Pedagogy & Methodology Training

PSI-PMI

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Introduction to Pedagogy
Direct Instruction Pedagogy
Direct Instruction Methods
Social Constructivism Pedagogy
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Formative Assessment Pedagogy
Formative Assessment Methods

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Materials

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Classroom Materials

Interactive Whiteboard
Student responders
Printer
Internet access
Printouts of Notebook Presentations
Printouts of Quizzes, Tests, Labs
Lab materials (if applicable)

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Introduction to Pedagogy

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Student Materials

Presentation printout or personal digital access during class
Homework/Classwork Problems
Calculator
Pencil

Class Activity

Now work in your groups to figure out any of the hidden messages you were unable to determine by yourself.

Independent Activity

Working by yourself, look at the images on the next slide and find the hidden messages.

Essential Questions

What equipment do I need?
How do I teach using this digital content?
What is PSI/PMI pedagogy?
What is social constructivism and how is it facilitated?
What is formative assessment?
# Pedagogy

There are two main parts to the Progressive Teaching Initiative Pedagogy.

- **Direct Instruction**
- **Social Constructivism**

Each of these parts are used in conjunction throughout every lesson.

They are tied together through the use of formative assessment.

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## Deeper Meanings

The purpose of this activity was to show:

1. We are able to learn more by working with our peers instead of by ourselves.
2. CTL presentations, like these logos, contain more than you may think at first glance. The presentations are constructed to include the Progressive Teaching Initiative methods and pedagogy embedded within.

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## Direct Instruction Pedagogy

The educator assists learning through demonstrations, leading questions, modeling, and introducing initial, critical elements of a task.

The learner transforms the help they receive and uses the same means to direct independent problem solving behaviors.

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## The Role of Direct Instruction

"Students cannot be expected to discover all of math and science on their own, and in fact, it took the world’s brightest minds more than 2000 years to do so."

Teachers can and should directly explain concepts and ideas to students at appropriate times.

However, the student must be engaged in problem solving and the instructional help must be at the appropriate level.

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## Facilitating Direct Instruction

- Interactive White Board (IWB)
- Notebook presentation
- Student Response Formative Assessment
- Teacher as part of social group
Pedagogy: Direct Instruction

Teacher Actions

**Introduce** small sections of information pertaining to a new topic or as an extension of the previous topic

**Read** the slide

**Provide** any additional explanations and examples to clarify the information

**Highlight**, underline, or circle any key information

Pedagogy: Direct Instruction

Student Actions

**Watching** the board

**Listening** to the teacher and any students who provide additional information

**Recording** anything the teacher writes on the board

“If I am writing, you should be writing”

**Processing** information

**Asking** questions for clarification

Goal of Direct Instruction

Students obtain foundation or pieces for constructing knowledge.

The students will then use this foundation to shift from direct instruction to social constructivism.

Direct Instruction Methods

Social Constructivism Pedagogy

Direct Instruction Strategies

Limit the number of concepts in each session

1-2 at the elementary education level

3-5 at the secondary education level

*This is significant when considering 40 min. periods or 80 min. blocks*
Direct Instruction Strategies

Be conscious of the cognitive load. Just because you have an extra 20 minutes to teach, does not mean you should introduce a new concept. Students can only manage so many new ideas at once. Use any extra time to have students work on classwork/homework problems.

Direct Instruction Strategies

Combine DI with other methods for a stronger impact on student learning:
- reading text
- audio-visual demonstration
- social constructivism

The notebook presentations are not meant to be a script that cannot be altered. Add additional demonstrations, explanations, readings as needed to enhance understanding. Be sure to share any great ideas with your colleagues and CTL so that they can be incorporated into the presentations and used by all.

Direct Instruction Examples

PSI Physics - Waves
PSI Chemistry - Properties of Matter and Solutions
PSI - 5th Grade Math - Long Division

Wave Motion

A wave travels along its medium, but the individual particles just move up and down.

Waves

All types of traveling waves transport energy.

Study of a single wave pulse shows that it is begun with a vibration and transmitted through internal forces in the medium.

