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Hong Kong
Examinations and
Assessment Authority

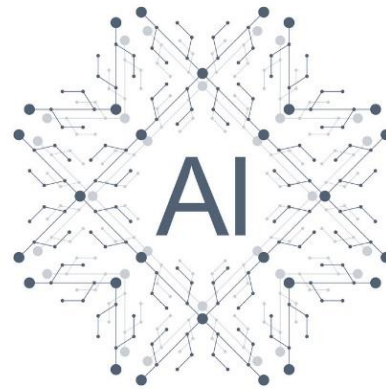
Is Adaptive Learning a Panacea or a False Promise?

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Hong Kong Examinations And Assessment Authority
(HKEAA)

Dec 9, 2022

Adaptive learning is good teaching at scale with the aid of AI technology.



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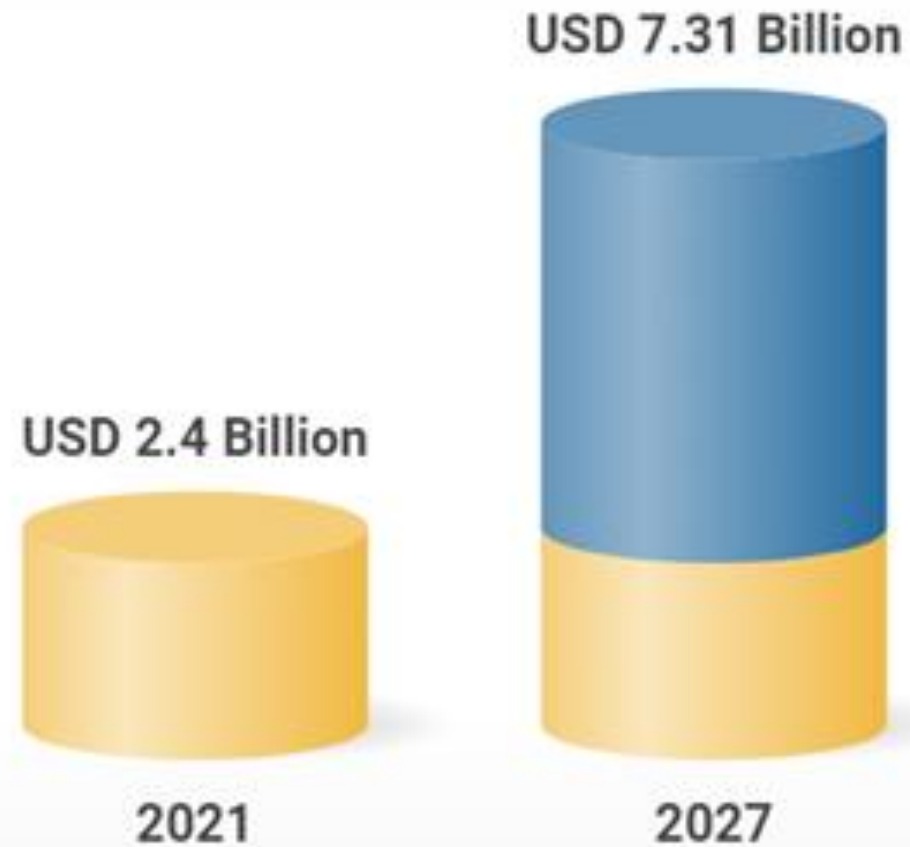
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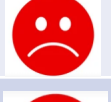


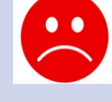




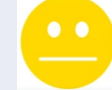


Global adaptive learning market is seeing exponential growth.

Global Adaptive Learning Market

Market forecast to grow at a CAGR of 20.4%



No company has all that it takes

		EdTech Start-up	Big publishers (e.g., Oxford)	EdTech assessment companies (e.g., ACT)	EdTech learning companies (e.g., Pearson)	Tech companies (e.g., IBM)
Technical	Learning design & content					
	Adaptive learning algorithms					
	Cognitive & non-cognitive					
	Assessment					
	AI					
Strong brand						
Robust distribution channels (B2B, B2C)						
Long-term investment						

