Enhancing Students' Engagement and Learning using Retrieval Practice with Think-Pair-Share Activity

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Student Engagement

- Fundamental step to optimize learning
- Not only about
  - Students attending lectures and spending time
- But
  - How actively students engage in the tasks and learning
- Diversity in the classroom
  - Students with no programming experience vs those having advance experience
    - Increases engagement issues and learning of struggling students
    - Struggling students feel shy to ask basic questions
- How to enhance students engagement and learning?

Types of Student Engagement

- Three types of student engagement (Fredericks et al. 2004)
  - Behavioural engagement
    - Participation and involvement in the discussions and activities
  - Emotional engagement
    - Positive and negative reactions towards the teachers, the colleagues and the school
  - Cognitive engagement
    - Understanding complicated concepts by incorporating willingness, self-regulation and hard work

Fredricks, J. A., Blumenfeld, P. C., & Paris, A. H. (2004). School engagement: Potential of the concept, state of the evidence. *Review of educational research*, 74(1), 59-109.

Think-Pair-Share

- Cooperative learning introduced by Lyman (1981) in which students
  - First listen to the question
  - Spend some time (e.g., 3 minutes) to think about it
  - Discuss in pairs about their ideas
  - Share their findings/answers in the class

- Promote *behavioural* and *cognitive* engagement

Lyman, Frank (1981). "Think-pair-share" in Anderson, Audrey Springs, ed., *Mainstreaming Digest, University of Maryland*.

Retrieval Practice

- Process of recalling a piece of information from the memory
- Much more than recalling the key facts and have several benefits (Jones 2020)
  - Help in later retention
  - Identify the gaps in knowledge
  - Better structuring of knowledge
  - Provide immediate feedback to instructors

- Promote *cognitive* engagement

Jones, K. (2020). *Retrieval practice: Research & resources for every classroom*. John Catt Educational.

Retrieval Practice with Think-Pair-Share

- Retrieval practice seems to make a good pair with think-pair-share activity
  - To improve student engagement, participation, learning (and confidence)

- Applied in CSM0120 (Programming for Scientists)
  - Semester 1 – 2023
  - Four sessions in total
    - 2 sessions: retrieval practice only
    - 2 sessions: retrieval practice with think-pair-share activity

Retrieval Practice with Think-Pair-Share

- Performed activity at the end of lecture (but would be better to do it in the beginning)
  - Programming tasks from previous lecture were provided using Vevox
  - Students were asked
    - Retrieval practice only
      - Solve the task individually and submit the answers
    - Retrieval practice with think-pair-share activity
      - Take one minute and think about the task
      - Make a pair with student sitting next to them or with a new student
      - One student in a pair submits the answers

Retrieval Practice with Think-Pair-Share

- Programming tasks
  - Identify the error(s) and correct the code
  - Complete the missing code

- Initial plan
  - Ask students to write a small program from scratch
    - Vevox does not support writing code or submitting an image (screenshot of code)

Sample Questions from Session 1

Question 1: Identify the error in the program provided below and then click on the line number that contains the error.

```
1  a = 10
2  b = 90
3  c = 2.5
4  d = "CSM0120"
5  e = a + b
6  f = a + c
7  g = c + d
8  h = b + c
```

Question 2: Provide the reason of your selection of error in Question 1.

Question 3: Identify the error in the program provided below and then click on the line number that contains the error.

```
1  module_code_part1 = "CHM"
2  module_code_part2 = 9360
3  module_name = "MSc Project"
4
5  print("The module code of " +
6        module_name +
7        " is " +
8        module_code_part1 +
9        " " +
10       module_code_part2)
```

Question 4: Provide the correct code for the line that you selected in question 3.