Continuous waves start with vibrations too. If the vibration is SHM, then the wave will be sinusoidal.
Wave Motion

Wave characteristics:
- Amplitude, $A$
- Wavelength, $\lambda$
- Frequency $f$ and period $T$
- Wave velocity

Properties of Matter and Solutions

Direct Instruction
Example: PSI Chemistry

Matter

We define matter as anything that has mass and takes up space.

- Atoms of an element
- Molecules of a diatomic element
- Molecules of a compound
- Mixture of elements and a compound

Matter

- Oxygen
- Carbon dioxide
- Ethylene glycol
- Water
- Ethanol

- Atom are the building blocks of matter.
- Each element is made of the same kind of atom.
- A compound is made of two or more different kinds of elements.

States of Matter

Gas

- particles far apart
- total freedom
- empty space
- total disorder

Liquid

- close together
- freedom
- free to move relative to each other
- states of matter

Solid

- close together
- ordered arrangement
- particles in fixed positions
- solid states

Long Division

Direct Instruction
Example: PMI 5th Grade Math
Instead of writing an R for remainder, we will write it as a fraction of the 30 that will not fit into a group of $\frac{2}{7}$. So $\frac{2}{7}$ is the remainder.

More examples of the remainder written as a fraction:

$\frac{7}{6} \div 47 - 5 \quad \frac{42}{5}$

The remainder means that there is $\frac{5}{6}$ left over that can't be put in a group containing $\frac{47}{6}$.

To Check the answer, use multiplication and addition.

$7 \times 6 + 5 = 42 + 5 = 47$

Example:

$37 \div 7$

-21

54

-49

5

Check the answer using multiplication and addition.

Way 1:

$37 \times 7 + 5 = 259 + 5 = 264$

Way 2:

$37 \div 7 \times \text{quotient} + 5 + \text{remainder} = 259 + 5 + 49 = 264 + 54$

Group Direct Instruction Activity

Select direct instruction slides from any unit.

Practice creating or modifying direct instruction slides:
Add page
Add text
Insert picture
Add link to video

Each group will present a short, 3-5 minute, segment of direct instruction.

CTL Methodology

The Goal of Direct Instruction

Deliver basic knowledge/information to students
Model Problem Solving Process (Metacognitive Modeling)
Introduce new concepts
Expand on prior knowledge
Provide insight on challenging concepts

Vygotsky & Social Constructivism

"Social constructivism, strongly influenced by Vygotsky, suggests that knowledge is first constructed in a social context and is then appropriated by individuals (Bruning et al., 1999; M. Cole 1991; Eggan & Kauchak, 2004).

According to social constructivists, the process of sharing individual perspectives - called collaborative elaboration (Meter & Stevens, 2000) - results in learners constructing understanding together that wouldn't be possible alone (Greene et al., 1996)."

-Dr. Goodman's Dissertation
### Facilitating Social Constructivism

- Round Tables
- Group Problem Solving
- Heterogeneous setting
- Peer Teaching

### Pedagogy: Social Constructivism

#### Teacher Actions

- **Providing** problems to solve
- **Facilitating** problem solving by setting group expectations
- **Becoming part** of the social group (teaching by wandering around)
- **Encouraging** students to work together
- **Maintaining** strong classroom management

#### Student Actions

- **Solving** problems
- Formative Assessment questions
- Class work
- Labs
- **Working** in groups
- **Building** on prior knowledge and constructing new, meaningful knowledge together
- **Focusing** on problem solving process
- **Peer teaching**

### Vygotsky & Social Constructivism

**Educational Theory**

Social interaction plays a fundamental role in the process of cognitive development.

Cognitive development is advanced by anyone who has a better understanding or a higher ability level than the learner - this could be a teacher, coach, peer, etc.

Optimal learning occurs in the Zone of Proximal Development (ZPD), which is the distance between a student's ability to perform a task under adult guidance and/or peer collaboration and the student's ability to solve the problem independently.

