

Pelatihan
**PENGEMBANGAN MODEL
DAN
METODE PEMBELAJARAN
BERTARAF
INTERNASIONAL**

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OLEH
**Task Force WCU
Universitas Negeri Yogyakarta**

A CRITICAL LOOK AT
International Level of
MATHEMATICS EDUCATION

Dr. Marsigit, M.A.

Department of Mathematics Education

Yogyakarta State University

International Perspective
Theory of Learning

Andragogy of Adult Learning

1. Adults must first understand why they need to know something before they actually invest time in learning it
2. Most adults have a fully formed self-image and tend to become resentful when these images are not valued in a learning situation
3. Adults need to feel as if their life experience is important as it helps them make connections between old and new knowledge

Knowles (1973)

Andragogy of Adult Learning

4. Adults will generally prepare more for a learning situation
5. Adults “want to learn to solve or address a particular problem, and are more satisfied with their learning if everyday experiences, is practical, or is current”
(Draves, p. 11).
6. Adults are more intrinsically motivated to learn than children are. They are in the learning situation by choice and do not require the extrinsic motivational rewards that children do.

Knowles (1973)

Empirical Evidences
on
Students' Learn Mathematics

Third International Mathematics and Science Study (TIMSS, 1995)

- Elaborate international comparison of mathematics and science education
- Large amount of data, unusually careful methodology
- Comparison of student performance, teacher preparation, textbooks, teaching styles

Wilfried Schmid, 2009

Conclusions drawn from TIMSS: US student performance

- Relative performance declines drastically in later grades
- Students do relatively well on one-step problems, but not well on multi-step problems
- Students do relatively well on “data analysis” problems
- Students do badly on problems requiring conceptual thinking

Wilfried Schmid, 2009

Implication to
Method and Model of
**TEACHING LEARNING
PROCESSES**

TRANSFORMATIF LEARNING

TRANSFORMATIF LEARNING **(is not *TRANSFORMATIF TEACHING*)**

The learner experiences an activating event, one that exposes the difference between what they thought they knew and what is actually happening. Earlier versions of this theory identified this as a single event, later work has noted that “several events may converge to start the process”

(Baumgartner, 2001, p. 19 in Patricia Cranton, 2002)

TRANSFORMATIF LEARNING
(is not *TRANSFORMATIF TEACHING*)

The learner then begins to
“articulate assumptions” about
their current mental models and
how this new information fits
with their currently thinking.

TRANSFORMATIF LEARNING
(is not *TRANSFORMATIF TEACHING*)

The learner then begins
to investigate
alternative viewpoints.

TRANSFORMATIF LEARNING
(is not *TRANSFORMATIF TEACHING*)

The learner then engages others in discussion about both previously held assumptions and new information learned during their search for facts and ideas.

TRANSFORMATIF LEARNING
(is not *TRANSFORMATIF TEACHING*)

The learner revises his or her assumptions to make them fit better with new situation.

TRANSFORMATIF LEARNING
(is not *TRANSFORMATIF TEACHING*)

The learner begins to put
the new assumptions into
practice.

PCMI

PCMI (Park City Mathematics Institute) Model of Professional Development

- Continue to learn and do mathematics
- Analyze and refine classroom practice
- Become a resource to colleagues and the profession

