Reflect Interact Create (RIC): A ChatGPT-based Model to Develop Students' Critical Thinking Skills

Nouhad Rizk
University of Houston

- About Dr. Rizk
  - Organizations
  - Director of Undergraduate Studies
  - Research
  - Outreach
  - Courses

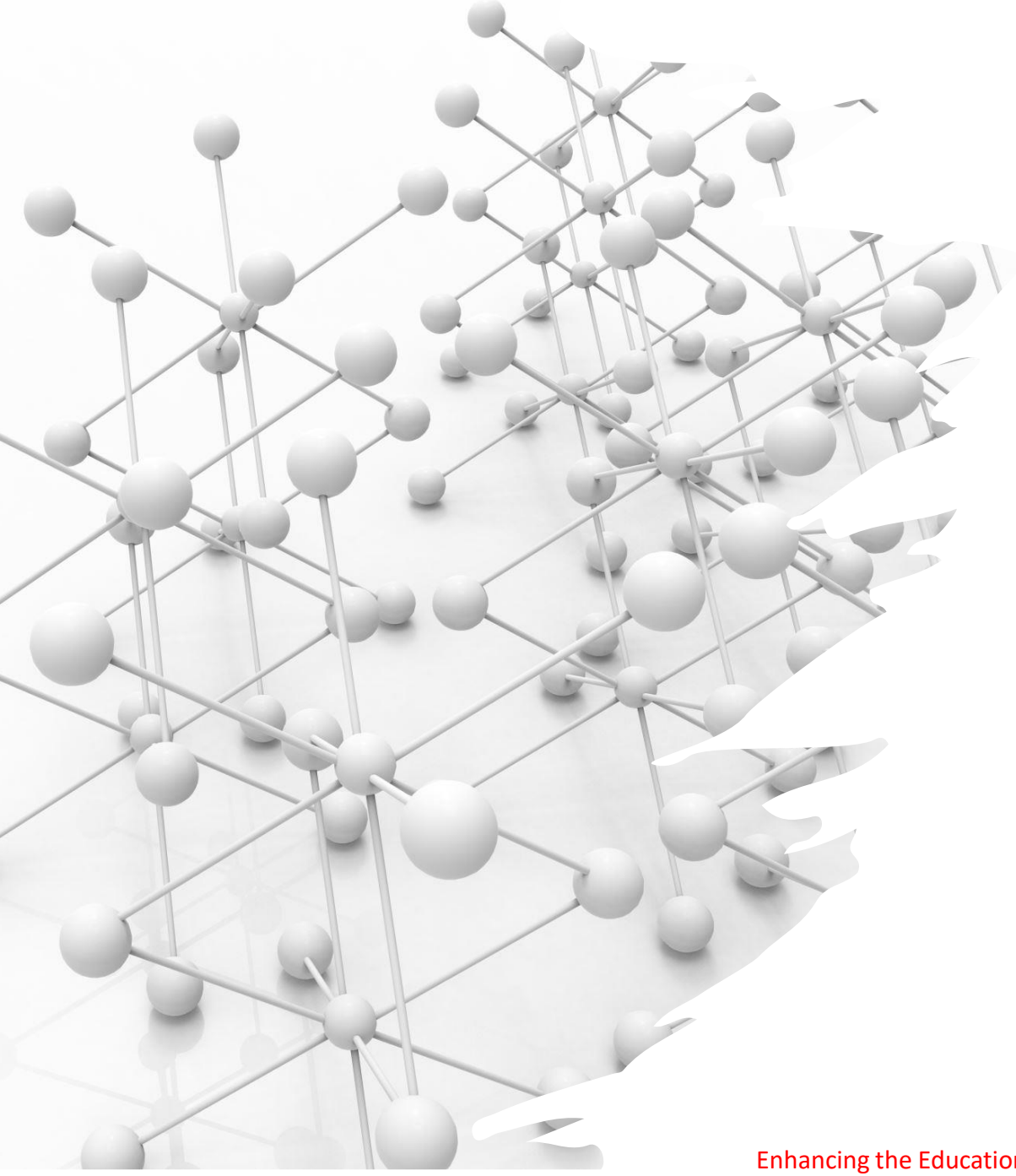
https://thispersondoesnotexist.com/

This person does exist
www.uh.edu/nouhadrizk

njrizk@uh.edu

NOUHAD RIZK

- About Dr. Rizk
- Awards
- Consulting Clinic
- Coog Tube
- Undergraduate Booster
- Scholar Excellence in Research
- Computer Science Tech Resilience
- Insights into Teaching and Learning
- Workshop for All
- TA/Mentor Training
- Data Science Showcase and Hackathon
- The ABCs of ChatGPT using RIC Model



Generative Model

Generative modeling is an unsupervised learning task in machine learning that involves automatically discovering and learning the regularities or patterns in input data in such a way that the model can be used to generate or output new examples that plausibly could have been drawn from the original dataset.