Each type of player has some gaps to close

EdTech
Start-ups

Lack of massive amount of good content

No robust distribution channels

No long-term investment in AI

Challenges in monetization

Big publishers

Lag behind in digital transformation

Lack of early investment in AI

Lack of assessment expertise

EdTech
assessment
companies

Lack of expertise in creating learning content at scale

Little brand recognition in learning

Lack of robust distribution channels

Business model gravitates towards assessment

EdTech
learning
companies

Lack of early investment in AI

Lack of strong assessment expertise

Tech company

No education expertise

No brand recognition in learning

AI technology not customized for education

Lack of robust distribution channels



2013



2014



2021



2019



Pearson

Partnership

2020



Investment

2020



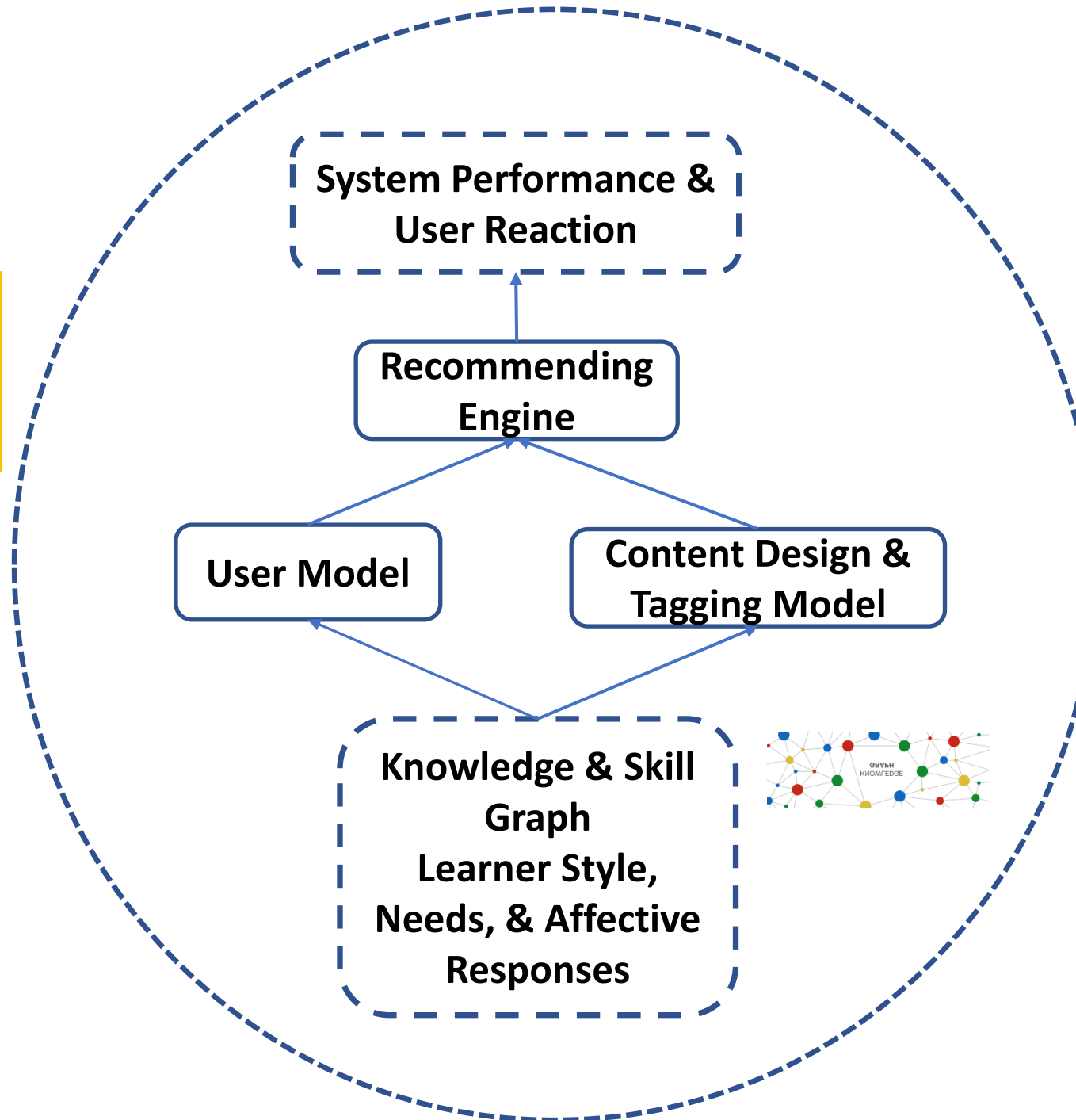
CAMBRIDGE
UNIVERSITY PRESS
& ASSESSMENT

2021



What his/her next experience is going to be

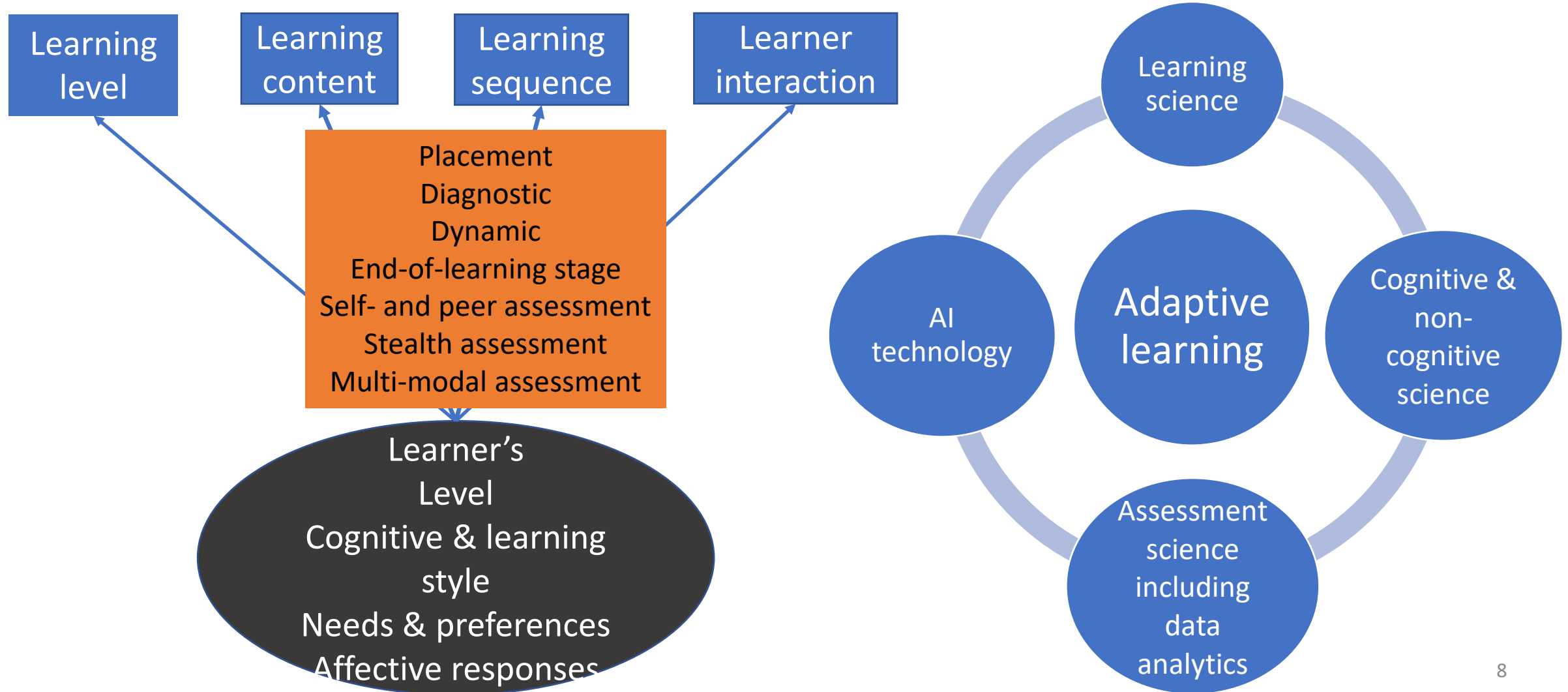
What a learner knows/can do

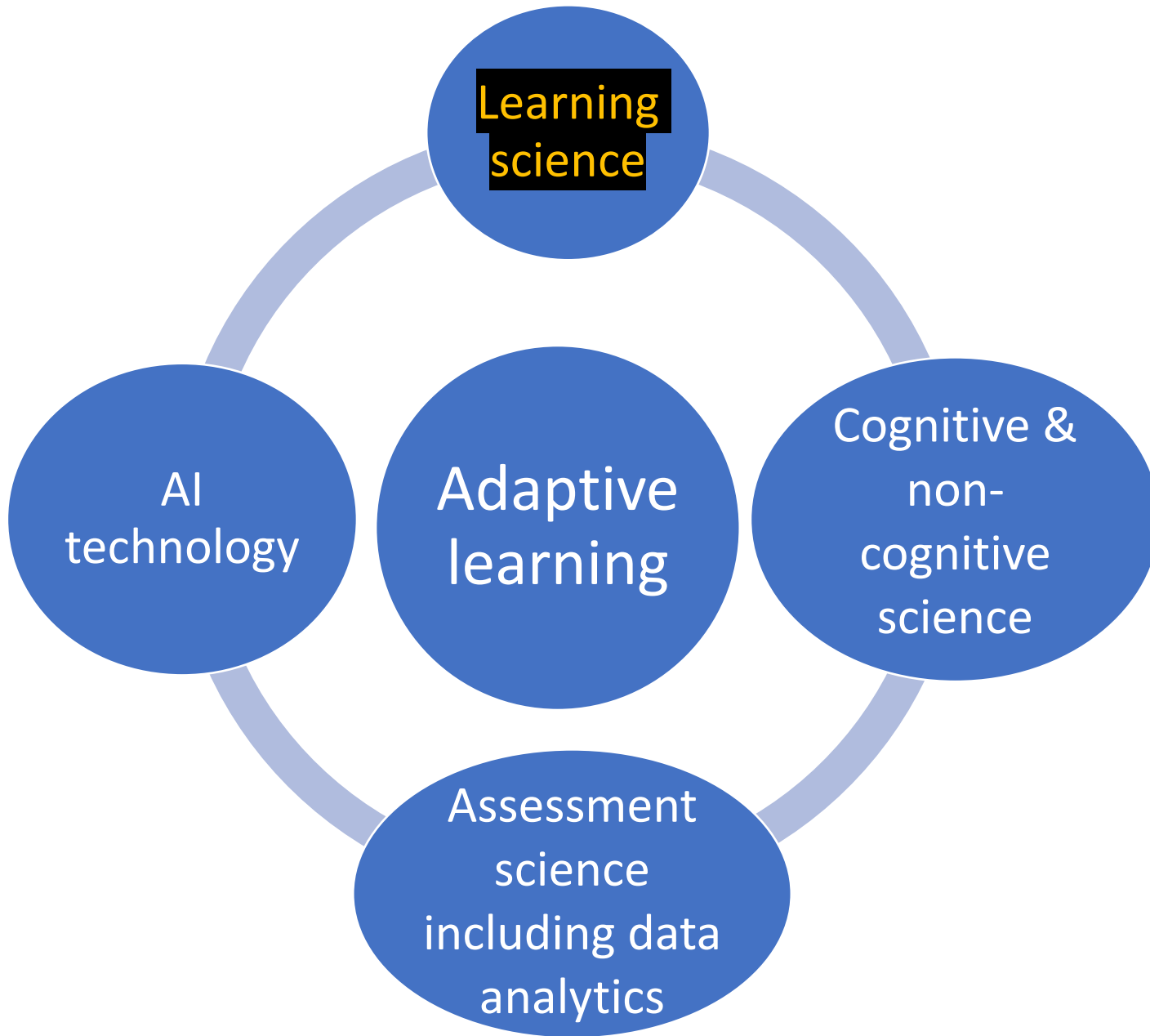


What his/her entire learning experience is going to be

**Architecture
of adaptive
learning
(Xi, 2022)**

Interdisciplinary talents are required to build a robust adaptive learning system