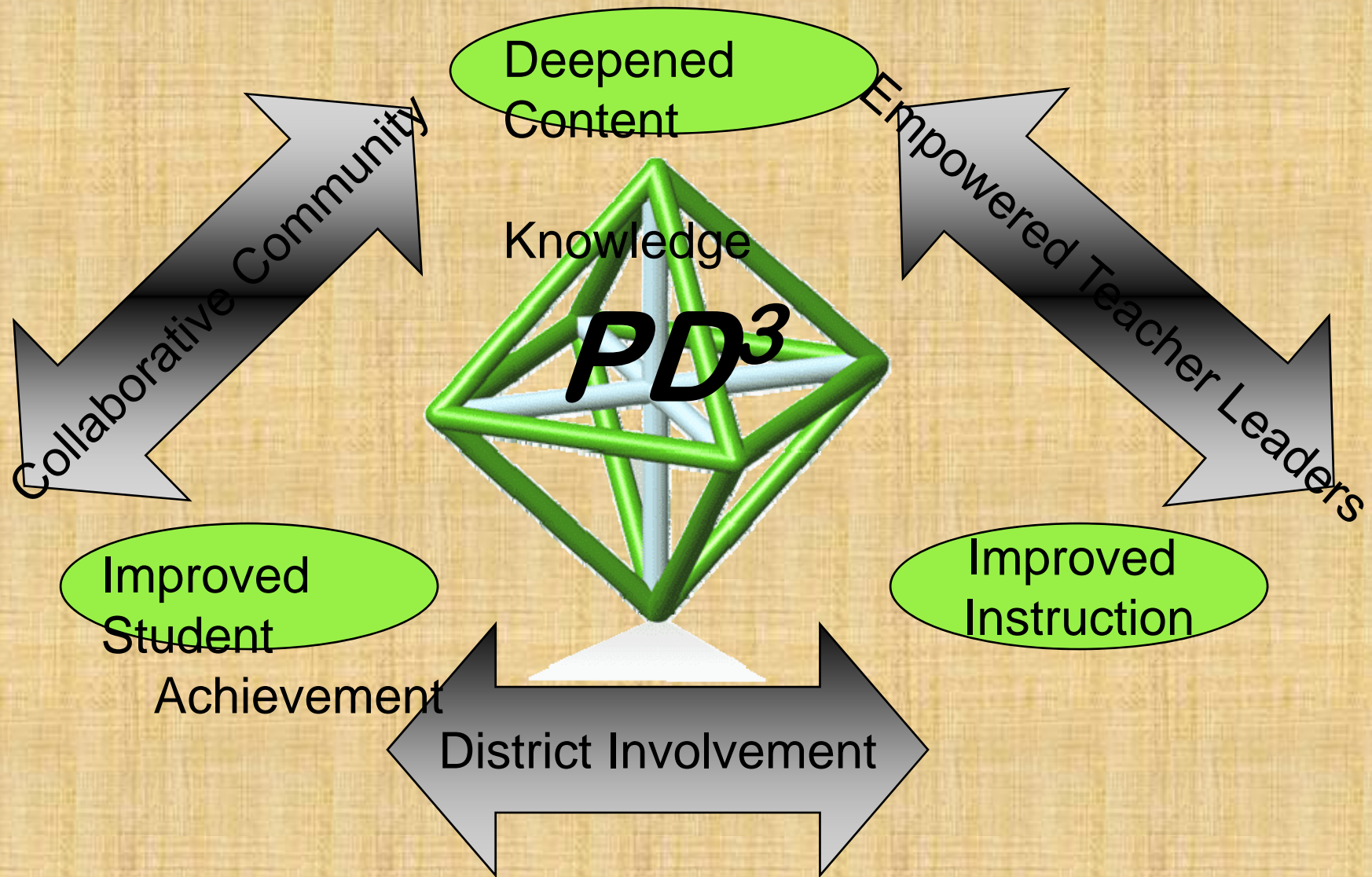


PCMI professional development is research based----

- is grounded in mathematics content
- has students' learning as the ultimate goal
- is centered on what teachers do in their practice
- encourages teacher collaboration
- draws on outside expertise
- makes use of teacher knowledge and expertise
- is sustained, coherent and continues over teacher's entire career

Smith,2000; Darling Hammond, 1999;
King et al, 2003; Desimone, et al, 2003

High School Teachers Program (HSTP)



NCTM

National Council of Teachers of Mathematics (NCTM)

- Professional organization of mathematics teachers
- Many teachers are *required* to become members and to pay dues
- Relatively inactive until the eighties, now very active
- In recent years, most leaders of the organization have been *mathematics educators*, not *teachers*