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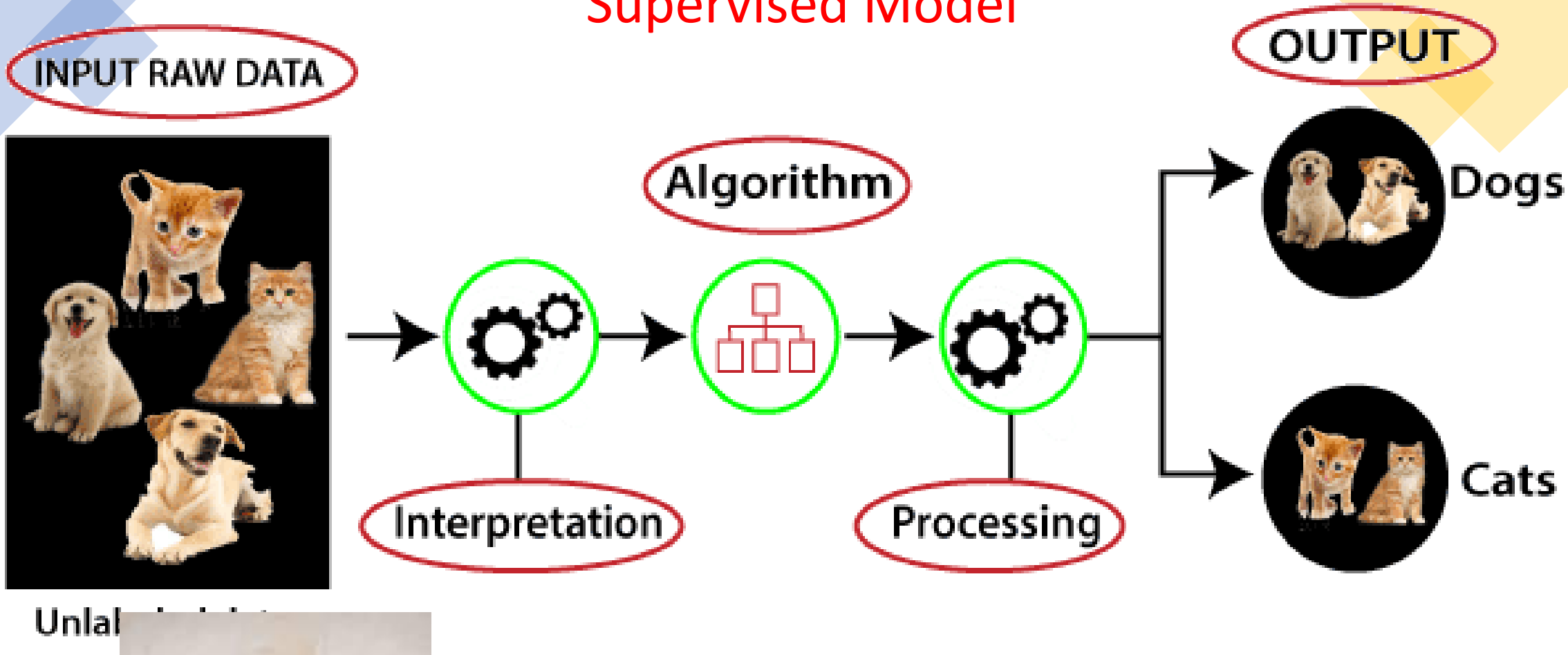
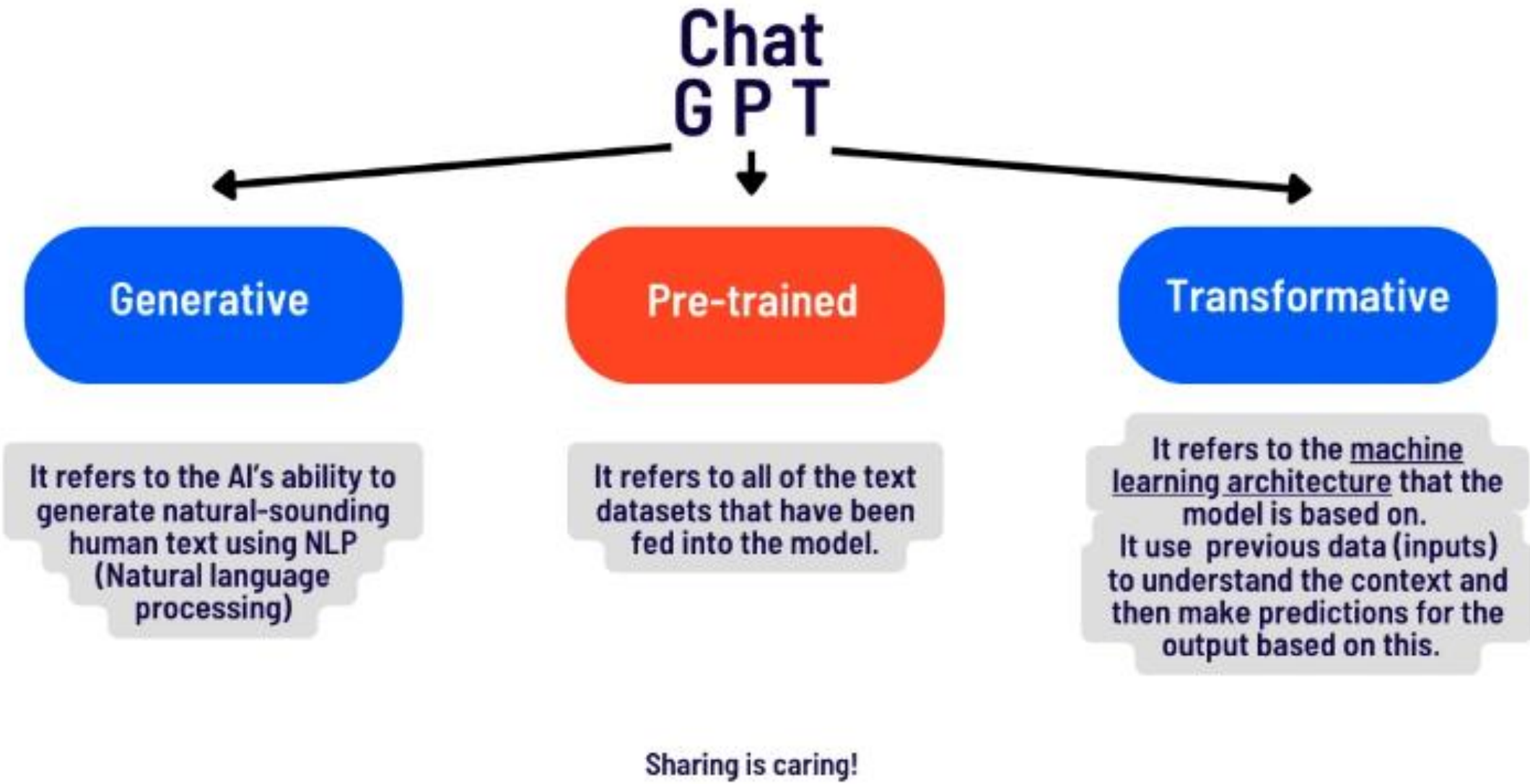
Supervised Model