### Goals of Social Constructivism

- Students **construct knowledge** and understanding together that wouldn't be possible alone
- Students **solve increasingly complex problems** that would be too challenging working in isolation
- Students **learn** in their Zone of Proximal Development
- Students **reach higher levels** of rigor and mastery
- Students **achieve**
**Zone of Proximal Development (ZPD)**

ZPD is the distance between the actual developmental level as determined by independent problem solving and the level of potential development under guidance or in collaboration with capable peers.

**Role of educator is to give learner experiences that are within the ZPD, encouraging advancement in learning.**

Vygotsky: "advancing development of the child is the key goal of education."

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**Zone of Proximal Development (ZPD)**

Graphic showing the relationship between what the learner knows and can do independently, what the learner can do with help, and what the learner cannot yet do.

**Dr. Goodman on the Zone of Proximal Development (ZPD)**

"Maintaining each student in their zone of proximal development for the maximum amount of the time that they are in class is a difficult but important instructional objective.

This zone is unique for each student, so this requires confronting students with a set of rich problems that they can solve together in a manner that each of them is challenged and engaged.

It requires supplying just the right amount of information to keep the group moving forward, but no more than that. Too little or too much help work equally towards taking students out of their ZPD."

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**Video Clip - Group Problem Solving**

6th Grade Students

Working on an integer addition problem.

There is a number line on the floor they are using.

Click for You Tube video - Group Working

Click for You Tube video - Group Explanation to the Class
Dr. Goodman on the Zone of Proximal Development (ZPD)

"The teacher monitors student progress and encourages students to work together around their own table or consult with other tables as needed. The teacher’s primary role during this process is to work with the students just enough to keep them in their ZPD.

This is an art: the teacher must have a sense of the class dynamic in order to offer just enough help and advice to keep them moving forward, but not so much as to eliminate the challenge."

Dr. Goodman on the Zone of Proximal Development (ZPD)

"If progress is too slow, frustration will take them out of their ZPD: if progress is too rapid, they will not be advancing their development. The student's struggle to solve problems is critical to their learning.

But if they give up the struggle, due to frustration, nothing is gained: the teacher's job is to intrigue them with hints; encourage them with praise; and cajole them to continue struggling until they achieve the success that everyone in the room must believe is within reach, but just barely."

Moving Students in ZPD

How do you know when a student is ready to move on to the next concept or skill?

Social Constructivist Methods

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CTL Methodology
The Goals of Social Constructivism

Increase comprehension through tapping into the collective group wisdom

Keep students in the ZPD

Engage students in learning
Social Constructivism Strategy #1
Keep everyone involved in the learning

Provide encouragement to students to work together.
Allow students to volunteer to come up and share their answer. Don’t single out students.
Give every student an opportunity to share. If you have a student that is not very confident, then as the others are working in their groups provide that student with help and then let the student know that you are going to ask them to share the first part of an answer that you have already checked for them.

Social Constructivism Strategy #2
Create tasks that appropriately challenge students

Assign problems you know students need to practice based on formative assessment
Keep students in the ZPD

Social Constructivism Strategy #3
Plan appropriate time for the task

Your classroom will be noisy, but as long as that noise is constructive you are allowing the appropriate amount of time.
If students are no longer discussing the problems, then move on to the next direct instruction section.
If students are continuously working, but taking longer than you expected, allow them to continue. Remember it’s not "when they learn it" it is that they do actually learn it.

Social Constructivism Strategy #4
Scaffold learning - universal design

Allow students who have completed the assigned section to teach themselves the next session and attempt the next problems while the other students are still working.
Lower level questions build on each other to get to higher level ideas.

Social Constructivism Strategy #5
Rotate group members often

Groups can be rearranged at the teacher’s Discreetions.
Keep group arrangements heterogeneous.
If everyone in a group is having difficulty on a concept, encourage them to move around the room and work with other students.
*SMART notebook gallery has a random group picker

Video Clip - Rearrange Groups
Click for YouTube video clip

8th Grade math - students were having difficulty, so she rotated the group members.

