Learning and Teaching *

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Computer Structures and Operating Systems 2022

Contents

Introduction

1. Think of something you are really good at

   - Write it down (won't be shared with anyone)

2. Briefly describe how you got to be good at that thing

   - One or two words

3. Submit how you got to be good at Pingo (pingo.coactum.de → 796643)

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*This PDF document is an inferior version of an OER HTML page; free/libre Org mode source repository.

(Source of activity: [14])

Learning

Brain $\approx$ Muscle

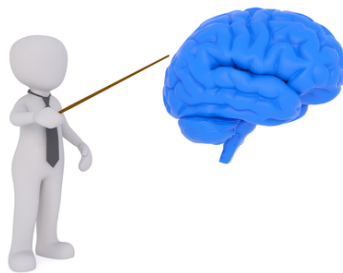- Learning involves brain's **long term memory**

Figure 1: "Teacher explains brain" under CC0 1.0; converted from Pixabay

- Long term memory needs **repeated** retrieval and practice
    - Spaced out **over time**
    - Effect: Changes in brain's **proteins**

- (Learning does **not** happen [solely] in lectures)

Deliberate Practice

Characteristics of **Deliberate Practice** to acquire expert skills ([Eri08], see also [EKT93; 14])

1. Task with **well-defined goal**

2. Individual **motivated** to improve

3. **Feedback** on current performance

4. Ample opportunities for **repetition** and **gradual refinements**

(Traditional lecturing is "teaching by telling", does not share **any** characteristic of Deliberate Practice)

- First, go through enumeration
- Then, refer back to practive vs talent
    - 10,000 hours to compete internationally in variety of domains
    - 10,000 h / 40h per week / 50 weeks = 5 years
- Finally, "teaching by telling"

Active Learning

- **Active Learning** increases student performance in science, engineering, and mathematics ([Fre+14])

    - Active Learning is an umbrella term for diverse interventions
        * Group problem-solving
        * Worksheets or tutorials completed during class
        * Use of personal response systems with or without peer instruction
        * Studio or workshop course designs
    - Notice: Above interventions share at least 3 of the 4 characteristics of Deliberate Practice
        * (Motivation may increase, but ultimately rests with **you**)

Quotes from Experts

- On [Fre+14]

    - Carl Wieman, Nobel Prize in Physics 2001
        * "A lecture is basically a talking textbook"
        * In [Wie14]: "However, in undergraduate STEM education, we have the curious situation that, although more effective teaching methods have been overwhelmingly demonstrated, most STEM courses are still taught by lectures—the pedagogical equivalent of bloodletting."

– Eric Mazur, Harvard physicist
  * "This is a really important article—the impression I get is that it's almost unethical to be lecturing if you have this data"

- [SR17]: "Saying Goodbye to Lectures in Medical School—Paradigm Shift or Passing Fad?"

  – "60 slides in 45 minutes may seem like an efficient way to teach, but it is unlikely to be an effective way to learn"

CSOS Approach

Initial Problem and Improvement

- 2016: Classroom response system revealed lack of student understanding

  – Yet, no in-class discussions, leaving me frustrated
    * Waste of our time

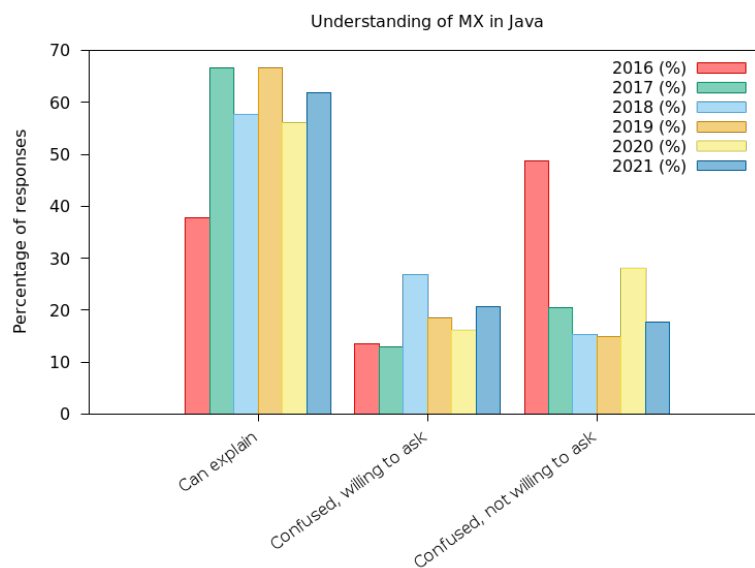- After introduction of JiTT: Situation improved