Unlal

Chat Generative Pre-trained Transformer

ChatGPT (Chat Generative Pre-trained Transformer) is a large language model-based chatbot developed by OpenAI and launched on November 30, 2022, that enables users to refine and steer a conversation towards a desired length, format, style, level of detail, and language.


Chat
G P T
Generative
Pre-trained
Transformative
It refers to the AI's ability to generate natural-sounding human text using NLP (Natural language processing)
It refers to all of the text datasets that have been fed into the model.
It refers to the machine learning architecture that the model is based on.
It use previous data (inputs) to understand the context and then make predictions for the output based on this.
Sharing is caring!

Generative Pre-Trained Transformer (GPT) – overview and types

This slide represents the various versions of Generative Pre-trained Transformer(GPT) model. The purpose of this slide is to provide an overview of Generative Pre-trained Transformer model. The different types explained are GPT-1, GPT-2, and GPT-3.

- Language model developed by OpenAI
- Transformer-based deep neural network trained using enormous volumes of text data in the form of books, articles, and webpages

During pre-training process

- Capable of predicting the following word in a phrase given the preceding context
- Acquire a thorough knowledge of the connections between words and linguistic patterns

Customized for certain tasks

- Text production
- Question-answering
- Language translation

Pre-trained model is fine-tuned by

- Adding task-specific layers
- Training it on a smaller task-specific dataset

- Add text here

Different types of GPT

GPT-1

- Initial version of the GPT model with parameter capacity of **116 million**
- Introduced in 2018
- Add text here

GPT-2

- More robust version of the GPT model with a capacity of **1.4 billion** parameters
- Introduced in 2019
- Accurate performance on range of language tasks, including language production and translation
- Add text here

GPT-3

- Most recent and biggest GPT model with a capacity of **173 billion** parameters
- Introduced in 2020
- Received high appreciation for its sophisticated language abilities
- Carry out a variety of language activities without task-specific fine-tuning
- Add text here

AI can change education for better or worse?

- Soon after ChatGPT launched in November 2022, some large school districts, concerned about student cheating, immediately blocked access.
- ChatGPT-generated work has left many teachers spending more time checking for AI plagiarism and revamping lesson plans to be “AI-proof." According to a recent survey, about 1 in 4 teachers have caught students cheating using the chatbot.
- **Some educators believe the benefits outweigh the risks and have embraced ChatGPT in their classrooms.**