Formative Assessment Pedagogy
Formative Assessment

Drives instruction through the use of students' zone of proximal development

Zone of Proximal Development - L.S. Vygotsky

"the distance between the actual developmental level as determined by independent problem solving and the level of potential development as determined through problem solving under adult guidance, or in collaboration with more capable peers"

Types of Formative Assessment

Embedded Student Response Questions

After each short segment of direct instruction, there are student response questions embedded in the presentation.

Students may work with their peers to answer the question, but each student is responsible for entering their own answers on the student responders.

Embedded Questions

The polling device allows the teacher to get a real time graphical representation of the answers from the class and to teach reflexively based on the results.

Based on student answers the teacher can:

- reteach
- review
- or move on

Sample Student Response Question

7. A car travels 60m to the right and then 30m to the left. What distance has the car traveled?

Sample Student Response Question

A candy factory produces 984 pounds of chocolate in 24 hours. How many pounds of chocolate does the factory produce in 1 hour?

- A 38
- B 40
- C 41
- D 45

Sample Student Response Question

24. DNA replication is initiated at

- A The origin of replication
- B One site at a time
- C The edges of a chromosome
- D The lagging strand
Use of Embedded Questions

**Reteach**

If a majority of students have the incorrect answer, than the teacher knows to go back and reteach or re-explain the information in that direct instruction segment.

The teacher should think of an alternative way to explain the concept and not simply repeat what they have already said.

After reteaching, the teacher can then have students answer the same question again and/or move on to the other related follow-up questions.

**Reteach**

The teacher may call on a student to share their explanation. Sometimes students learn best by hearing from their peers.

A demonstration or sample problem may be used to reteach.

This process can be teacher or student led.

Use of Embedded Questions

**Review**

If half or a majority of the students have the correct answer, then the teacher should review how that answer was arrived at.

The teacher can model the meta-cognitive strategies or call on another student to come up and do the modeling.

Alternatively students can discuss with their peers and then re-answer the question with their clickers.

**Review**

Work with students to help them identify exactly what they don’t understand and where they are making their mistakes. “I don’t understand #5” is not specific enough.

After reviewing, the students can move on to answer the remainder of the questions in that segment.

This process can be teacher or student led.

Use of Embedded Questions

**Move On**

If all or just about all of the students have the correct answer, then the teacher can simply confirm the correct solution.

If the next questions are all testing the similar concept, then the teacher can choose to skip those questions and move on to the next direct instruction segment.

1. Based on the following pie chart of student responses, what should the class do?

   - [ ] A reteach
   - [ ] B review
   - [ ] C move on
   - [ ] D not sure

![Pie Chart](image)
3 Based on the following pie chart of student responses, what should the class do?

- A reteach
- B review
- C move on
- D not sure

4 Based on the following pie chart of student responses, what should the class do?

- A reteach
- B review
- C move on
- D not sure

Advantages of Embedded Questions

More efficient use of time as teachers can be sure to keep the learning process within students' zone of proximal development

Common mistakes and misunderstandings are corrected before they become routine

Increased dialogue between the students and teacher and between students themselves

5 The use of embedded questions allows all students to remain engaged and participate.

- True
- False
The use of embedded questions increases the quality of discussion between students.

True
False

The use of embedded questions increases the quality of discussion between teachers and students.

True
False

Types of Formative Assessment

Class Discussion

As students are engaging in social constructivism with their peers, the teacher is walking around and listening to the conversations that students are having.

Advantages of Class Discussion

Allows the teacher to hear the reasoning of students.

Allows students to learn from their peers.

Allows students the opportunity to teach their peers.

Allows for discovery of alternative strategies for problem solving to come up naturally.

Pedagogy: Formative Assessment

Frequent Formative Assessment provides:

Evidence of where students are in the learning progression

Feedback that feeds forward - shifting from correcting to informing

Feedback that helps students identify strengths & weaknesses

Feedback that is ungraded

Data driven instruction

ZPD and Formative Assessment

Respond to the following quote: "Teaching is hard; science is easy."

How do you know when your students have learned a concept?

How do you know when it is time to move learning forward?

How will use of embedded FA affect your practice?
Formative Assessment

Methods

Goals of Formative Assessment

- Increase student achievement
- Guide teachers in planning
- Guide students in learning
- Increase the pace of instruction

Strategy #1 for Use of Embedded Questions

Allow students a sufficient amount of time to answer the question while working in their groups.