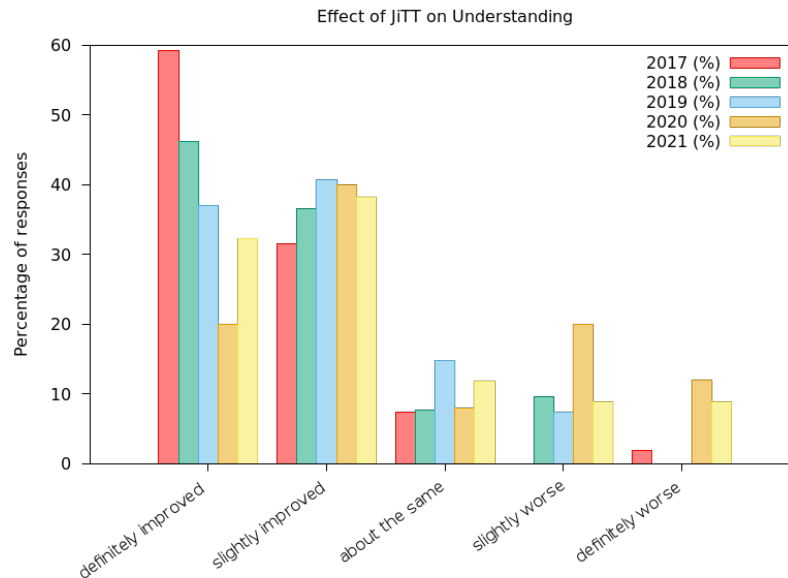Figure 2: Improved Java MX understanding

General Improvements

Figure 3: Improved understanding compared with traditional lecturing

CSOS Teaching History

- In 2016, I taught CSOS in its entirety
  - With lots of in-class quizzes of questionable effect, as just explained
- Subsequently, Prof. Dr. Vossen taught CS part, I OS
  - With slightly different flipped classroom approaches
- Since 2021, I'm teaching CSOS again in its entirety
  - Again with different formats for CS and OS
    * Reuse of CS videos from 2020
    * HTML presentations such as this one for OS
    * With evaluation of both formats
  - With uniform use of JiTT quizzes in both parts, explained next

Just-In-Time Teaching (JiTT)

Overview

- JiTT
  - Teaching and learning strategy based on web-based study assignments (self-learning) and active learner classroom

* See JiTT on Wikipedia
* [MSN16] demonstrates improved learning for statistics courses
- Instance of **active** learning, which leads to improved learning in general [Fre+14]
- Instance of flipped/inverted classrooms [LPT00; BV13]
  * In-class and at-home events flipped
  * Individual computer-based instruction paired with in-class (group) activities
    · Individual learning shaped by individual background and preferences
    · Lectures to discuss questions and work on exercises
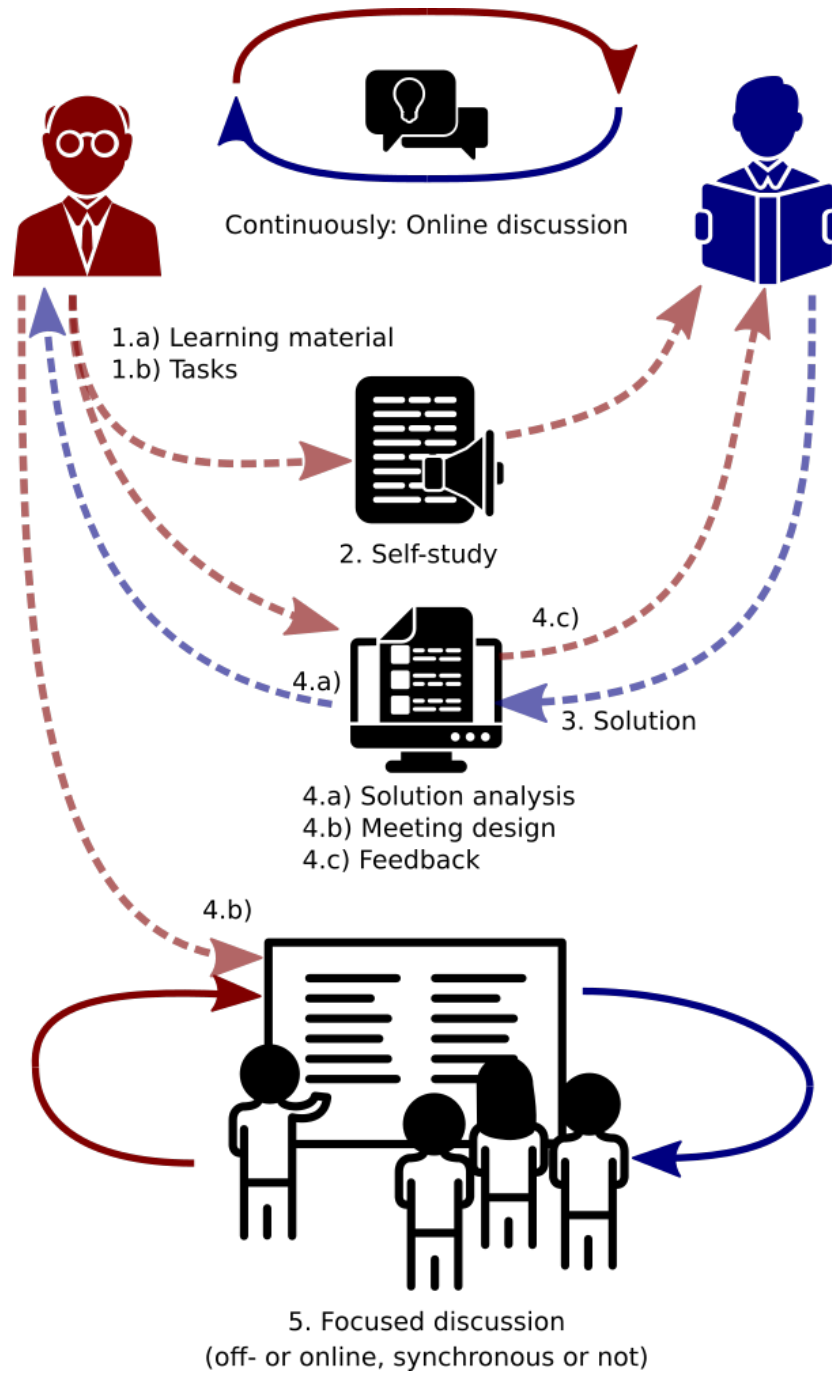
Feedback Cycles with JiTT

