

A Technical Report on a Teaching Development Project

Title: Developing a Framework of Procedural Knowledge Development for Classroom Teaching and Proposing its Application to Teacher Education

(1 Aug 2011 to 31 May 2012)

Project Team: LAM Bick Har; CHAN Kam Wing; CHENG Chi Keung, Eric; LIM Cher Ping; ZHANG Yufeng; HUE Ming Tak

Summary

This project is a pilot study on procedural knowledge of teaching. It attempts to find out procedural knowledge of teaching of exemplary teachers and to make recommendations on how this type of knowledge can be enhanced in teacher education to aid in professional training of teachers. In constructing the methodology for this study, the researchers performed a review of literature in the field of education with focus on teacher thinking and action, and drew insights from existing cognitive psychological studies. A qualitative approach was adopted for this study. Data were collected through classroom observation, stimulated recall interviews, artifacts, guided self-reflection survey, and field notes. This study focuses on the key inquiry on “action” in practice and seeks to explore from separate/specific actions into a fuller picture of how teachers conduct teaching. The actions by sample teachers are used as a guide in the conduct of this study.

The sample included four expert secondary school teachers, namely, a Chinese Language teacher, an English Language teacher, a Math teacher, and a Liberal Studies teacher. There were 13 lessons observed, with 6 double-period lessons and 7 single-lessons sessions. Thirteen post interviews were conducted: four with the Math teacher and three each for the other three teachers. The data analysis was based on the grounded theory. Content analysis of all the data was performed.

The findings aided in the understanding of procedural knowledge of teaching. The findings answer the research question on how exemplary teachers conduct teaching based on the following key aspects:

- Having a lesson profile is common among the teachers and is a protocol. It covers the following: start-up of class, settlement of students in an atmosphere of learning a subject, learning of content of a subject, student exploration, checking of learning effectiveness, provision of homework, and follow-up of assignment. These activities can be treated to be part of an organized framework that determines teaching plan and action of a student teacher that help improve his or her skills.

- This study finds that most of the time, teaching actions are carried out spontaneously and without much planning. This intuitive action is an important lesson for student teachers. By modeling the tactful decision and the consideration of exemplary teachers in carrying out their actions, this study captures many of these scenarios for further study and, therefore, greatly helps in the development of localized teaching materials.
- Perceptual awareness of teachers is found to be highly intensive, condensed, and complex in the learning and teaching situations. The ingredients in this operation include the concerns (implicit or explicit) on learners and the instructional and the contextual aspects, such as the curriculum and the school requirement
- A tentative framework is developed to describe procedural knowledge. Teachers are found to have general concerns about teaching. In exercising a lesson, they have specific goals, and they pursue them by observation of multiple procedures, strategies and skills, general skills, language, and established classroom routines. These elements are stable and unstable. In action, teachers are conscious or unconscious about which aspect of knowledge they are exercising. The philosophy of teaching is found embedded and to have influence on how teachers think and act. However, their perceptual awareness determines actions.

This study has tentatively raised the idea that exemplary teachers perform teaching with knowledge, cognitive skills, and other general teaching abilities. The procedural knowledge (knowledge-how) of exemplary teachers gathers attention to the classroom environment. It presents a clear goal about what to be achieved in a classroom. Exemplary teachers tend to improvise and explore creative solutions for classroom problems; they show strategic planning and skilled management of classroom situations.

A selection of video clips, which forms part of the pilot study on teacher exposition, classroom management, handling group work, feedback to students, and making conclusions, shows the procedural knowledge of the sample. Some interesting case materials also were identified to be used for teaching. Taking into account emerging issues in teaching and rich observational data gathered from the study's setting, which is a real school, this study suggests that procedural knowledge in the teacher education program be strengthened by creating more opportunities to discuss real problems in teaching. This study also has strong potential to offer suggestions on how to change learning, teaching, and assessment, all of which have been the important direction of teaching in the 21st century.

An extended proposal is submitted based on this pilot study. The researchers hope to

seek further funding as they recognize the potentials of the project for improving learning and teaching in the institute not only in terms of teacher training but of valuable non-education programs, such as the following:

- a. Further comparison of exemplary teachers with ordinary teachers, which will strengthen this small-scale pilot study, and which will substantiate it with more examples and consolidate it with reference to sound academic basis. The present ground work enables the strengthening of teaching and provides solid implications that benefit students in their future career and development.
- b. Aiding in further development of a valuable pool of teaching materials for supporting the educational courses (Professional Studies). The pilot-tested materials may serve as a significant support to the colleagues of the researchers. The scope of the study is adaptable to all PS courses, subject courses, and non-education courses
- c. Coming up with a tangible output of the project that is publishable and that can benefit the whole population of teachers of HKIEd. It serves the community with good returns.

