MODUL 3:
KAEDAH DAN TEKNIK P&P/ ASAS PEDAGOGI

MODUL 3L:
PEDAGOGICAL CONTENT KNOWLEDGE (PCK)

MODUL 3: PENGAJARAN DAN PEMBELAJARAN
MODUL 3L: PEDAGOGICAL CONTENT KNOWLEDGE (PCK)

JUMLAH JAM: 6 JAM (BERSEMUKA)

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1. SYNOPSIS

Pedagogical content knowledge (PCK) has been embraced by many of the recent educational reform documents as a way of describing the knowledge possessed by expert teachers. PCK included those special attributes a lecturer possessed that helped him/her guide a student to understand content in a manner that was personally meaningful. PCK includes an understanding of how particular topics, problems, or issues are organized, presented, and adapted to the diverse interests and abilities of learners, and presented for instruction. PCK was the best knowledge base of teaching. The key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy, in the capacity of a lecturer to transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students.

2. LEARNING OUTCOMES

At the end of the module, participants should be able to:

- explain about teaching knowledge base
- define pedagogy in relation to subject matter and develop lesson plan
- illustrate pedagogical content knowledge relevant to the subject matter.

3. DETAILED OUTLINE

NO	TOPIC	HOUR
1.	• Teaching knowledge base • Pedagogy • Pedagogy content knowledge • Elements of PCK • Activity	1 HOUR 1 HOUR 2 HOUR
2.	• Assesment of PCK • Importance of PCK • Limitation of PCK • Activities	2 HOUR
	TOTAL	6 HOURS

4. ASSESSMENT (SELF APPRAISAL CHECK LIST)

No	Elements	Yes	No
1	Content and Curriculum		
2	Knowledge of students and their learning		
3	Learning environments		
4	Assesment		
5	Planning and instruction		
6	Professionalism		

6. REFERENCES

Allen, J., & Wolmut, P. (1972). *Development and Evaluation of Course Goals in Science and Language Arts for Grades K-12. Final Report* . East Lansing, MI: National Center for Research on LecturerLearning. (ERIC Document Reproduction Service No. ED061043)

Brady, J. A. (1990). Lewis Structure Skills: Taxonomy and Difficulty Levels. *Journal of Chemical Education, 67,* 491-493.

Brown, C. L. (1989). *The Secondary Schools Taxonomy (SST)* . East Lansing, MI: National Center for Research on LecturerLearning. (ERIC Document Reproduction Service No. ED315544)

Eaves, R. C., & McLaughlin, P. J. (1981). *Middle School Curriculum for Visually Impaired Students* . East Lansing, MI: National Center for Research on LecturerLearning. (ERIC Document Reproduction Service No. ED231118)

Grossman, P. (1990). *The Making of a Lecturer: LecturerKnowledge and LecturerEducation*. New York: Lecturers College Press.

Hanipah, Hussin. (2004). *Learning to be Reflective*. Tanjung Malim: UPSI Press.

Hurd, P. H. (1997). *Inventing Science Education for the New Millennium*. New York: Teachers College Press.

Krathwohl, D., Bloom, B., & Masia, B. (1964). *Taxonomy of Educational Objectives the Classification of Educational Goals: Handbook II Affective Domain*. New York: David McKay Company Inc.

McCormack, A. J., & Yager, R. E. (1989). A New Taxonomy of Science Education. *Science Teacher, 56*(2), 47-48.

Moore, D. S. (1982). Reconsidering Bloom's Taxonomy of Educational Objectives, Cognitive Domain. *Educational Theory, 32*(1), 29-34.

HURAIAN KANDUNGAN

1.0 Teaching knowledge base

Critical decisions about the (a) content and structure of lecturer education, (b) policies and procedures for demonstrating the quality of programs, (c) standards used in evaluating lecturers, and (d) systems for assessing and certifying professional competence all depend, in part, on the way this question is answered. Thus, the significance of understanding the issues involved in defining the knowledge base cannot be overemphasized.

At one level, concern about the knowledge base focuses on improving the respect and status accorded teaching, thereby making it a more rewarding career (Shulman, 1987). In this regard, the professionalization of teaching depends on showing that teaching, like other learned professions, requires mastery of a specialized body of knowledge that is applied with wisdom and ethical concern.

