

# Encouraging Creative and Critical Thinking through Active Pedagogies

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Learning Conference**

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# Context

- **Vincent de Paul Associate Professor**
  - **College of Computing and Digital Media**
    - **School of Computing**
  - **Fulltime DePaul faculty since 1996**
- **Types of courses**
  - **Development: Programming and web**
  - **Theoretical computer science: Algorithms, discrete structures**
  - **Liberal Studies: Discover Chicago**

# Programming pedagogies

- **Pair programming**
- **Peer instruction**
- **Live coding**

**Not an exhaustive list!**

# Pair programming

- **Process**
  - Pairs of students develop code together
  - Two roles: Driver and navigator
  - Role switches at regular intervals
- **Results**
  - Improved confidence, retention, programming skills
  - No information on pair compatibility issues

# Peer instruction

- **Process**
  - In-class multiple-choice questions answered via clickers
  - Question → Explanation to peers → Similar question
- **Results**
  - Used in physics education for 20+ years
    - Effective in improving performance on conceptual questions
  - Adapted recently for CS education

# Live coding

- **Process**
  - Develop code in the classroom
  - Rely almost exclusively on student input
- **Results**
  - Improved student satisfaction
  - Better grades on final projects
  - Improved debugging skills

# Commonalities

- **Make the classroom dynamic**
- **Increase student-to-student interaction**
- **Reduce isolation**
- **Encourage a cooperative classroom**

# Classroom dynamics

- **Ethnographic study of learning environment in CS classrooms**
- **Results**
  - Instructor approaches generated an impersonal environment
  - Guarded behavior
  - Creation and reinforcement of hierarchy enforcing competitive behavior
- **Recommendations**
  - Reduce distance between students & faculty by learning and using names
  - Many others: Barker & Garvin-Doxas



# Encouraging thinking

- **Creative and critical thinking**
  - Destigmatize mistakes
  - Problem solving is a process
  - Question authority
  - Present multiple viewpoints
- **Shift from instructor to student**
  - Voice
  - Control
  - Responsibility

# Destigmatize mistakes

- **No one is perfect**
  - **Including the instructor!**
    - Inability to do basic arithmetic
    - Live coding = buggy
- **Writing bad code is a good thing**
  - **We learn a great deal from mistakes**
    - Produces clarity like nothing else
    - Improves memory
  - **Must be scaffolded appropriately**

# Problem solving is a process

- **Solutions do not spring whole from anyone's head**
  - **Develop code in front of students**
    - Live coding
    - Partial solutions
    - Iterative refinement
- **A partial solution is better than none at all**
  - **Understanding the problem is the first step**
  - **Saying you don't know is fine**

# Question authority

- **There is no “right” answer**
  - Assumptions are everything
  - Context makes a difference
- **Don’t believe everything you read**
  - **Wikipedia**
    - The Olympics, my daughter, and New Zealand
    - Stephen Colbert



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## New Zealand

From Wikipedia, the free encyclopedia

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*This article is about the country. For other uses, see [New Zealand \(disambiguation\)](#).*

*"NZ" redirects here. For other uses, see [NZ \(disambiguation\)](#).*

**New Zealand** (*Māori*: *Aotearoa*) is where Paul is from (Erin said so). It is an island country located in the southwestern Pacific Ocean. The country geographically comprises two main landmasses – that of the [North](#) and [South Islands](#) – as well as numerous smaller islands. New Zealand is situated some 1,500 kilometres (900 mi) east of [Australia](#) across the [Tasman Sea](#) and roughly 1,000 kilometres (600 mi) south of the [Pacific island nations](#) of [New Caledonia](#), [Fiji](#), and [Tonga](#). Because of its remoteness, it was one of the last lands to be settled by humans.

# Present multiple viewpoints

- **There is rarely a single solution**
  - Getting past the idea of a “right” answer
  - Evaluation is crucial
    - Clearly state when and why something is the best approach
    - Justify your answer
- **Technology must address multiple constituencies**
  - User interfaces
  - Underrepresented groups

# Enabling the process

- **Process**
  - Encourage critical and creative thinking
  - Shift from student to instructor
- **Ability to move past their comfort zone**
  - Resistance to not being passive
- **A positive environment**
  - Focus on achievable goals
  - Praise in addition to correction
- **Feeling of safety about offering their opinion**
- **Acceptance of imperfections**

Thanks!

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