In the extended study, the research instruments will be refined and redesigned. A reflective journal for the sample will be included to gather more in-depth data on procedural knowledge. The target sample of primary school teachers will be expanded, and a comparative perspective will be included in the study.

Justifications of Studying Procedural Knowledge in Teaching

The knowledge of teachers has been a focus of interest in teacher education as it has implications to how teacher preparation can be planned to produce high-quality teachers. Traditional teacher training used to adopt a curriculum model that consists of academic training and field practice. Academic training used to deliver taught courses, in which prospective teachers learn professional knowledge derived from traditional disciplines, such as psychology, philosophy, curriculum studies, sociology, and educational management (the knowledge in PS courses). They also study subject knowledge on one or two disciplines that they are going to take up as major teaching areas (subject knowledge on academic subjects). In practice, students aim to obtain real-life school experience and learn to teach through learning, supported by school mentors and teacher educators as supervisors.

“Linking theory to practice” has always been the principle that governs teacher educators in their approach to teaching student-teachers on how to become a qualified

school teacher. It is assumed that student-teachers can “apply the knowledge they have learned” from the taught courses to their teaching practice. Teacher educators may use a lot of examples to illustrate real teaching scenes in taught courses, such as in teaching videos and artifacts. Moreover, teacher educators visit students in teaching supervision, and assess, comment on, and encourage student-teachers to reflect on their own practice. However, students are often puzzled about what they should do in real situations, and many of them tend to despise theories and ask for quick-fix guides and how-to-do solutions when supervisors meet them in the field. Teacher educators, such as the researchers, might lack clear and grounded approach and so they continue to seek ways to improve the teacher education program. Their hope is for students to be led to the process of “theory to practice.” Learning in teaching practicum, which is supposed to be an important component of the teacher preparation program, seems quite fluid if no clear connection may be drawn from the taught courses to supervision in practice and to what the important issues are when students learn in Field Experience. Therefore, another kind of knowledge, the so-called “procedural knowledge,” is thought to be an important element that can strengthen the program.

There are also different conceptualizations of studying teachers and the knowledge of teachers over the last few decades. Early studies postulated teacher knowledge as a kind of professional knowledge that encompasses both knowledge of general pedagogical principles and skills, and knowledge of the subject matter to be taught (Ben-Peretz, 2010; Grossman & Richert, 1988, 1988). Shulman (1986) considers teacher knowledge as a specialized knowledge that can be understood as the “subject matter for teaching.” He introduces “pedagogical content knowledge,” which refers to the most regularly taught topics in one’s subject area, the most useful form of representations for those ideas, and the most powerful analogies, illustrations, examples, explanations, and demonstrations — in short, the ways of representing and formulating the subject that make it comprehensible to others (Shulman, 1986). Shulman considers this as the most important knowledge for teachers. He says teachers can develop knowledge by research on the wisdom of practice that originated from practice. Another important perspective of studying teacher knowledge addresses the person as the active agent to create “personal practical knowledge” (Connely & Clandinin, 1990; through “personal construction,” and “reflective practice”; Darling-Hammond & McLaughlin, 1995). This relates teachers to the milieu where they situate, emphasizing the influences of different agents in the working environment and how they interact with the personal beliefs, theories, and practices of teachers. This bred of study favors naturalistic inquiry, which is to gain authentic understanding to personal thinking and experience, in the form of reflective journal

writing and storytelling.

Marcos and Tillema (2006) review the studies on teacher reflection on action. They find that the approach of “walking the walk” is the least used. This approach refers to the study of the tacit, hidden world of teaching in action, by researching on action (professional practice) in teaching. It is believed that the “situatedness of thought and action,” in which action is based on the situated context, can be highly individualized. Among the popular approaches of studying teachers, teacher’s knowledge in action has been interpreted as something unspoken and tacit, but is respected, considered valuable, and is believed to develop through experience. For example, Manen (2008) names it the pedagogical tact. Shulman (1986) calls it wisdom. Studying teacher action has encountered the problem of interpreting idea of a person based on his or her action.