Beyond the interest in achieving professional status, questions about appropriate knowledge imply the need for serious deliberation in the professional community about (a) the types of knowledge required and relationships among the categories identified, (b) conceptual frameworks for organizing and using knowledge and (c) the modes of inquiry used in creating and validating knowledge claims in the field. In this way the intellectual and socio-political aspects of the field would be complementary.

This means that the process of determining the knowledge base is communal, i.e., conceptual frameworks, and the norms for judging them, are created and recreated socially. Changes occur with new insights and evaluations through the cooperative efforts of the entire community. Although leaders in the field usually initiate this process, they seek mutuality of understanding within the community. Similarly, attempts to resolve differences in perspective require critical reflection and discussion of alternative conceptualizations, both their limits and possibilities (Valli & Tom, 1988).

In keeping with this tradition, several knowledge base frameworks have emerged recently, including two sponsored by national organizations for lecturereducation. The American Association of Colleges for LecturerEducation (AACTE) released the Knowledge Base for Beginning Teachers (Reynolds, 1989) and the Association of LecturerEducators (ATE) released the Handbook of Research on LecturerEducation (Houston, 1990).

Current discussions reflect several perspectives and historical concerns that have surrounded attempts to define the knowledge base. As Edelfelt suggested in 1980, the problem of finding some basis for agreement about the definition and organization of the professional knowledge base remains as one of the major challenges facing the field.

Addressing dilemmas related to conceptualization, Griffin (1983) noted that some scholars question the legitimacy of defining "essential" knowledge in teaching,

maintaining that adequate definition depends on the ends considered desirable--a matter of judgment, not science. In contrast, others argued that, properly understood, the knowledge base is a framework that consists of several different types of knowledge, including statements about valued ends and the methods used in evaluating or justifying them (Shulman, 1986 & 1987).

Ayers (1988) posed the problem of scope of definition, expressing concern about defining the knowledge base too narrowly and ignoring context, or too broadly and losing clarity and precision. According to Edelfelt (1980), even if there could be agreement on the essential knowledge and skills involved, these understandings would not apply in all teaching situations, given the variations in schools, pupils, faculties, resources, and administrative leadership.

Similarly, several educators cautioned against an overemphasis on empirical evidence as the sole basis for knowledge about teaching. This parallels concerns about the technical orientation that dominates the professions and current efforts to improve lecturereducation (Cornbleth, 1986; Henderson, 1988; Schon, 1983). These educators pointed out

significant aspects of teaching, such as the moral, aesthetic, political, and personal dimensions (Kirk, 1986; Liston & Zeichner, 1987). According to Lather (1986), the failure to include this type of knowledge distorts and limits understanding of teaching. From this view, knowledge about teaching is not separate from actual practice; it is coextensive. Rather than draw from a "storehouse" of knowledge discovered by outside experts, such practical knowledge is created by the lecturers themselves (Ayers, 1988).

Finally, still others have concerns that extend beyond questions about the content of the knowledge base. At issue are alternative patterns or frameworks for organizing the professional knowledge base (Shulman, 1988). Starting from distinctions between two conceptions of the knowledge base--an "expert system" in a computer program versus the "expert" who possesses the knowledge, history, and rules needed to perform a complex task--Shulman identified several images of how to organize the store: the knowledge base as encyclopedia, library, handbook, manual, or case book.

2.0 Pedagogy

Pedagogy is the art or science of being a lecturer. The term generally refers to strategies of instruction, or a style of instruction.

Pedagogy is also sometimes referred to as the correct use of teaching strategies (see instructional theory). For example, Paulo Freire referred to his method of teaching adults as "critical pedagogy". In correlation with those teaching strategies the instructor's own philosophical beliefs of teaching are harbored and governed by the pupil's background knowledge and experiences, personal situations, and

environment, as well as learning goals set by the student and lecturer. One example would be the Socratic schools of thought.