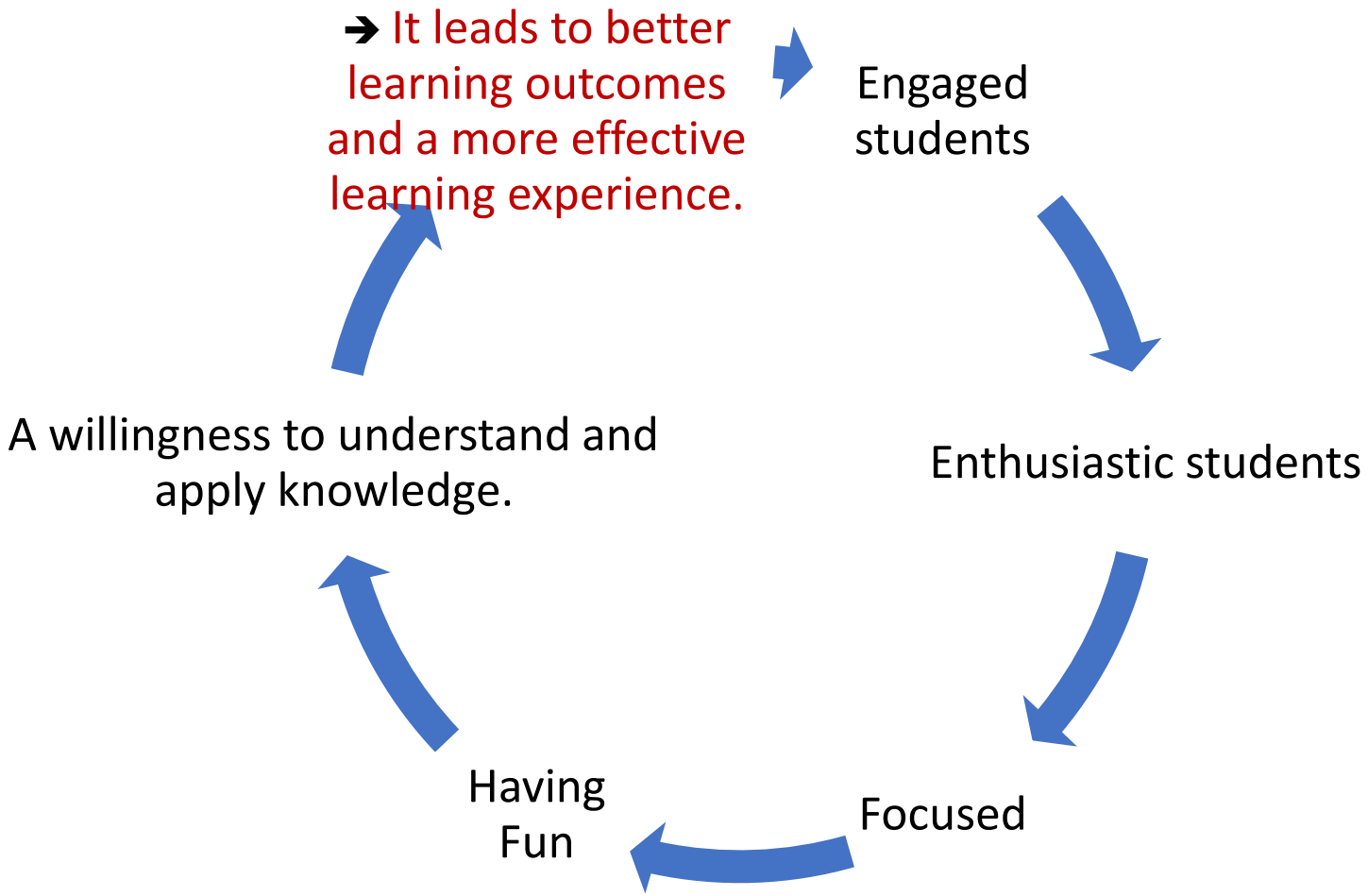
Motivation of using ChatGPT is based on

The transformative power of students in learning rather than transformative power of technology in education.

Increasing engagement

Improving learning by empowering students to use ChatGPT as a tool to prepare them for their future careers, while having fun.

Innovative approach =>effective learning experience



RIC Approach is transformative, seamlessly merges the best of both traditional classroom teaching and the use of artificial intelligence as a tool.

Critical thinking skills

- ✓ Analysis
- ✓ Communication
- ✓ Inference
- ✓ Observation
- ✓ Problem-solving

Critical thinking is not

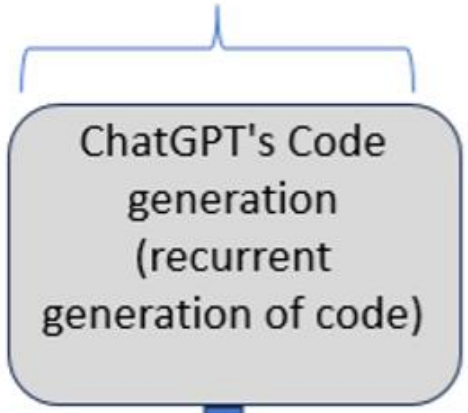
- ❖ Memorizing
- ❖ Group thinking
- ❖ Blind acceptance of teacher/leader's decision

The Reflect-Interact-Create model is designed to help students acquire critical thinking skills in analyzing and designing coding practices and handling the implementation of optimal solutions in preparation to meet the demands of the workplace's competitive technological environment.

Pre learning(Teaching):

Generation phase

Evolution of learning using AI. RIC: A recurrent model to understand generated code and generate original program. Student can repeat the three steps until he is able to create a better or similar solution



Step 1

self-exploration

Reflect

Learner's self evaluation

Step 2

cooperation

Interact

Construction of knowledge

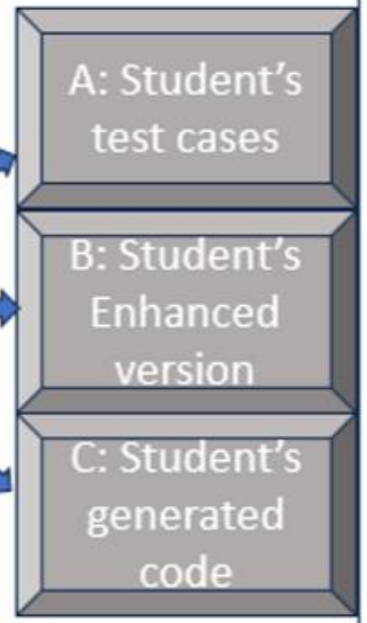
Step 3

Production

Create

Creation of autonomous knowledge

Create: The facilitator asks student A how student B understands the problem and vice-versa.



Reflect : Evaluate the code (poor- good-very good-Excellent)

A can I add test cases

B can I enhance the code and/or use it

C can I create a better solution?

D I need to discuss it with somebody

Interact : **Students A and B decide the final code rating**

Listen to other ideas and suggestion from a partner

compare A/B/C/D

Objective is to remove D and collaborate

1-Reflect

insights on the interaction of students and AI to jointly solve complex problems in the computer science domain-coding

- Self-exploration
- Self evaluation
- DECISION➔

A-Add test case to the code (quality assurance)

B-Enhance the code…adding functions ..

C-Create a better solution

D- Discuss it with somebody

2-Interact

students share their thoughts about the design of the code and ways of improvement or writing the new code.

- Cooperation
- Construction of Knowledge
- DECISION➔
- (Objective remove the D)

A-Add test case to the code (quality assurance)
B-Enhance the code…adding functions ..
C-Create a better solution
D- Discuss it with somebody

students are more willing to share their ideas and **boost their confidence** by promoting peer collaboration and communication.