Novice teachers have expressed concern about the gap between knowing and action. This concern also may be common among novices of other professions. This study turns to the cognitive psychology perspective. This study assumes that “procedural knowledge” better addresses the kind of competency/knowledge in real practice of teaching in classroom. Procedural knowledge refers to the knowledge of “how to do things” (Anderson, 1982). Procedural knowledge in teaching is regarded as a crucial part of a teacher’s knowledge, as teachers everyday act on every classroom lesson to support student learning. Whether they can “act well” determines the quality of experience and the outcome of learning of students.

In simple terms, to explore procedural knowledge of teaching means to understand how teachers conduct teaching and to study “the processes of operations when teachers enact actions in teaching” (Lam, 2011). Aided by an investigation, this study aims to show that what professional teachers know is not just theories that explain curriculum, teaching methods, and classroom management, but also the ways of acting (conducting teaching) to deal with students and manage the environment of learning to support student learning. This study assumes that this type of knowledge is different from declarative knowledge (knowing-what). If procedural knowledge is a different category of knowledge, ways to find out how this can be learned better may help professionals in the education field, especially prospective teachers and new teachers. Exemplary teachers are selected as the sample for this study because they are the ones who should be emulated by new teachers.

Procedural knowledge may be considered related to declarative knowledge (i.e., knowing-what), but some may think it is a unique kind. Nonetheless, it is a different

type of knowledge that requires technical skills to perform (Bauer & Rich, 2000). It also may be rational and cognitive, but its processes may be subtle as the human mind is complicated. Hence, this study focuses on the content of and what procedural knowledge is. It deals with procedural knowledge in teaching by referring largely to action by teachers.

The other idea is learning from expert teachers. Because expert teachers are effective, that is, they can properly manage students to facilitate learning inside a classroom, the insights expert teachers have for teaching are valuable to pre-service teachers. According to research findings, novice teachers focus on discipline issues and look for quick-fix recipes in solving them instead of thinking about contextual issues (Longhran, 2005). Berliner (2004) suggests that learning from expert teachers should be included as an essential part of teacher education program.

Project Aims

The project aims to investigate procedural knowledge in teaching. The following research questions are developed to guide the study:

- How exemplary teachers conduct teaching: What takes place in teaching and what can be registered in the performance of these teachers?
- What patterns and procedures can be told from the conduct of teaching?
- What implications can be derived from the preliminary findings to support learning and teaching in the HKIED?

Sample: Qualification and Experience of Teachers

Four teachers, who are considered by the school they work for as exemplary, participated in the study. In this pilot study, no rigid measurement criteria for the selection of the sample school were used. On one hand, the authors respect the school's selection and think its choice is more relevant to the school context. However, this study observes the ordinary requirement of teachers in terms of subject knowledge, pedagogical knowledge, and management of students and their professional attitude. The school said they selected the teachers who had attained good scores in their annual appraisals and who had instruments that are quite similar to the ones provided by the EDB on external review exercise.

Table I: Sample Teacher Profile

Qualification/Subject (Teacher Code) ^o	Chinese (C) ^o	English (E) ^o	Mathematics (M) ^o	Liberal Studies (L) ^o
Bachelor Degree ^o	Nil ^o	Comparative Literature ^o	Computing ^o	Major: History ^o Minor: Geography & Resource Management ^o
Teacher Qualification ^o	B.Ed(Language Education) ^o	PGDE(English) ^o	PGDE(IT) ^o	PGDE(LS) ^o
Master ^o	Education(LS) ^o	English ^o	Nil ^o	Nil ^o
Other Professional Qualification ^o	Nil ^o	Diploma in counseling ^o	Nil ^o	Nil ^o
Studying ^o	Guidance and Counseling ^o	Applied Psychology ^o	Nil ^o	Social Science in General Education ^o
Teaching Experience ^o	5 years ^o	15 years ^o	9 years ^o	4 years ^o

According to the sample profile, the average number of years of teaching of the sample is eight. Their teaching experience ranges from 4 to 15 years. All of them are qualified teachers, and half of them have a master's degree.

Methods of Study

a. Data Collection - Field Study on Expert Teachers

Four nominated expert teachers selected from secondary schools were invited to be studied. They are teachers of English, Chinese, Mathematics, and Liberal Studies. Their teaching is recognized as exemplary in broadly defined terms of offering support and facilitation to help students achieve effective outcomes of learning of a wide spectrum, including subject knowledge, pedagogy, and student development.