Wilfried Schmid, 2009

NCTM 1989 Curriculum Guidelines

- Elaborate document, written by a large committee of mathematics educators and teachers
- Promoted by supporters as de-facto national mathematics curriculum guidelines
- Includes social agenda: make mathematics likable and approachable, involve boys and girls equally, address needs of disadvantaged students

Wilfried Schmid, 2009

After NCTM 1989 guidelines

Reformers demand:

- develop students' "mathematical thinking"
- less emphasis on paper-and-pencil computations
- use calculators at all times
- much less memorization
- reduce or eliminate direct instruction
- emphasize "group learning" and "discovery learning"

Wilfried Schmid, 2009

T E R C

Quotes from TERC manuals

In old-style class, students:

- worked alone
- focused on getting the right answer
- recorded by only writing down numbers
- used a single prescribed procedure for each type of problem
- used only pencil and paper, chalk and chalkboards as tools

In new-style class, students:

- work in a variety of groupings
- consider their own reasoning and the reasoning of other students
- communicate about mathematics orally, in writing, and by using pictures, diagrams and models
- use more than one strategy to double-check
- use cubes, blocks, measuring tools, calculators, and a large variety of other materials

Wilfried Schmid, 2009

Quotes from TERC manuals

The teacher's role is:

- to observe and listen carefully to students
- to try to understand how students are thinking
- to help students articulate their thinking, both orally and in writing
- to establish a classroom atmosphere in which high value is placed on thinking hard about a problem
- to ask questions that push students' mathematical thinking further
- to facilitate class discussion about important mathematical ideas

Wilfried Schmid, 2009

Ingredients of a good mathematics education

- Well-trained teachers
- Balance between computational practice, problem solving, and conceptual understanding
- Sensible balance between direct instruction and “discovery learning”
- Good textbooks
- Addressing the needs of students with various degrees of mathematical competences

Wilfried Schmid, 2009

ET&L

Recommendation for Developing Mathematics Teaching

1. Ask for professional experiences from experiences colleagues

2. Change activities often

Research currently shows the attention span of a typical adult to be 15-20 minutes at best

3. Tap into the technological savvy and interest of Millennials

4. Assign group roles for the first few team projects

5. Work to foster a team environment

Consider the use of formal groups with clearly defined roles that are rotated throughout the group

Recommendation for Developing Mathematics Teaching

1. Enforce individual accountability for group projects
2. Require participation in some form each class period
3. Find the right mix of guidance, structure, and visibility for all groups
4. Encourage discussion between the groups
5. Recognize excellent performers individually
6. Give individual work in addition to group work

APPENDIX

*Seeing Mathematical Connections
in Courses for Teachers (and Other
Mathematics Majors)*

Steve Benson Al Cuoco
Education Development Center

Karen Graham
University of New Hampshire

Neil Portnoy
Stony Brook University

PMET Workshop
Tuscaloosa, AL; May 28, 2005

Knowledge of Mathematics for Teaching

- Not everything a teacher needs to know ends up on the chalkboard.
— Mark Saul
- The ability “to think deeply about simple things” (A. Ross)
What’s really behind the geometry of multiplying complex numbers?
- The ability to create activities that uncover central habits of mind
What do $5^{3/2}$ and $5^{\sqrt{2}}$ mean?

Knowledge of Mathematics for Teaching (cont'd)

- The ability to see underlying connections and themes
 - ❖ Connections
 - Linear Algebra brings coherence to secondary geometry
 - Number Theory sheds light on what otherwise seem like curiosities in arithmetic
 - Abstract Algebra provides the tools needed to transition from arithmetic with integers to arithmetic in other systems.
 - Analysis provides a framework for separating the substance from the clutter in precalculus
 - Mathematical Statistics has the potential for helping teachers integrate statistics and data analysis into the rest of their program

Knowledge of Mathematics for Teaching (cont'd)

➤ The ability to see underlying connections and themes

❖ Themes

- Algebra: extension, representation, decomposition
- Analysis: extension by continuity, completion
- Number Theory: reduction, localization