3-Create

- Production
- Creation of autonomous knowledge

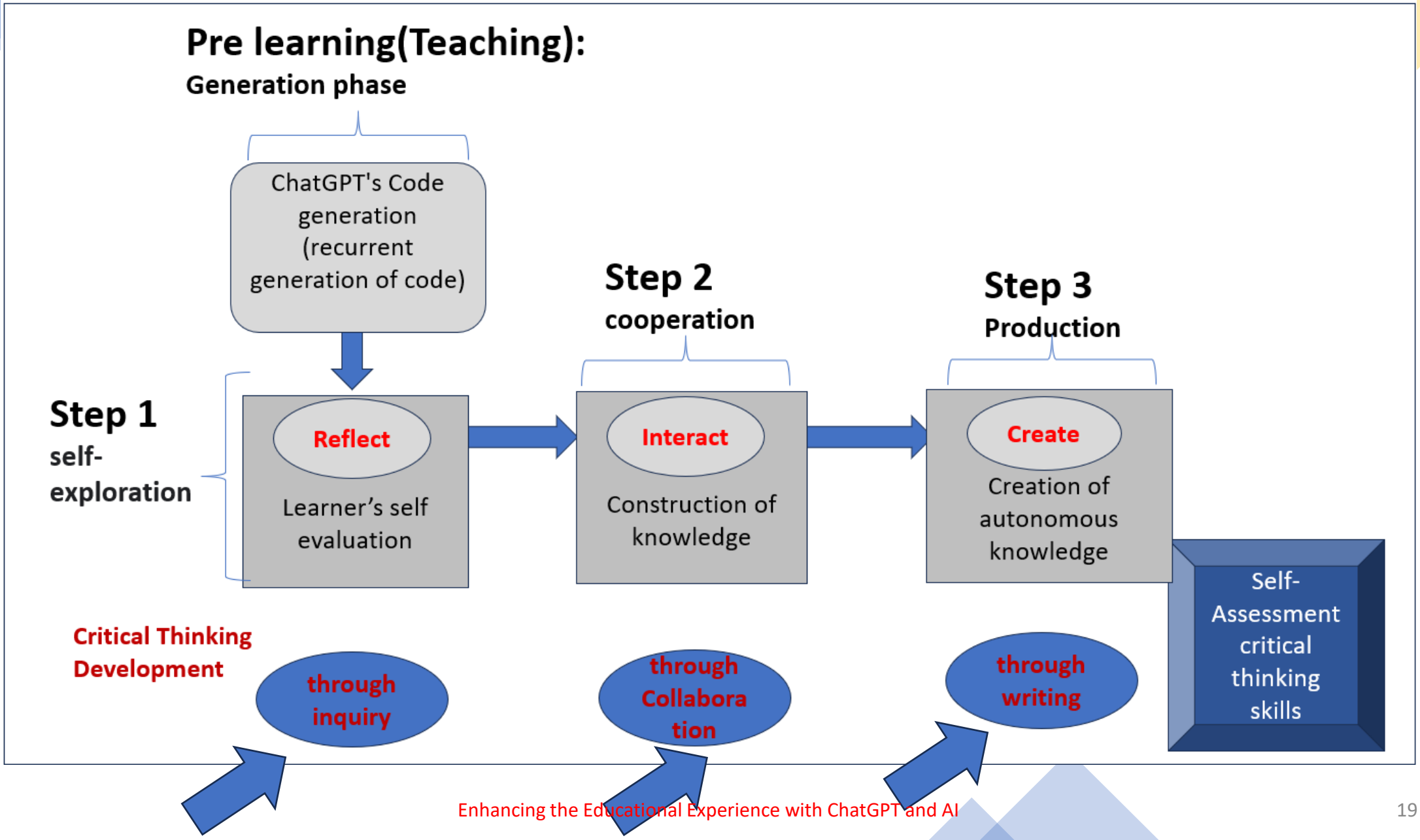
A-Add test case to the code (quality assurance)
B-Enhance the code…adding functions ..
C-Create a better solution
D- Discuss it with somebody

Self- learning

Give a man a fish, and you feed him for a day; teach a man to fish and you feed him for a lifetime.

- Run a code
- Repeat all steps outside classroom

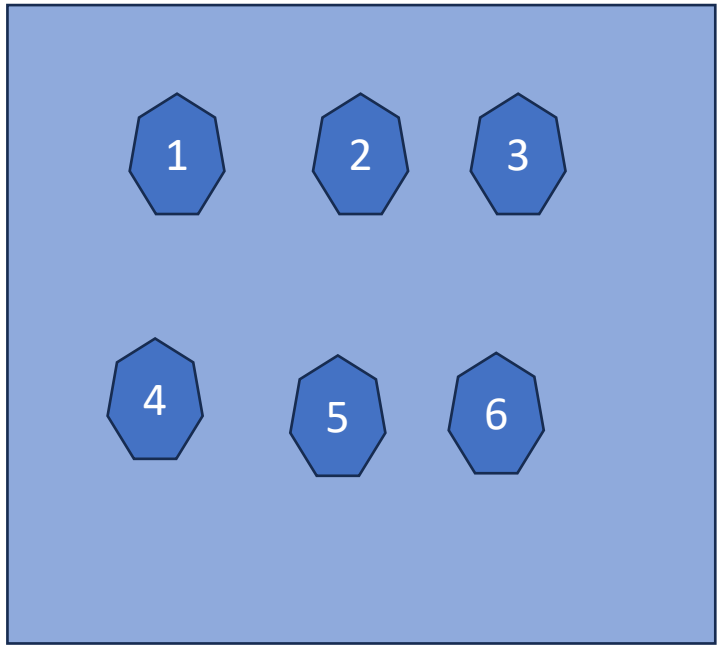
RIC trains students in **how to think** rather than how to access the information.
RIC can **close the critical thinking skills gap** between the high and low ability students.