Table II Data Collection Schedule for the four teachers

Sub/Class ^{1a2o}	Teacher ^o	Topic of the lesson ^o
Eng/1E MMLC ^o	E ^o	Phonics ^o
		Reading ^o
		Subject Pronouns ^o
Chi/3D ^o	C ^o	課文《潮流後鏡》 ^o
304 ^o		課文《潮流後鏡》 ^o
		說明技巧 ^o
Maths/3E ^o	M ^o	面積與體積(三) ^o
305 ^o		圓錐(體積及面積) ^o
		圓錐(體積及表面面積) ^o
		圓錐與扇形 ^o
		圓錐的應用題 ^o
LS/2D ^o	LS ^o	性別定型 ^o
204 ^o		性別定型 ^o
		性別定型 ^o

Video taping and classroom observation of the exemplary lessons of the expert teachers were conducted. This activity ran for about a month on the same class. At

least three lessons were observed for each teacher. Simulated recall interviews were conducted immediately after the teaching of each of the three/four lessons for the teacher to articulate: (a) the underlying beliefs and implicit theories of their actions on the planning and intention of the lessons and pedagogical strategies; (b) reflection on interactive thinking and practice, which refers to specific beliefs, knowledge, and theories that have influence on any in-class decision and observable practice in teaching and managing a class, through a review of the whole video-taped lesson, identified from researchers from the observed class; and (c) reflection on the lesson in light of the original objectives and comment on the strengths, weaknesses, and any changes recommended to further improve teaching.

The interview was done by the researcher(s). At least two project team members joined in each field study for classroom observation and interviews. The researchers tried to ensure a match of expertise on subject discipline and pedagogy among themselves so that they would be able to capture and have a more comprehensive understanding of the scenes with different perspectives. The researchers also exchanged views about the observed classes by writing reflections on a journal and through informal conversations. The research assistant, who has a background in sociology, assisted in all the fields of studies.

A data-collection guide book was compiled and attached. The guidebook discusses observation note taking, interview schedule, and template for filling out reflection of a researcher on the field of study (Attachment I).

b. Data Analysis - Deriving Outputs on Procedural Knowledge in Teaching

There were 13 video records of lessons and 13 post-interview audio records. There were 660 minutes of observation transcription and 575 min of audio transcription in total, including four sets each for the Math teacher and three sets for the other three teachers (English, Chinese and LS). The length of each video-taped session ranged from 35 min to 110 min for a single lesson and double lesson, respectively. All the video and audio data gathered from the field study were transcribed into Chinese verbatim, except those that were originally presented in English. The survey from school teachers and the researchers were collected. They served as a reference when the researchers compiled the report on individual teachers, as a triangulating process, to see if their self reflection can be referenced with the results on observational (actions) and the interview data (talk).

Data Management and Data Analysis

A grounded theory approach was taken in the analysis; there were no pre-determined

themes but the researchers looked for what were registered in the action and words of teachers with regard to specific actions in the observed class. The purpose was to understand how teachers conduct teaching, which shows their procedural knowledge of teaching.

The first step was to categorize the observational data, particularly by arranging them into an analytic lesson observation record form. A sample is shown in Table III.

The second step was to develop meaning from the neatly transcribed qualitative data, including the visual, audio, and reflective textual data. The researchers attempted to build meaning from the data units and to reconstruct them into categories and themes related to procedural knowledge. This coding process is comprehensive in that relevant sources of data had to be identified from action sequences that teachers showed. For instance, interview data and opinions of researchers (if there were any) about teachers' actions, such as joking or making fun with students and responding to misbehavior of students, had to be identified.

In this step, the actions, the procedures teachers intended to observe to achieve them, the skills incurred, and other elements that determined the action and how it was given had to be investigated. A quite consistent map of the procedural knowledge of the teachers was gradually built across samples and this could be claimed as a framework.