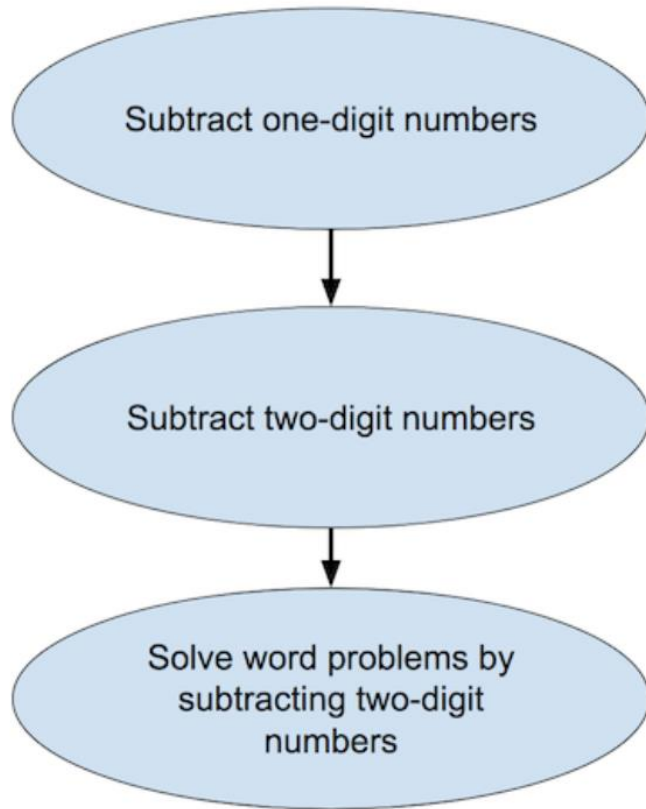




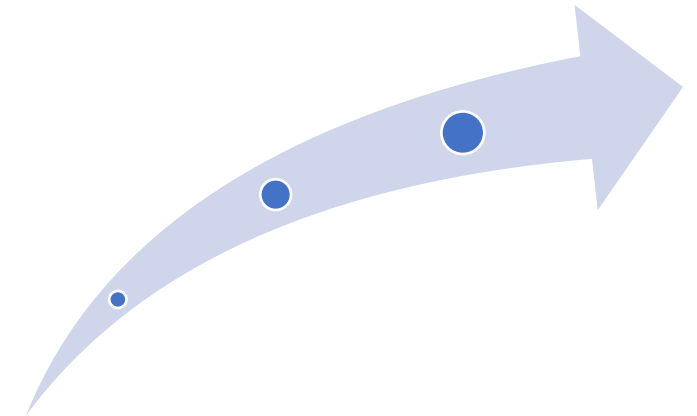
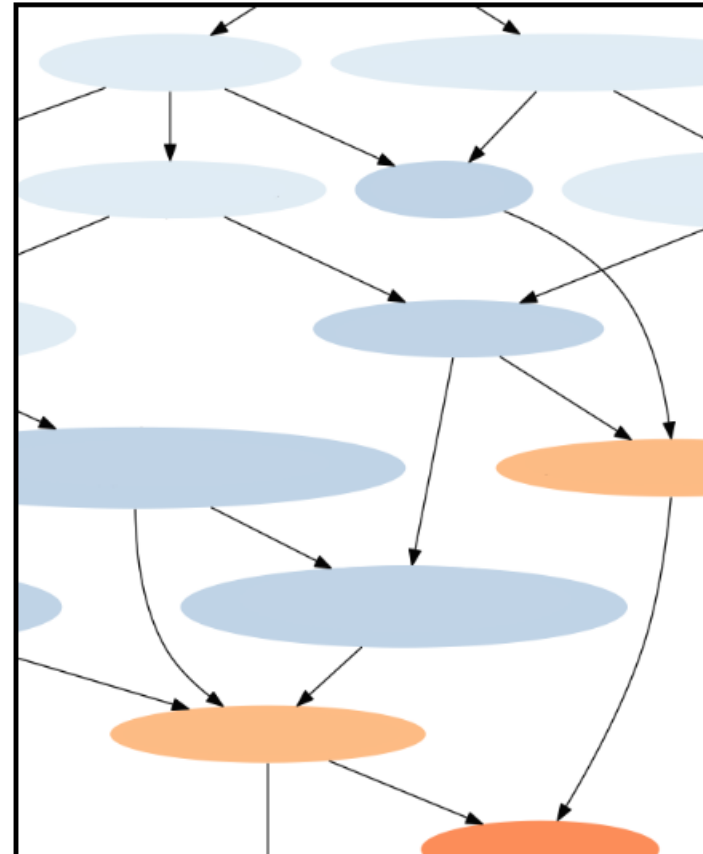
How do learners acquire and retain knowledge and skills in general? In the specific domain? What knowledge & skill points are useful to capture in the KSG? How do they interact with one another?

Construction of knowledge and skill graph (KSG) is key

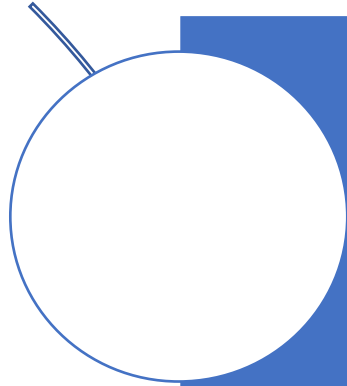
Granular



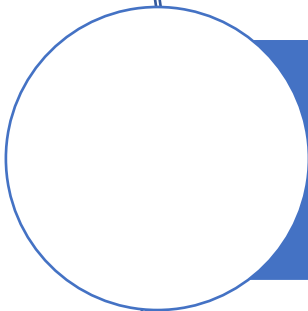
Dynamic



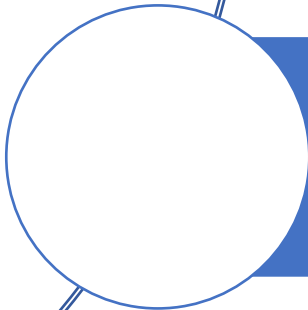
Cornerstone – KSG still needs to be the focus