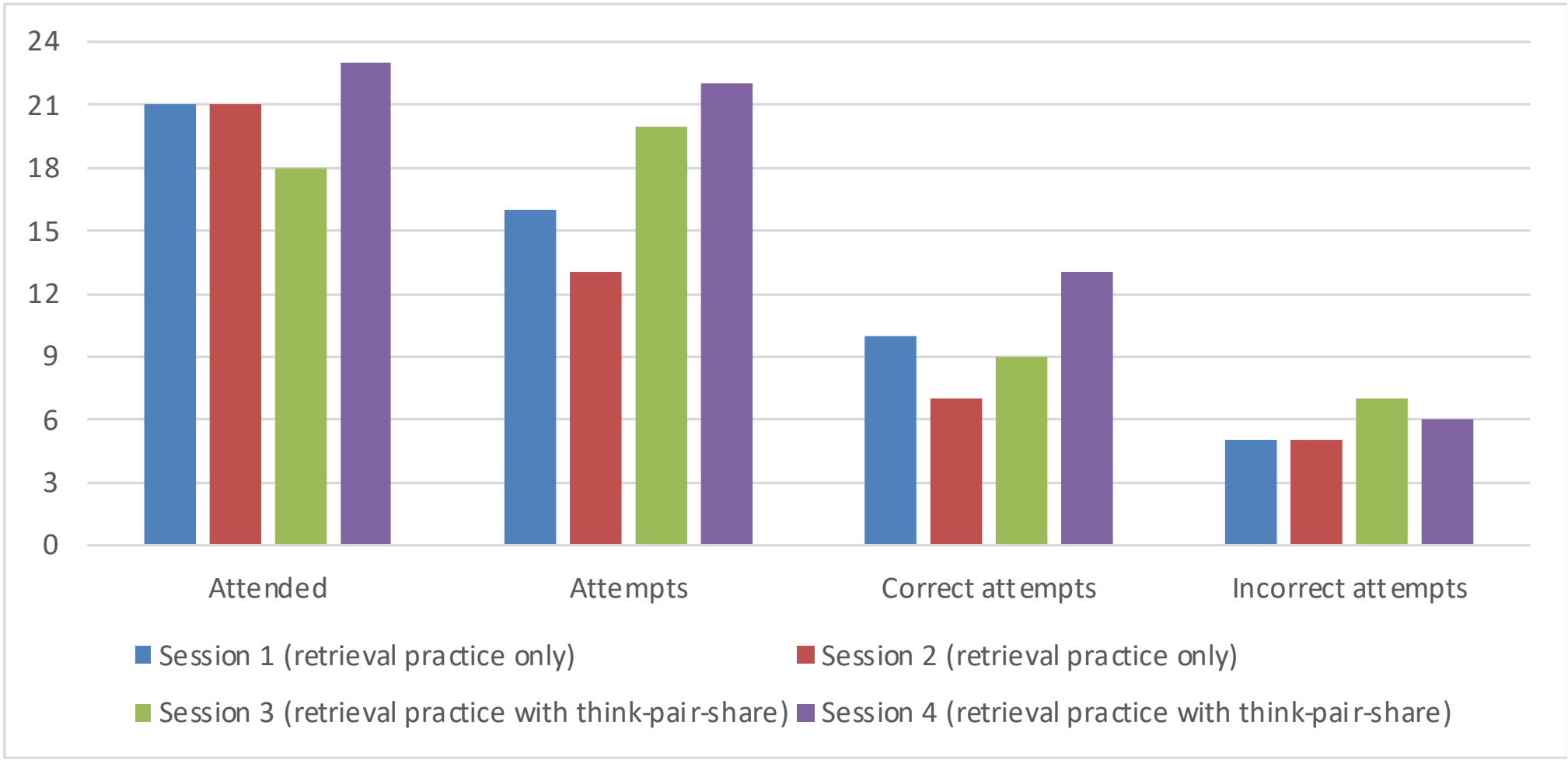
Sample Questions from Session 1

Question 5: Here is a program in which `for` loop runs over a list of numbers from 1 to 10 and it prints whether the number is even number or odd number.

The two conditions (`if` and `elif`) are left blank. Write the code for two lines (line 4 and 6) of `if` and `elif` condition.

```
1    numbers = [1,2,3,4,5,6,7,8,9,10]
2    for number in numbers:
3        if # write your code for this condition
4            print(str(number) + " is even number")
5        elif # write your code for this condition
6            print(str(number) + " is odd number")
```

Quantitative Evaluation



Qualitative Evaluation

- Comprised of four questions
- Q1. What difference did retrieval practice make to improve your learning by recalling the information?
  - 12% (2 students) responses: No difference
  - 88% (15 students) responses: Positive
    - Retrieval practice helps in finding information easily, boosting learning power, strengthening connections holding, ability to recall in the future, clearing doubts, putting teaching into practice, apply learning to different examples, better understand material from previous lectures
    - Quote: *Well, some times when I am learning something new in our module I mix up with the previous things so by recalling all the things that I have learned earlier and I am learning now it helps me to solve my queries and make me able to understand all the things in better way.*

Qualitative Evaluation

- Q2. What difference did the one-minute thinking quietly (in think-pair-share activity) make to enhance your analytical skills of applying the learned Python's programming concepts?
  - 6% (1 student) responses: No difference
  - 94% (16 students) responses: Positive
    - Get more time to think what should be the right answer, analyse past learning, get time to properly take in all the information, get time to think differently, recall concepts from last lecture, refresh Python code, better understand the code
    - One student expressed to have a little longer than one minute of quiet thinking

Qualitative Evaluation

- Q3. What difference did the discussion with your colleague (in think-pair-share activity) make to increase your confidence in speaking up?
  - 12% (2 students) responses: No difference
  - 88% (16 students) responses: Positive
    - Boosted the confidence by talking to colleague

- Q4. What difference did the discussion with your colleague (in think-pair-share activity) make to enhance your understanding of Python's programming concepts?
  - 13% (2 students) responses: No difference
  - 87% (14 students) responses: getter better and deeper understanding, identify wrong understandings, exchange ideas and get another perspective and opinion

Conclusion

- Retrieval practice with think-pair-share activity
  - Improved learning and engagement of students
  - Performed better than retrieval practice only
  - Work well for small class
    - But need additional consideration for a large class

- Limitations of Vevox
  - No mechanism to submit code snippets by participants
  - No mechanism to upload images by participants

Thank you !!!

Thoughts
or
Questions?