, Brown & Newman, 1989). The facilitator (instructor) attempts to get the trainee teachers to discuss beyond the surface reasons for disturbing behaviour in the classroom and attempts to get the trainee teachers to source for solutions to these problems. In this constructivist fashion, the facilitator also leads trainee teachers to source for materials – including online resources.

The learning 'classroom' context or environment is a technology-enhanced room focusing on learning rather than technology. The computers are arranged along the sides of the room, each shared by a group of four to five students. With movable chairs and tables, it affords a collaborative environment where the learners can hold discussions around the computer as a supporting tool, or move to the

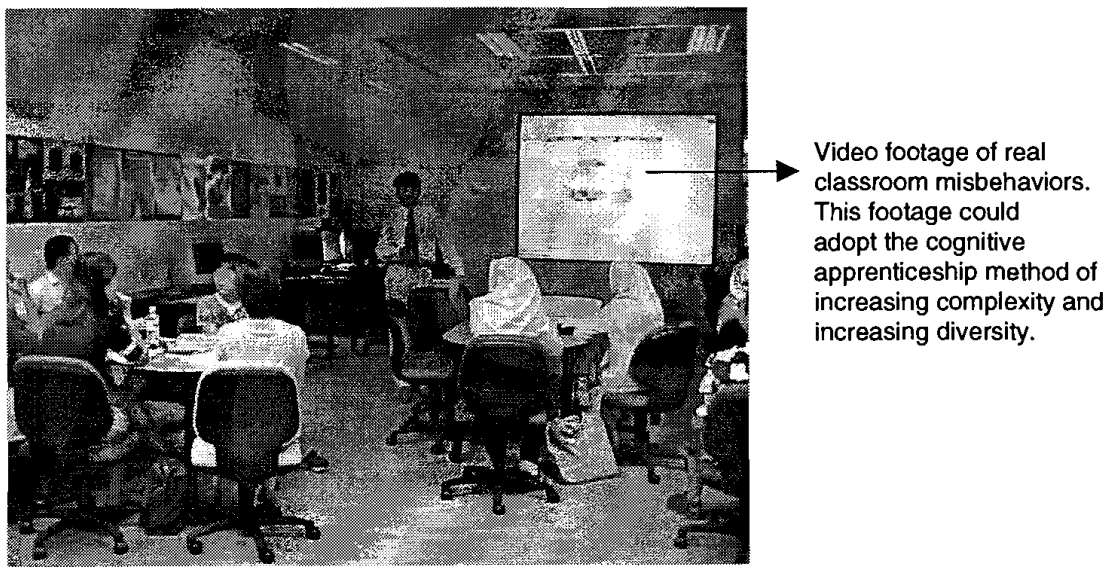

Fig. 6. Trainee teachers discuss in groups video-based classroom footage.

centre of the room for tasks that do not rely on the use of computers. Within this context, trainee teachers discuss in smaller groups strategies to cope with problems presented in the classroom video footage. In the process of their own discoveries and development of understanding, the trainee teachers use video-conferencing to connect to real practitioners who can tele-mentor them on their learning concerns. These tele-mentors could be the actual mentors of the trainee teachers when they are attached to the schools for their teaching practice (see Fig. 6).

The use of thin client technology allows learners to log in to applications with a smart card so that they can prepare materials and access information. The learner's activity is stored on a server, which is accessible with the use of a network smart card anywhere in the campus with a thin client terminal. That means the learner can continue his work at other terminals on the network system with the same card. Physical barriers do not exist for the learners as far as the room is concerned. Because the trainee teachers cannot be confined to the physical location of their tutorial or classroom, wireless access is provided for them throughout the campus and they can communicate with their colleagues whenever the need arises.

Conclusion

The e-pedagogies in the making at NIE are reflections of the kinds of initiatives and formulations in the learning sciences. Although preliminary findings (predominantly quantitative) show that students are adopting the above e-pedagogies in the modules within NIE, more qualitative research is needed to ascertain the kinds of learning outcomes desired through e-technologies. Our future research attempts will try to determine if learning has qualitatively improved through our formulations of e-pedagogies. The framework for e-pedagogies as described was based on our observations thus far.

Universities all over the world are revamping their curriculum gradually to cater for more active, problem-centred, and constructivist forms of learning. Online and e-learning initiatives are following in similar directions making headway into such pedagogies. Today's technologies can open up the horizons of students and learners beyond the constraints of the classroom, and as educators we need to facilitate the learning and exploratory opportunities such technologies afford.

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