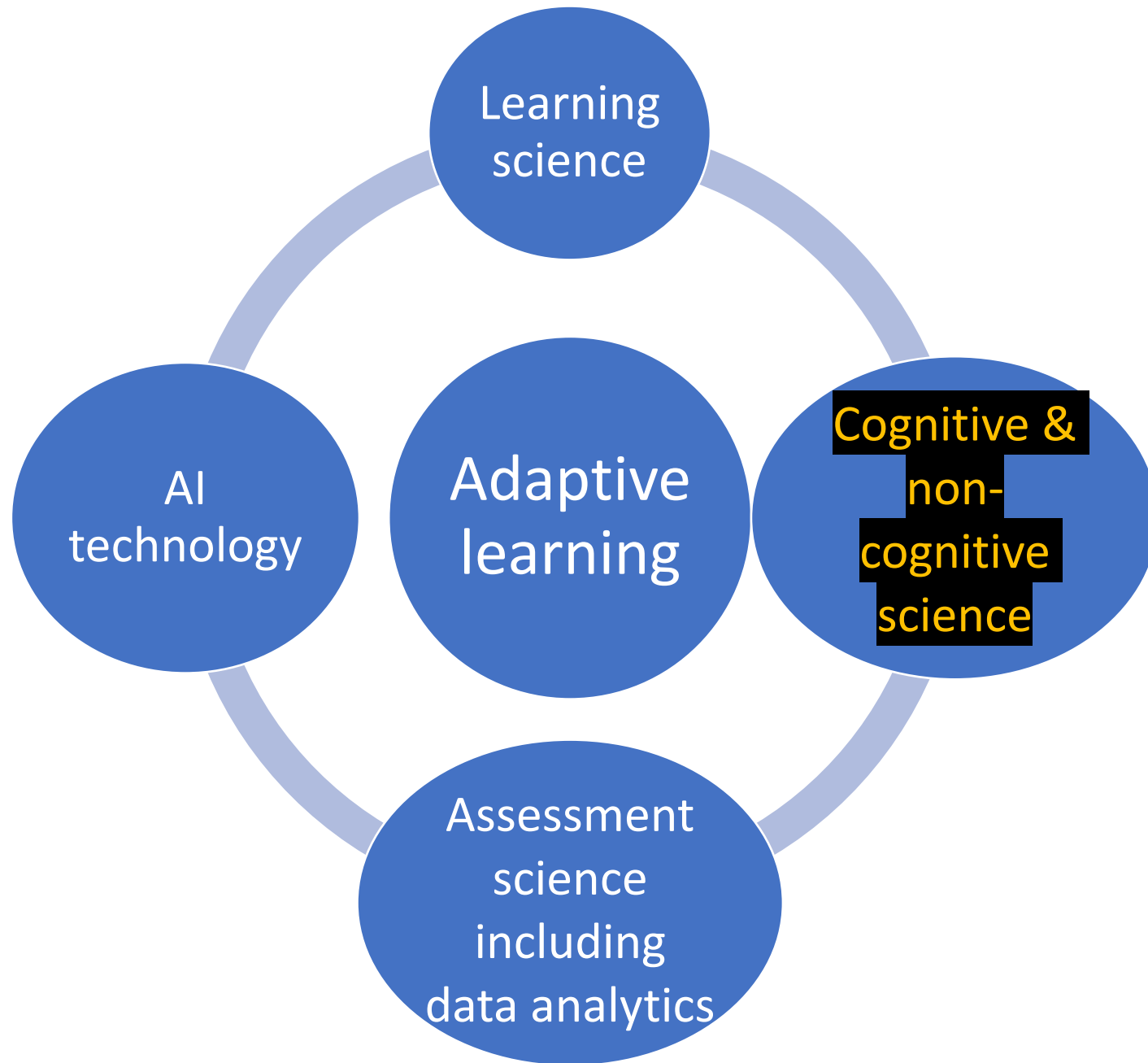
No established development sequences for some domains such as foreign languages – impacted by learning environment, curriculum emphases and individual characteristics