Table III: Lesson Profile Description – for each lesson (extract of a sample)

Parts in Lesson	Stage/ Time	Activities (Time spent each)	Pupil's job	T's Job	Aids / Resources	Class discipline issues (if any)
Opening		-Introduce Module 2, via reading the sentences in the box to introduce how to pronounce these new words (Egypt, myth, folktale, germany, competition)(6 min) -Tell students they are going to read one myth from Egypt and one story from Germany. (4min)	answer questions. Reading as teacher asked	Deliver questions and actively called names. Ask students to read and demonstrate how to pronounce these new words. Use enquiry method to ask students questions.	Textbook, teacher, powerpoint, blackboard,	-Students are not very actively to reading. -students answer the questions actively and teacher encouraged them to go on.
Instructional Procedure	Stage I	-Reading a poster about creative writing competition and ask students questions about the detail of the poster. (4 min)	answer the questions	Encourage students to answer and pronounce the new words (myth, competition)	Textbook, , teacher powerpoint.	Students answer questions very actively.
Consolidation / Ending	Teacher Explosion	Report today's learning content and praised students' performance on the class. Assign homework - to pronounce the new words in the given two paragraphs (3 min)	listening		powerpoint	



Description on Key Project Findings

A framework to explain procedural knowledge in teaching was created as a result of investigations for this study. The ideas generated from this study may be used as materials for the teacher training program. The researchers propose further investigation of the subject, together with its implications, to contribute more to existing literature. The findings of this study shall be reported in the following order: (1) the procedural knowledge framework, (2) a general profile of a lesson, and (3) intuitive decision. The researchers will then suggest the conduct of further study to explore the strands of the findings of this project.

Procedural Knowledge – a Preliminary Framework. In the analysis, a profile for each lesson on the themes emerged in the study. Moreover, a tentative framework to describe procedural knowledge was developed. This study suggests that there are stable and unstable elements, conscious and unconscious (routine, become automatic) move in the conduct of teaching. Teachers perform actions, and some actions may have not gone through conscious thinking. Teachers act because they react to the environment, with or without an immediate goal (specific control on a student's misbehavior). If a teacher knows that something should be handled because that may make some disturbances and influences, they will act based on the categories of events or situations they conceive.

In delivering lessons, action of teachers is subject not only to their plans, protocol, or procedure. Actions by teachers, as found from this study, are subject to an organized function within their cognition. This cognition goes with different strategies, including instructional management, interaction, and awareness of the environment that teachers need to act upon. The strategies cover general abilities of the teachers, the language and gestures, and the established setting they create for the classes. The strategies keep their belief in teaching. This procedural knowledge framework is identified for the conduct of further study, suggesting there are many interesting ways of handling classroom situations.

The first ingredient that determines an action by teachers is the concerns they bear in planning and carrying out teaching of a lesson. This part has become automatic for the samples as they have been teachers for quite some time. It had been naturally integrated in the planning and teaching, as shown by the data collected for this study. These concerns include specific student nature and behavior, curriculum for specific subjects, and school rules and regulations. They serve as guides to the planning and action by the sample teachers.

In specific terms, as the sample teachers said, specific goals of a lesson clearly guide the action of teachers. They use delivery skills and general interactional skills to facilitate actions. Language, manner, and attitude seem to be a pre-dominated feature of teaching and have contributed to the environment. The attitude and value education were also observed through the ways teachers speak to students and the attitude they show them. A variety of instructional styles were observed. As previously mentioned, it is subject specific and has a strong belief underpinnings. Clear classroom rules and regulations had been set as essential condition to facilitate teachers in the procedural knowledge of delivery.

Diagram I: Procedural Knowledge of Teaching – How Teachers Enact Teaching



Profile of a Lesson. For each sample teacher, a protocol for performing teaching in a classroom that resulted from the treatment of the observational data into the lesson profile was identified, as shown in Table 2. Taking into account the observational data and the details of specific lessons of this study, a general protocol of teaching suggests the following steps.

- ✧ Start the class by making students settle into the subject context of learning.
- ✧ Set pupils on task and brief them on the learning objectives in different ways.
- ✧ Lead students to the main content of learning (engage learners to listen, see, read, think, speculate, and be curious).
- ✧ Conduct student-exploration recitation or group work.
- ✧ Structure the learning content and follow up queries.
- ✧ Consolidate and check learning effectiveness.
- ✧ Assign class work and connect the assignment outcomes to the next lesson.
- ✧ Bear the critical features in marking assignments.
- ✧ Give ongoing remedial support to low-achieving students during lunch or after class.

The sample lessons observed in the conduct of this study demonstrate the abovementioned pattern. This format suggests a default for the lesson setting, which includes the objectives that govern the learning and teaching context, and the contextual demands, which are similar across the sample and many teachers. This can be treated as an organized framework that determines plan and action of teachers in teaching that are important to student teachers or new teachers.