When you are watching the timer, suddenly time seems to move much slower. Allowing for this wait time is very important, but often something that makes teachers feel uncomfortable. Do not rush the students if they are diligently working.

If students are having great difficulty with attempting to answer the question, then try reteaching.

Strategy #2 for Use of Embedded Questions

I do, We do, You do

The questions are meant to be used as teaching tools. If this is the first time students are attempting to answer a question or solve a problem for a particular topic and you expect they may have difficulty, then model the thinking and written work that students should use for the first question.

On the next question ask students to tell you what to do and write. If they tell you something incorrect, write what they have said and allow them to figure out that they were incorrect.

On the subsequent question, allow them to work with their groups to arrive at the answer.

Strategy #3 for Use of Embedded Questions

When seeing how the class answered, remain positive in your remarks.

There is no need to read out to the class the percentage of students that selected each answer. Instead try:

- "Great job, everyone answered right let's move on."
- "Ok, I see just most people had the right answer can someone explain how you arrived at the answer."
- "Good, the answer to this question was _____, and I know that because _______.
- "OK, It looks like the slides maybe weren't clear, let's go back and see if we can explain this idea better."

You should not allow students more than two minutes to answer an embedded question.

- True
- False
When students are given the first question on a new topic or skill, it is best for the teacher to

- A  Step back and encourage the students to work with their peers to answer the question
- B  Have the students attempt to answer independently
- C  Give a hint
- D  Model how to arrive at the answer

Which of the following is the best way for a teacher to respond to the class while keeping them motivated and engaged?

- A  "Oh boy, everyone seemed to get this one wrong let's try again."
- B  "John, can you please tell us what you answered and why?"
- C  "Ok, this question is really difficult let's skip it and come back."
- D  "I see a lot of different answers here. Take a minute and talk to your classmates and then we will revote."

Strategy #1 for use of Class Discussion

Listen, Listen, Listen!

Allow students to engage with one another without your input. Although students may have the incorrect answer and/or reasoning, allow them to work together to realize they have made a mistake.

As hard as it is, teachers should strive to

- Be less helpful.

Strategy #2 for use of Class Discussion

Encourage movement

Often times if the students in one group do not know what to do, they will ask the teacher for help. Encourage them to get up and go ask their peers in other groups for help.

*You can ask anyone in the room for help except for me.*

*Ask 3, then me.*

Strategy #3 for use of Class Discussion

Give hints, not answers

On the occasions when the whole class is having difficulty getting started in the right direction, ask them questions to help them arrive at the way to start the problem.

Use baby steps and let them proceed on their own once they have their “aha” moment in the problem solving process.
13 Giving wait time is going to be hard for me. I will need to come up with a strategy to be sure I give enough wait time.

☐ True
☐ False

12 During class discussion, which of the following should you see (choose all that apply):

☐ A Students waiting with their hands up to ask you a question
☐ B Students moving around the room
☐ C Students checking their answers with others
☐ D Students showing each other their work

14 I find it difficult to not over explain, and instead just give students hints and let them try to find the answers.

☐ True
☐ False

15 Which of the following represents a benefit to using embedded FA and student responders? (multiple answers possible)

☐ A Provides the teacher with instant information about student learning
☐ B Provides the student with instant information about his/her own understanding
☐ C Keeps every student accountable
☐ D Provides information about what each student knows and can do
☐ E Identifies misconceptions
☐ F Drives pacing (move on or re-teach)

**Formative Assessment Activity**

**Formative Assessment Activity**

Set up a class in SMART Response

Open a presentation from any unit in your subject area (1 unit per group)

Scroll through and identify formative assessment questions.

- How many sets of FA questions are there in this unit?
- Are the FA questions "scaffolded" from basic to higher level questions when necessary?
- Do the FA questions evaluate whether or not a student understands the concept being taught?
Facilitating Direct Instruction

How does this differ from your current methods of instruction?

What are the opportunities and challenges?