Fine-grained for designing useful adaptive learning solutions

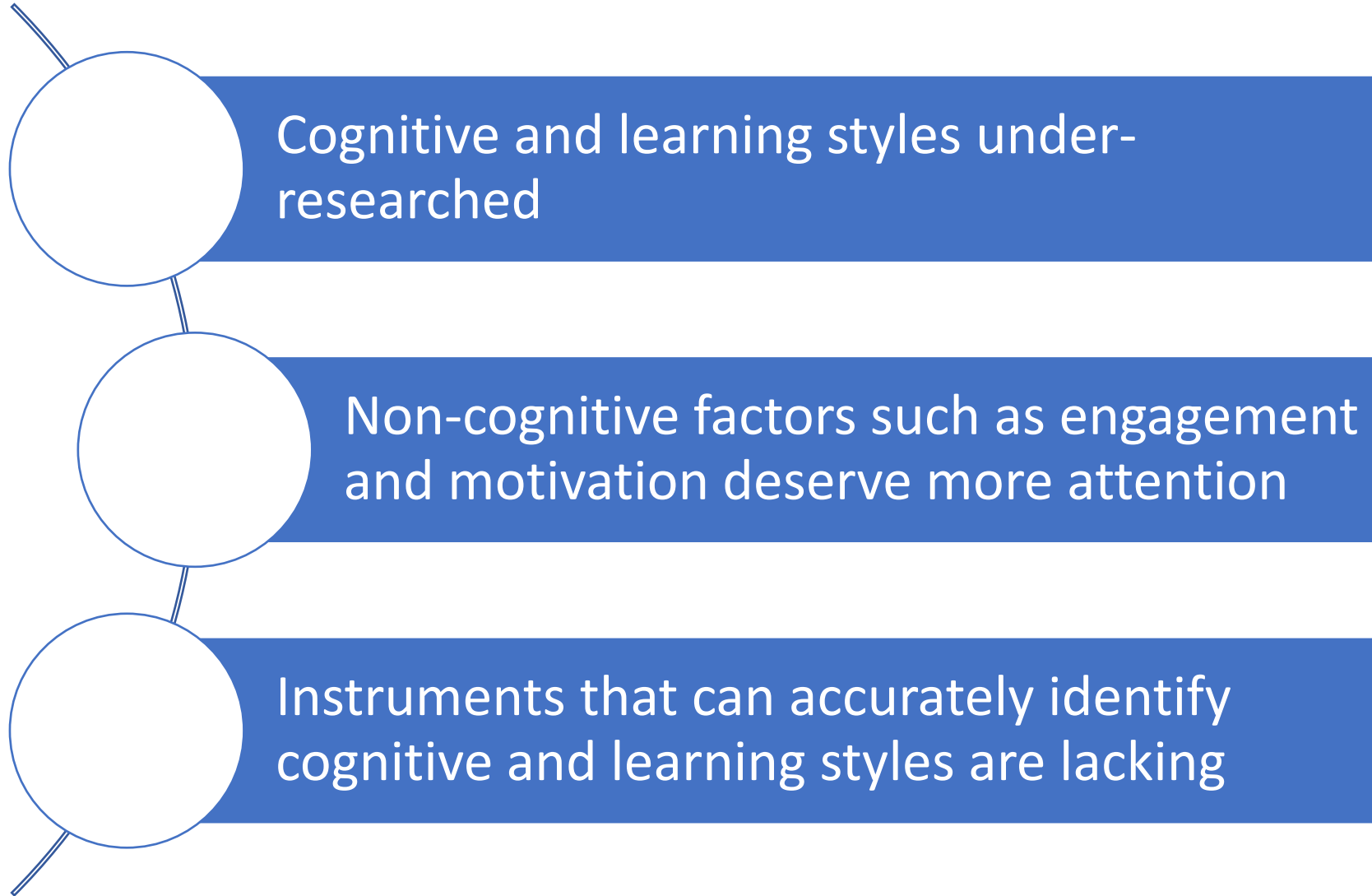


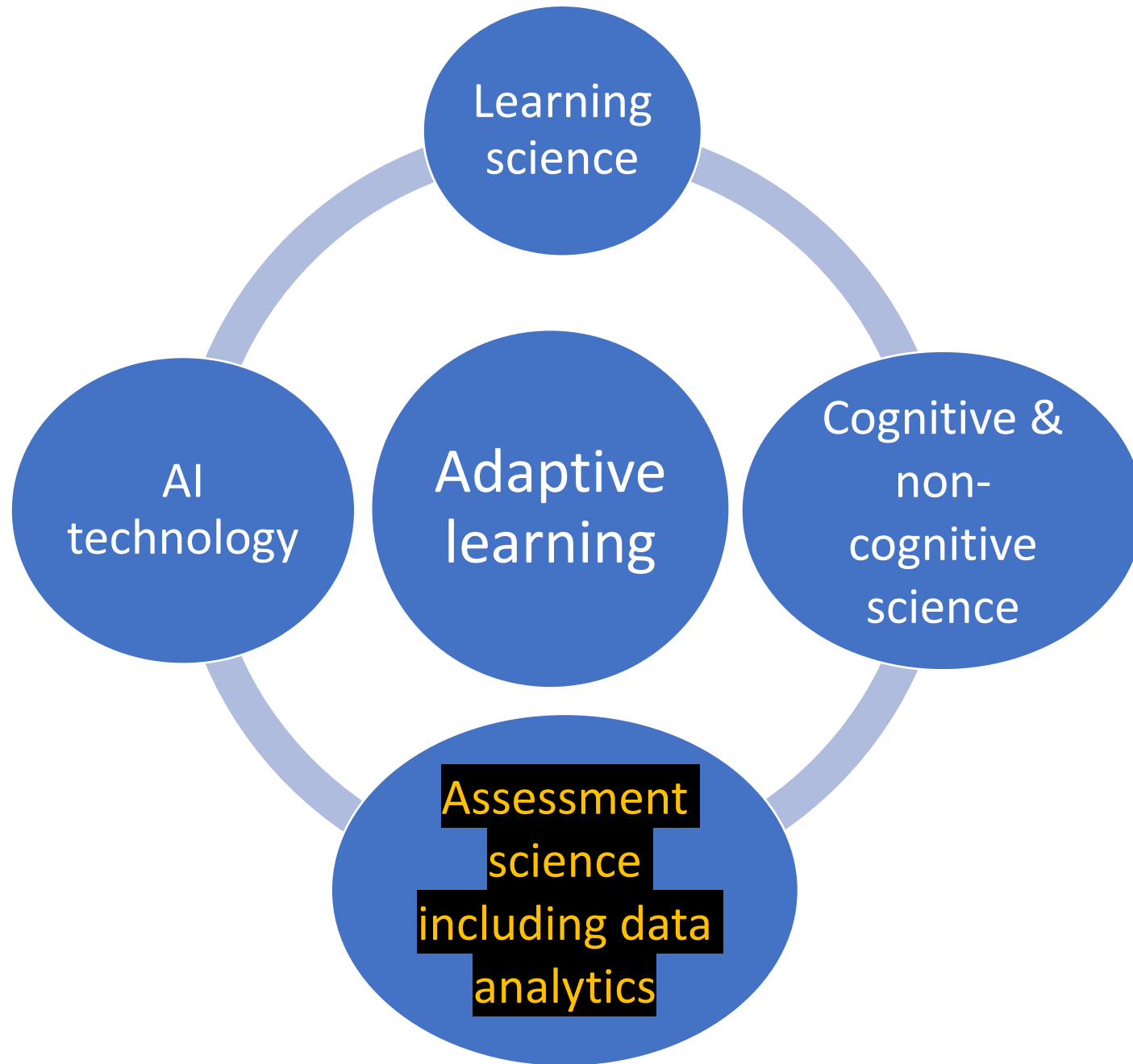
Need both expert judgment and empirical verification