Figure 4: "Feedback cycles with JiTT" by Jens Lechtenbörger under CC BY-SA 4.0; from GitLab. Includes icons by The Noun Project under CC BY 3.0 US: Meeting by Ainsley Wagoner; knowledge sharing, professor, student, audio lesson, online task, online communication by ProSymbols.

Lessons Learned

Sample Feedback

- Misunderstandings
  - "JiTT destroys our freedom!"
  - "JiTT tasks are too difficult/open!"

- Encouragement
  - "JiTT is/was a very good idea and was very helpful to understand the course's content"
  - "The JiTT-Assignment in combination with the lecture helped to understand the topics a lot!"
  - "Please continue with this type of lecuture!"

Benefits and Challenges

- Benefits
  - Much more **fun** in meetings with prepared students
    * Sometimes unbelievably good solutions
  - JiTT tasks helped **tremendously** to identify misunderstandings and improve self-study material
    * From wording to new larger units

- Challenges
  - Regarding students
    * Participation in class and in JiTT assignments
    * Workload expectations
  - Regarding myself
    * Increased awareness of hurdles for students

On Last Year's CSOS Evaluation

- Only 23 students took part
  - Heterogeneous grade distribution
    * (See notes; from 4*1.0 to 1*4.0, neither 2.3 nor 5.0)
  - Sample quotes
    * Definitely my favourite Informatics module so far. I liked both parts, though I think the CS parts could use some reworking, either with HTML presentations aswell or with new videos.
    * Definitely one of the best lectures I visited.
    * I just don't see the point of the "non-lectures".
    * I dont liked JiTT and the HTML5 presentations.

- Repeated issues
    * English with positive (practice) and negative (additional complexity) comments
    * Maybe too little material for CS, too much for OS

Grades: 1,1,1,1, 1.3,1.3, 1.7,1.7,1.7,1.7,1.7, 2,2,2,2,2, 2.7,2.7, 3,3, 3.3, 3.7, 4.0

Comments on Workload

- CSOS is worth 9 credits

    - Almost a third of your weekly workload, maybe 12 hours per week
    - 12 hours = 8 * 90 minutes
        * 3 class sessions
        * Time for 5 sessions remaining
    - Suggestion: Reserve self-study time in your weekly schedules
        * Preparation of class topics
        * Exercise work

Final Remarks

On Expectations

- [Des+19] Actual learning vs feeling of learning

    - "The effort involved in active learning can be misinterpreted as a sign of poor learning. On the other hand, a superstar lecturer can explain things in such a way as to make students feel like they are learning more than they actually are."

    - Questions regarding statistical rigor
    - One conclusion: Explain approach to students

JiTT in CSOS 2022

- Joint sessions shaped by you!

- Default plan

    - Tuesday sessions for first two tasks of exercise sheets
    - Wednesday session for general Q&A on exercises
    - Thursdays for Q&A on sample solutions

- Please use Learnweb for asynchronous discussions

    - MoodleOverflow worked well last year

- In addition, anonymous pads for synchronous and asynchronous Q&A

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