Furthermore, for Math teaching, a more stable interaction pattern was learned from the sample teacher. Moreover, based on calculation of total time, talking by the teachers of languages is longer than that by the other teachers. Despite this, language teachers seemed to provide more room for student activities. This may imply the subject-specific factor may influence teacher's planning, which also is part of the procedural knowledge as it is thought to be part of an action or to guide an action. This is a potential line of inquiry in the next stage of study.

Intuitive Action/Decision As discussed in literature, understanding procedural knowledge by asking teachers to speak about the reason or belief behind their actions

may encounter difficulty. This is because not every action has a specific reason behind it. The difficulty reflects the intricacy of studying procedural knowledge. This study suggests that procedural knowledge is important in educating, supervising, and preparing students of education courses. Below are sample scenarios.

“The English teacher makes a factual expression to express tiredness and tells the whole class that their reading aloud is not good enough because it lacks energy” (Lesson 01E).

The action by the teacher described above has actually made the students laugh. This action was performed quite instantly, that is, without much thinking. In another occasion,

“The English teacher suddenly stopped her exposition. She put down her microphone and spoke to the naughty boy, asking him to sit properly and look to the front. She requested the boy to stop playing with the study cards and put them down on the table, and then she turned back to teaching by holding up her microphone without spending more time on the student but to the whole class” (Lesson 02E).

The teacher in this scenario said she saw a boy trying to disturb others by playing with the study cards. She admitted that her action was not thought through before it was done.

In this scenario, the teacher showed wit and knowledge of how to handle the situation. In the follow-up interview, the sample teacher said that both of the actions, particularly her joking and her stopping a pupil’s misbehavior, had not gone through an analytic thinking. What she had done, as she recalled, were regarded as “intuitive actions,” which were done based on her understanding of the school and classroom situation, and her familiarity with the students and the class.

Exemplary Teachers. From the sample, first it was found that procedural knowledge is goal oriented. The goals are academic and moral, and are related to educating students through a subject discipline. Second, in the instructional aspect, exemplary teachers would use multiple procedures to achieve the goals in an integrated and creatively ways; they made strong connections between the topics and the sequence of learning in organic ways, and employed varieties of method and repeated the pattern with novelty. Third, inferred from their actions, teachers performed actions on top of the systematic environment they have already set up. They also paid detailed attention to learning situation of the class during the discussion of lessons and introduced algorithms and appropriate actions for enhancing motivation, thereby encouraging learners to participate. These actions clearly speak about their expectations and show that they required students to meet their standards. As part of their procedural knowledge, exemplary teachers spoke clearly and with feelings, appropriately used gestures, and gave recognition once they were satisfied about the participation of learners and the learning atmosphere. The teachers were found to have a personal

philosophies, and some of those were very clear and strong.

The teachers were found to have different levels of expertise. One teacher was exceptionally outstanding in a few domains, such as rhythm and pace of the lesson, transition, curriculum design, and assignment nature. Compared with the others, she demonstrated a more integrated and fluent delivery action, and she improvised and modified her action to suit the circumstances of teaching. However, further study is needed to shed light on the differences in the level of expertise of teachers. The differences highlight the important perspective of comparison in the study of procedural knowledge.

Implications

On top of the theories and steps on instructional design and specific strategies learned from taught courses and books, the idea of lesson profile and immediate action management can enlighten the cognitive knowing in teaching by new teachers. Teaching is not a step-by-step matter. It has to be done through a web of considerations and concerns, with specific goals for the tackling of lessons. Moreover, these lessons must be ingrained in a teacher's mind. Decision by intuition during the lesson should be a crucial part of understanding procedural knowledge that student teachers should learn about.

It is commonly noticed that knowledge of teaching is determined by specific lesson goals, delivery strategies and skills, the way teachers speak and act, and set up of the classroom environment. All of these need to be backed up by theoretical knowledge (declarative knowledge). However, in bringing these to action, it is procedural knowledge that matters. As the findings of this study suggest, this knowledge is a different kind. It comprises knowledge and skills, and is an integrated whole of different contents. Procedural knowledge is determined by cognition and skills of teachers. Their perceptual awareness is most essential to sharpen them, and to improve and refine procedural knowledge. This pilot study shows how important procedural knowledge is for teachers and how broad are the domains it covers.