Pre learning(Teaching):
Generation phase
ChatGPT's Code generation (recurrent generation of code)
Step 1
self-exploration
Reflect
Learner's self evaluation
Step 2
cooperation
Interact
Construction of knowledge
Step 3
Production
Create
Creation of autonomous knowledge
Self-Assessment critical thinking skills
Critical Thinking Development
through inquiry
through Collaboration
through writing

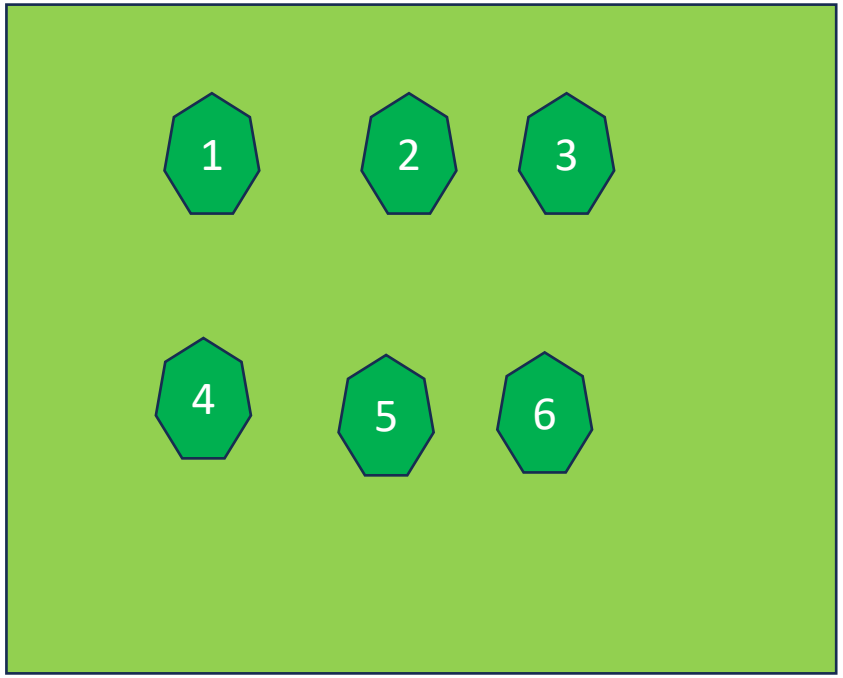
Classroom Setting for Critical Thinking Development

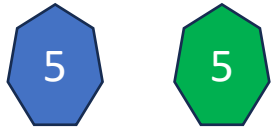
Each Session

Blue set



Green set





Team 5

1- 10 minutes Reflection

- Each student tries to reflect on a code
  - A can I add test cases?
  - B can I enhance the code? Adding functions….
  - C can I create a different and optimized solution?
  - D Do I need to discuss it further?

1- Critical Thinking Development: through inquiries

Reflect Questions

- What do we already know about the topic?
- What are the principles of the topic?
- How does this topic tie in with what we learned before?
- Can you explain the code?
- What will happen if we use static array instead?
- What does the output mean?

Problem Description Card

- Briefly summarize your understanding of the given question prompt.
- Explain in your own words what the problem is asking you to achieve.
- What is the input?
- Do you have enough resources , skills and knowledge about the topic?
- Are you confident you can write some procedures and metrics related to the topic?
- Can you produce a reliable output?
- Propose at least two test cases that you will use to verify the correctness of your code.
- If you were to discuss your approach with a peer, what key points would you emphasize? Are there any specific challenges or concepts you find noteworthy in this problem?

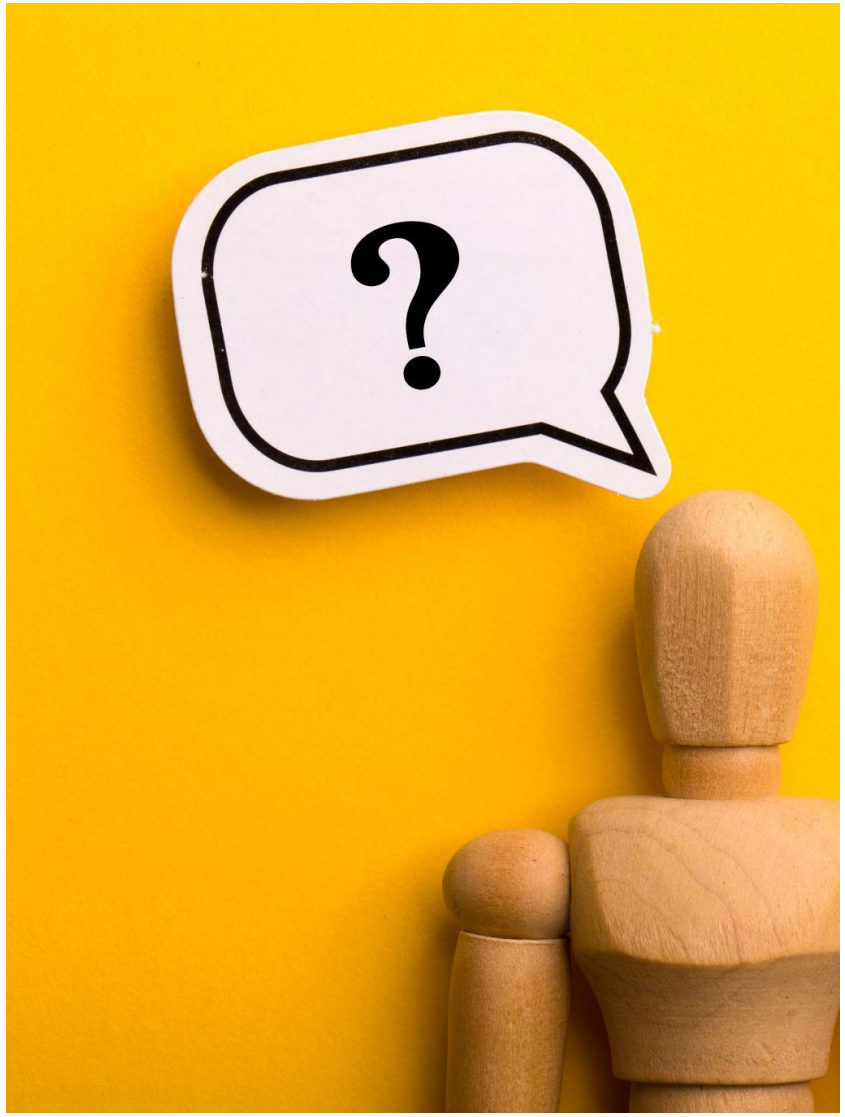
2- 10 minutes Interacting with another partners