3.0 Pedagogy content knowledge

Pedagogical content knowledge was first proposed by Shulman (1986) and developed with colleagues in the *Knowledge Growth in Teaching* project as a broader perspective model for understanding teaching and learning (e.g., Shulman & Grossman, 1988). This project studied how novice lecturers acquired new understandings of their content, and how these new understandings influenced their teaching. These researchers described pedagogical content knowledge as the knowledge formed by the synthesis of three knowledge bases: subject matter knowledge, pedagogical knowledge, and knowledge of context. Pedagogical content knowledge was unique to lecturers and separated, for example, a lecturer from a scientist. Along the same lines, Cochran, King, and DeRuiter (1991) differentiated between a lecturerand a content specialist in the following manner:

Lecturers differ from biologists, historians, writers, or educational researchers, not necessarily in the quality or quantity of their subject matter knowledge, but in how that knowledge is organized and used. For example, experienced lecturer knowledge of science is structured from a teaching perspective and is used as a basis for helping students to understand specific concepts. A scientist's knowledge, on the other hand, is structured from a research perspective and is used as a basis for the construction of new knowledge in the field (p. 5).

Pedagogical content knowledge has also been viewed as a set of special attributes that helped someone transfer the knowledge of content to others (Geddis, 1993). It included the "most useful forms of representation of these ideas, the most powerful analogies, illustrations, examples, explanations, and demonstrations-in a word, the ways of representing and formulating the subject that make it comprehensible to others" (Shulman, 1987, p. 9).

Furthermore, Shulman (1987) stated that PCK included those special attributes a lecturerpossessed that helped him/her guide a student to understand content in a manner that was personally meaningful. Shulman wrote that PCK included "an understanding of how particular topics, problems, or issues are organized, presented, and adapted to the diverse interests and abilities of learners, and presented for instruction" (1987, p. 8). Shulman also suggested that pedagogical content knowledge was the best knowledge base of teaching:

The key to distinguishing the knowledge base of teaching lies at the intersection of content and pedagogy, in the capacity of a lecturerto transform the content knowledge he or she possesses into forms that are pedagogically powerful and yet adaptive to the variations in ability and background presented by the students (p. 15).

Some research that has stemmed from the introduction of PCK has attempted to address the question of how pre-service lecturers learn to teach subjects that they already know or are in the process of acquiring (Grossman, 1990; Grossman, Wilson, & Shulman, 1989; Gudmundsdottir, 1987; Magnusson, Borko, & Krajcik, 1994; Marks, 1991).

4.0 Elements of PCK

According to Shulman (1986) , PCK includes "the most useful forms of representation of [topics], the most powerful analogies, illustrations, examples, explanations, and demonstrations - in a word, the ways of representing and formulating the subject that make it comprehensible to others ...Pedagogical content knowledge also includes an understanding of what makes the learning of specific topics easy or difficult: the conceptions and preconceptions that students of different ages and backgrounds bring with them to the learning of those most frequently taught topics and lessons."

Pedagogical content knowledge is an accumulation of common elements;
- Knowledge of subject matter
- Knowledge of students and possible misconceptions
- Knowledge of curricula
- Knowledge of general pedagogy.

PCK is knowing what, when, why, and how to teach using a reservoir of knowledge of good teaching practice and experience.

5.0 Importance of PCK

Lecturers have been recently introduced to documents that represent the collective thinking of many national leaders in science education. These documents detail what and how engineering should be taught in schools. The two most notable documents are the *Benchmarks for Scientific Literacy* developed by the American Association for the Advancement for Science (AAS, 1993) and the *National Science Education Standards* (NSES) developed by the National Research Council (NRC, 1996). These publications were developed to guide the reform effort in engineering curriculum development and lecturerpractice. The NSES states, "The current reform effort requires a substantive change in how engineering is taught; an equally substantive change is needed in professional practices" (p. 56). In order to implement such a change in professional practice, the NRC recommends the creation of national professional development standards. Since their publication, these professional development standards have been used as criteria for engineering education reform (National Science Teachers Association [NSTA], 1999).