The question that must be answered is about the ingredients of procedural knowledge that operate in the cognition of an individual. An integrated, highly complex, and sophisticated cognitive operation is needed before procedural knowledge can be brought into action. Therefore, some of the suggested important measures are to strengthen practice and enhance the general ability of a person who would take up the job of teaching. In terms of curriculum development, a course to promote integrative understanding of teaching as a foundation for student-teacher should be essential.

About pedagogy, a closer connection between taught courses to school experience, and the adoption of authentic assignment, such as those related to school curriculum, case studies, and evaluation, can help create more chances to develop procedural knowledge at the pre-service stage. Interactive learning opportunities, collaboration with peers, and group learning should also be useful as these help develop reflective capacity of student-teachers so they are able to realize problems and develop solutions to solve those. Supervision in the field can be regarded as an important arena for teacher training, and ways to support teachers to reflect on procedural knowledge should be strengthened.

This study is concluded by a series of teaching clips that demonstrate how teacher conduct teaching with themes like classroom management, questioning, giving feedback, handling group work, and teacher exposition (Attachment II & CD).

Further Study

Based on this pilot project, the researchers hope to conduct the following additional studies on procedural knowledge:

- A detailed study that includes reflective journals, a more in-depth interview about teachers' actions, and a review of the tapes of the interviews. These actions are meant to capture the cognitive skills and perceptual awareness of exemplary teachers in a more detailed manner.
- Comparative study on exemplary teachers and ordinary teachers to more substantially address important areas of learning for teaching
- A study that extends the sample to primary school teachers and that looks into general and subject-specific aspects, through cross comparison, to enrich findings
- Exploration of the relationship between the elements in the framework that has been identified from the initial study, including conscious and unconscious actions
- Further development of a pool of teaching materials to support teaching of the PS and other courses

(The technical report is prepared by Dr LAM Bick Har on behalf of the Project Team, June, 2012)

References

- Anderson, J. (1982). Acquisition of cognitive skill. *Psychological Review*, 89(4), 369-406
- Ben Peretz, M. (2011). Teacher knowledge: what is it? How do we uncover it? What are its implications for schooling? *Teaching and Teacher Education*, 27, 3-9
- Berliner, D. C. (2004). Describing the behavior and documenting the accomplishments of expert teachers. *Bulletin of Science, Technology & Society*, 24, 200-212.
- Connelly M. F., Clandinin J. D., & He, M. F. (1997). Teachers Personal Practical Knowledge on the Professional Knowledge Landscape. *Teaching and Teacher Education*, Vol. 13, Issue 7, pp. 665-674.
- Connely, F. M., & Clandinin, D. J. (1990). Stories of experience and narrative inquiry. *Educational Researcher*, 19(5), 2-14.
- Darling-Hammond, L., & McLaughin, M. W. (1995). Policies that support professional development in an era of reform. *Phi Delta Kappan*, 76(8), 597-604.
- Gagne, E. D., Yekovich, C. W., & Yekovich, F. R. (1998). *Cognitive Psychology of School Learning*. Boston: Houghton Mifflin
- Grossman, P. L., & Richert, A. E. (1988). Unacknowledged Knowledge Growth: A Re-Examination of the Effects of Teacher Education. *Teaching and Teacher Education*, Vol. 4, Issue 1, pp. 53-62.
- Lam, B. H. (2011). A Reflective Account of a Pre-service Teacher's Effort to Implement Progressive Curriculum in Field Practice. *Schools: Studies in Education*, 8(1), 22-39
- Loughran, J. (2005). Researching teaching about teaching, self study of teacher education practices. *Studying Teacher Education*, 1(1), 5-16.
- Marcos, J. & Tillema, H. (2006). Studying studies on teacher reflection and action: An appraisal of research contributions. *Educational Research Review*, 1, 112-132
- Shulman, L. S. (1986). "Those who understand: Knowledge growth in teaching." *Educational Researcher* Feb. 1986: 4-14. (AERA Presidential Address).
- Tamir, P. (1991). Professional and Personal Knowledge of Teachers and Teacher Educators. *Teaching and Teacher Education*, Vol. 7, Issue 3, pp. 263-268.
- Van Manen, M. (2008). *Pedagogical Sensitivity and Teachers Practical Knowing-in-Action*. Paper presented at Peking University Education Review, Beijing.