- Both students share their ideas on their initial selection?
- Each team member should be able to explain the other student choice.
- Team decision
  - A can we add test cases?
  - B can we enhance the code? Adding functions….
  - C can we create a different and optimized solution?
  - D do we need to discuss it further?

2- Critical Thinking Development: through Collaboration

Interact Questions

- What is the difference between your decision and your teammate's decision?
- What are the implications of … ?
- How does … affect …?
- Why is … happening?
- What is the best … and why?
- Do you agree or disagree with the statement … ?
- What evidence is there to support your answer?
- What are the strengths and weakness of … ?



3- 20 minutes Interacting with The professor

- **The instructor select randomly B1 or G1. He can ask student B1 about his decision, G1 decision and the final decision**
- **Many students can be selected from different teams**

3- Critical Thinking Development: through Writing

Create Questions

- What is the solution to the problem of … ?
- What do you think causes … ?
- What is another way to look at … ?
- How confident are you as a team to combine different functions and create a new solution?
- How confident are you as a team to create a new solution from scratch?

3- 40 minutes Development of a new solution

- **This phase can be continued outside classroom**

Problem : Delete From End of Circular Linked List

Reflect: “I understand that we need to first use a ‘curr’ pointer to traverse through the linked list. We need to also remove the last node, so that means that the last node that points to the ‘head’ will need to change since that will be deleted. I think I can just traverse to the end of the linked list and update pointers. I don’t really understand how we will know we’re at the end of the list since we can’t use while(curr → next != nullptr) and it’s circular”

Problem : Delete From End of Circular Linked List

Interact: “After talking with my group, I realized there was an issue with my approach. Before I thought I had to traverse to the very end of the list, but if I do that, I won’t have access to the node before that that will point to ‘head’, so I need to stop at the second to last node to do it properly. We also found out we can use while(curr → next → next != head) as the way to know that we’re at the second to last node.”

Problem : Delete From End of Circular Linked List

Create

```
void linkedList::deleteLastElement(node* head){
    if(head == nullptr)
        return;

    node* curr = head;

    // traverse until 2nd to last node
    while(curr -> next -> next != head)
        curr = curr -> next;

   // deallocate memory of node to delete and update pointers
    node* lastNode = curr -> next;
    curr -> next = head;
    delete lastNode;
}
```

Students' Feedback

- "The practice sheets and talking/thinking through the problem really helps with my understanding of the concepts" .

- "[The RIC Model implemented in our workshop] allows individual thought in order for the individual to understand the question by themselves. Then we are able to get input from those around us bringing in new ideas and concepts in order to better understand the problem."

- "The class structure does help, I can really think to myself and connect with my peers."

Students' Feedback

- "I think RIC works, so that we can think about the problem and then talk about it with the group and see different thought processes."
- "The RIC model helps a lot because it helps me get ideas on how to solve a problem "
- "The RIC model was helpful in my opinion because I usually do not think about the process/logic of the problem before writing out the code. It allowed me to reflect first and also ask my peers for things I was missing in my logic. For example, another pointer I may have needed or edge cases I was not accounting for. "

Students' Feedback

- "... the RIC helps tremendously because I get a chance to think about the problem first even if my answers are wrong. It helps me understand the logic better when the solutions are revealed because I know where I went wrong."
- "Completing this form forces me to stop and think about the steps I need to take, rather than just jumping into the problem. Also, talking to my groups makes me think of edge cases that I hadn't thought of before. Thinking of edge cases is something that I don't always quite do well at."

Self-Learning Problems

- Develop a C++ program that initializes a dynamically allocated array, calculates the average of its elements, dynamically reallocates the array to include more elements, recalculates the average, and prints the updated array for efficient memory handling.
- Create a C++ program that dynamically allocates memory for a two-dimensional array, allows user input to fill its elements, and prints the resulting array, ensuring proper memory management.
- Write a C++ program showcasing dynamic memory allocation for arrays with different dimensions (e.g., 1D, 2D, and 3D), demonstrating the versatility of memory management for various array structures.