What are the cognitive theories relevant to the domain?
Motivation, engagement, learning style and learning agency

Most systems ignore cognitive and non-cognitive factors



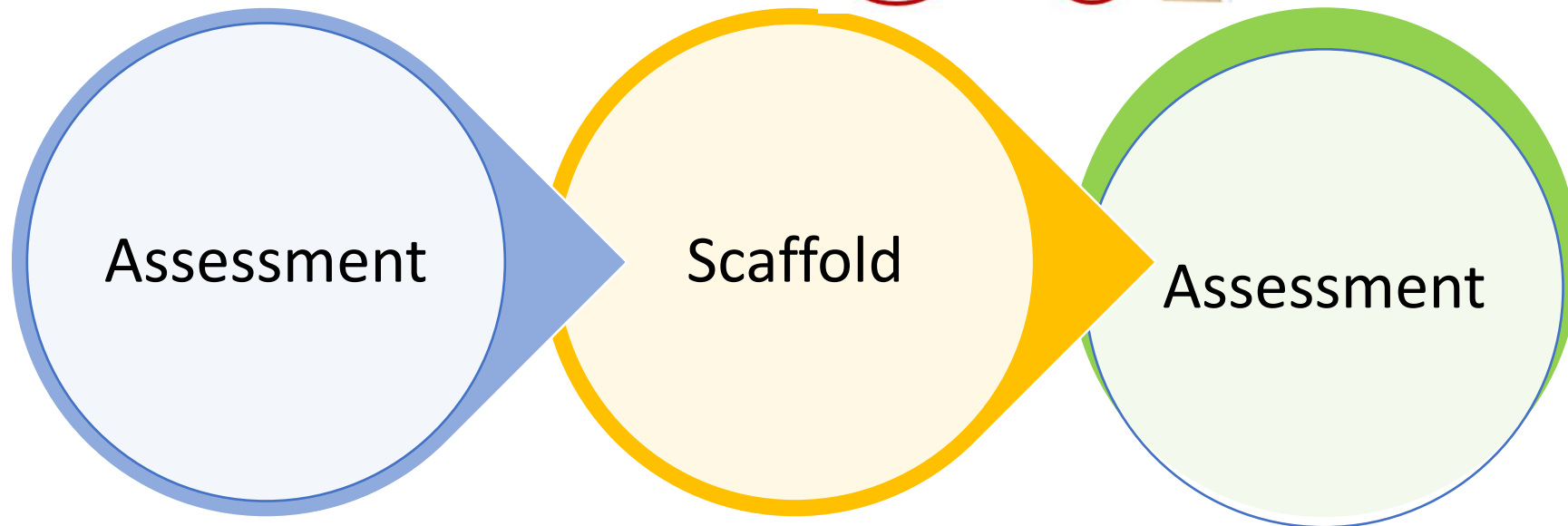


Placement
Diagnostic
Dynamic
End-of-learning stage
Self- and peer assessment
Stealth assessment
Multi-modal assessment