One important aspect of these education reform documents is the "call" to change science lecturer ducation. The NSES states, "Implicit in this reform is an equally substantive change in professional development practices at all levels. Much current professional development involves traditional lectures to convey engineering content and emphasis on technical training about teaching" (p. 56). Similarly, Cochran, King,

and DeRuiter (1991) stated that the professional preparation of engineering lecturers was often separated or disjointed. Hewson and Hewson (1988) emphasized that this separation occurred when prospective lecturers learned pedagogy apart from subject matter. Some engineering education reform efforts have recently begun to bridge the gap between the pedagogical and content aspects of engineering lecturer preparation by advocating the development of a cohesive knowledge base (Doster, Jackson, & Smith, 1994). Pedagogical content knowledge (PCK) has been suggested as one knowledge base for lecturer preparation (Anderson & Mitchener, 1994). Anderson and Mitchener (1994) have suggested that PCK could be an alternative perspective from which engineering educators could view engineering lecturerpreparation. The epistemological concept of PCK offers the potential for linking the traditionally separated knowledge bases of content and pedagogy.

Historically, knowledge bases of lecturer education have focused on the content knowledge of the lecturer(Shulman, 1986). More recently, lecturereducation has shifted its focus primarily to pedagogy, often at the expense of content knowledge (Ball & McDiarmid, 1990). Research on pedagogy has focused on the application of general pedagogical practices in the classroom, isolated from any relevant subject matter. However, several researchers (e.g., Ball & McDiarmid, 1990; Magnusson, Krajcik, & Borko, in press) have rekindled the discussion about the importance of teachers content knowledge in learning to teach.

Shulman (1986) developed a new framework for lecturereducation by introducing the concept of pedagogical content knowledge. Rather than viewing lecturereducation from the perspective of content or pedagogy, Shulman believed that lecturereducation programs should combine these two knowledge bases to more effectively prepare teachers. The use of PCK as a topic for research and discussion about the nature of an appropriate knowledge base for developing future engineering teachers has steadily increased since its inception (NRC, 1996; NSTA, 1999; Tobias, 1999).

The topic of developing future teachers also extends beyond engineering teachers and "traditional" teachers. Darling-Hammond (1991) cited several studies demonstrating that teachers admitted to the teaching profession through alternative programs (e.g., emergency licensure, private schools, and out of content assignments) had difficulty with pedagogical content knowledge and curriculum development. The current reform initiatives in engineering provide a guide for some lecturereducators to develop models of engineering lecturerdevelopment (Bell & Gilbert, 1996; Cochran, DeRuiter, & King, 1993; Cochran, King, & DeRuiter, 1993; Magnusson, Krajcik, & Borko, in press; Sakofs et al., 1995). Some of these models have been specific to PCK development of pre-service engineering teachers (Cochran, DeRuiter, & King, 1993; Cochran, King, & DeRuiter, 1991; Magnusson, Krajcik, & Borko, in press). Recently, the National Science Teachers Association (NSTA, 1999) developed engineering lecturerpreparation standards that highlight the need for teachers to develop PCK. These standards are intended for use in accreditation reviews of engineering lecturerpreparation programs for the National Council for Accreditation of LecturerEducation (NCATE, 1994). Accordingly, lecturereducators continue to recognize the need for an adequate model for lecturerpreparation.

Currently, there are few models for lecturer development (Bell & Gilbert, 1996; Cheung, 1990; Sakofs, et al., 1995; Saunders, et al., 1994). As part of the standards for accreditation, the National Council for Accreditation of LecturerEducation (NCATE, 1994) demands that professional education programs adopt a model that explicates the purposes, processes, outcomes, and evaluation of the program. The taxonomies in this paper warrant construction and analysis for two reasons. First, there exists a "traditional" polarization of content and pedagogy in engineering preparation programs. Second, current models fail to accurately address and outline the role of PCK in engineering lecturerprofessional development. Professional development in this paper will refer to engineering lecturer preparation. The current NSTA, NCATE, and NSES documents support the idea of models for lecturerdevelopment. In particular, engineering reform initiatives on the national and state level are beginning to require more rigorous standards for certification. As part of the certification process, developmental models are needed to guide engineering educators through the labyrinth of knowledge bases. This paper presents two taxonomies that can serve as models for engineering lecturer preparation.

6.0 Activity

HOW DO YOU CONCEPTUALIZE YOUR OWN SUBJECT

- CONTENT KNOWLEDGE……
- PEDAGOGY KNOWLEDGE……
- PEDAGOGICAL CONTENT KNOWLEDGE……..
- TECHNICAL PEDAGOGICAL KNOWLEDGE……
- TECHNICAL PEDAGOGICAL CONTENT KNOWLEDGE

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