Individual Performance

	Introductory dynamic Array					Moderate Dynamic Array					Challenging Dynamic Array					Total			
	A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D
Student 1	1	0	0	0		1	0	0	0		0	0	0	1		2	0	0	1
Student 2	0	0	0	1		0	1	0	0		1	0	0	0		1	1	0	1

Incentive points to be added based on a scale A=0.1 B =0.2 C=0.3 D=0				
0.5	0.75	1	0	
				1
				1.25

Incentive for horizontal improvement

Teams' Performance

	Introductory dynamic Array					Moderate Dynamic Array					Challenging Dynamic Array					Total			
	A	B	C	D		A	B	C	D		A	B	C	D		A	B	C	D
Team 1	1	0	0	0		1	0	0	0		0	0	0	1		2	0	0	1
Team 2	0	0	0	1		0	1	0	0		1	0	0	0		1	1	0	1
Team 3	1	0	0	0		1	0	0	0		0	0	0	1		1	0	1	0
Team 4	0	0	0	1		0	1	0	0		1	0	0	0		1	1	1	0
Team 5	1	0	0	0		1	0	0	0		0	0	0	1		1	0	1	1
Team 6	0	0	0	1		0	1	0	0		1	0	0	0		1	1	0	1

Measures of Success

Self-Competency critical thinking skills test (before exams)

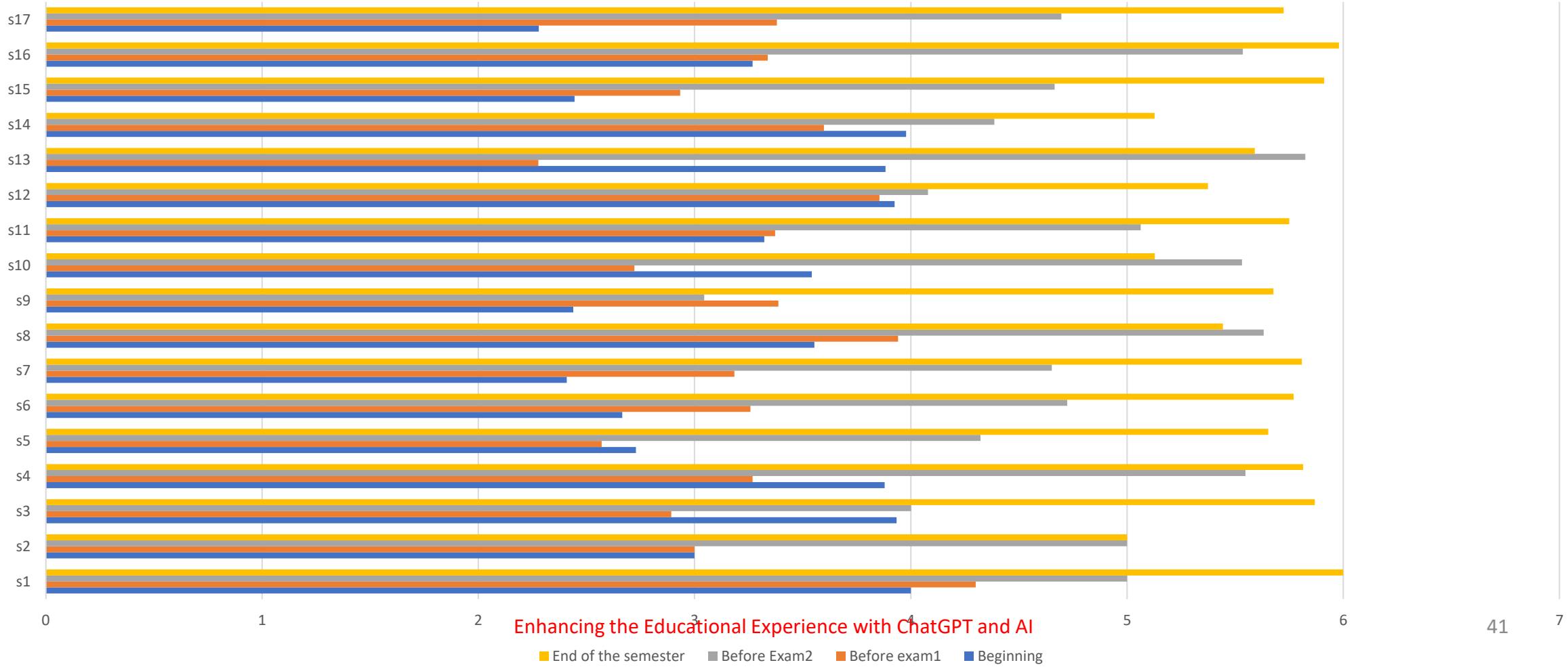
The survey consists of five-point Likert as (1) never, (2) rarely, (3) sometimes, (4) Often, (5) Always.

How critical a thinker is you?

1. I can explore.
2. I can use evidence to make simple judgments.
3. I can ask questions and consider options.
4. I can use my observations, experience, and imagination to draw conclusions and make judgments.
5. I can gather and combine new evidence with what I already know to develop reasoned conclusions, judgments, or plans.
6. I can evaluate and use well-chosen evidence to develop interpretations, identify alternatives, perspectives, and implications; and make judgments.
7. I can examine and adjust my thinking.
8. I can examine evidence from various perspectives to analyze and make well-supported judgments and interpretations about complex issues.

Measurement of skills horizontally

Critical thinking skills growth



RIC succeeded in incorporating critical thinking in teaching and learning

- **It promotes a teamwork approach to problem-solving**
- **It triggers self-assessment of student's performance**
- **It allows students to practice open ended summary**
- **It encourage them to add questions like pros and cons**
- **It allows them to evaluate assignment with different level of difficulties/time**

AI meets human needs and not vice-versa

We will always win the challenge !!!

RIC model across many disciplines

Adopting the RIC model is a chance to grow with artificial intelligence.

Students perform problem-solving and decision-making more effectively.

RIC is a perfect self-engaging guide for whoever is interested in programming and coding or in any STEM subject

The ABCs of ChatGPT in Mathematics

Physics

etc…

If interested email me *njrizk@uh.edu*

Dr. Nouhad Rizk

The ABCs of ChatGPT

in Computer Science