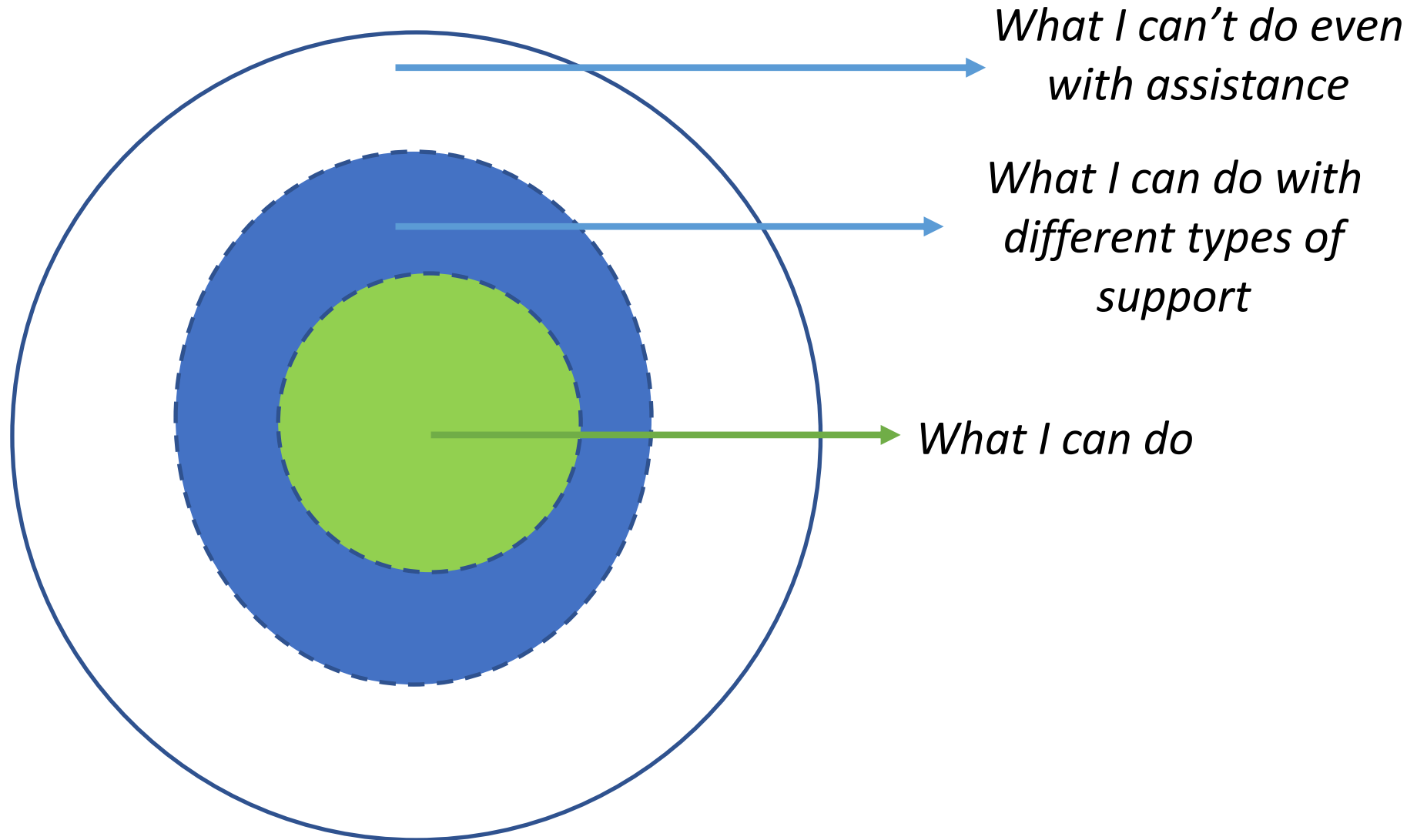
Dynamic assessment with scaffolding

Dynamic assessment

**Graduated
prompting**



Possessed vs. developing capabilities



DA for receptive skills



Chinese Reading Comprehension
Center for Language Acquisition

12. Why did 'I' complain?

- a. My health was poor.
- b. The doctor was not friendly.
- c. Friends were too busy.
- d. I bought too much medicine.
- e. The doctor was not happy.

That's not the correct answer. Read the highlighted part again.

submit answer

第11 - 13题:

很奇怪,这些年来,四周的朋友日子越过越好,却总听到他们抱怨。这使我想起以前,有一次我气喘,医生叫我买了几瓶非常名贵的药。可是才用两次,我的气喘就好了。我对医生抱怨说:“要是早知道,何必买这么多瓶。”医生回答我:“老天爷要是早知道你会抱怨,何必要你这么快就好了?”

Highlighting relevant part of text



Chinese Reading Comprehension
Center for Language Acquisition

12. Why did 'I' complain?

- a. My health was poor.
- b. The doctor was not friendly.
- c. Friends were too busy.
- d. I bought too much medicine.
- e. The doctor was not happy.

That's still not the correct answer. Did you notice the highlighted part 可是才用两次,我的气喘就好了。What does it mean?

submit answer

第11 - 13题:

很奇怪,这些年来,四周的朋友日子越过越好,却总听到他们抱怨。这使我想起以前,有一次我气喘,医生叫我买了几瓶非常名贵的药。可是才用两次,我的气喘就好了。我对医生抱怨说:“要是早知道,何必买这么多瓶。”医生回答我:“老天爷要是早知道你会抱怨,何必要你这么快就好了?”

Highlighting relevant sentence

Poehner et al, 2017



Chinese Reading Comprehension
Center for Language Acquisition

12. Why did 'I' complain?

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Let's try it one more time. 可是才用两次, 我的气喘就好了 means 'I only took the medication twice and then I recovered from asthma.' What does this sentence tell you?

submit answer

Providing a hint



Chinese Reading Comprehension
Center for Language Acquisition

12. Why did 'I' complain?

- a. My health was poor.
- b. The doctor was not friendly.
- c. Friends were too busy.
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第11 - 13题:

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The correct answer was 'd.'

[Click to View an Explanat](#)

next item

Providing rationale

Poehner et al, 2017

DA for productive skills

What's the weather like today in your city?



Oh, that's too bad. I guess you'll have to stay home. How was the weather yesterday?



Oh, lovely! Was it warm?



Well, do you think it will get warmer tomorrow?



That's good to know. Now, what kind of weather do you like best?



Many children like snowy days. What do you usually do when it snows?



It sounds so fun!



What's the weather like today in your city?



raining



Oh, that's too bad. I guess you'll have to stay home. How was the weather yesterday?



sunny



Oh, lovely! Was it warm?



quite cold



Well, do you think it will get warmer tomorrow?



warmer



That's good to know. Now, what kind of weather do you like best?



snows



Many children like snowy days. What do you usually do when it snows?



build a snowman; go sledding



It sounds so fun!



What's the weather like today in your city?

It's raining.



Oh, that's too bad. I guess you'll have to stay home. How was the weather yesterday?

It was sunny.

Oh, lovely! Was it warm?

No, it was quite cold.

Well, do you think it will get warmer tomorrow?

Yes, I think it's going to be warmer tomorrow.

That's good to know. Now, what kind of weather do you like best?

I like it when it snows.

Many children like snowy days. What do you usually do when it snows?

I build a snowman. I also go sledding.

It sounds so fun!



What's the weather like today in your city?



Oh, that's too bad. I guess you'll have to stay home. How was the weather yesterday?



Oh, lovely! Was it warm?



Well, do you think it will get warmer tomorrow?



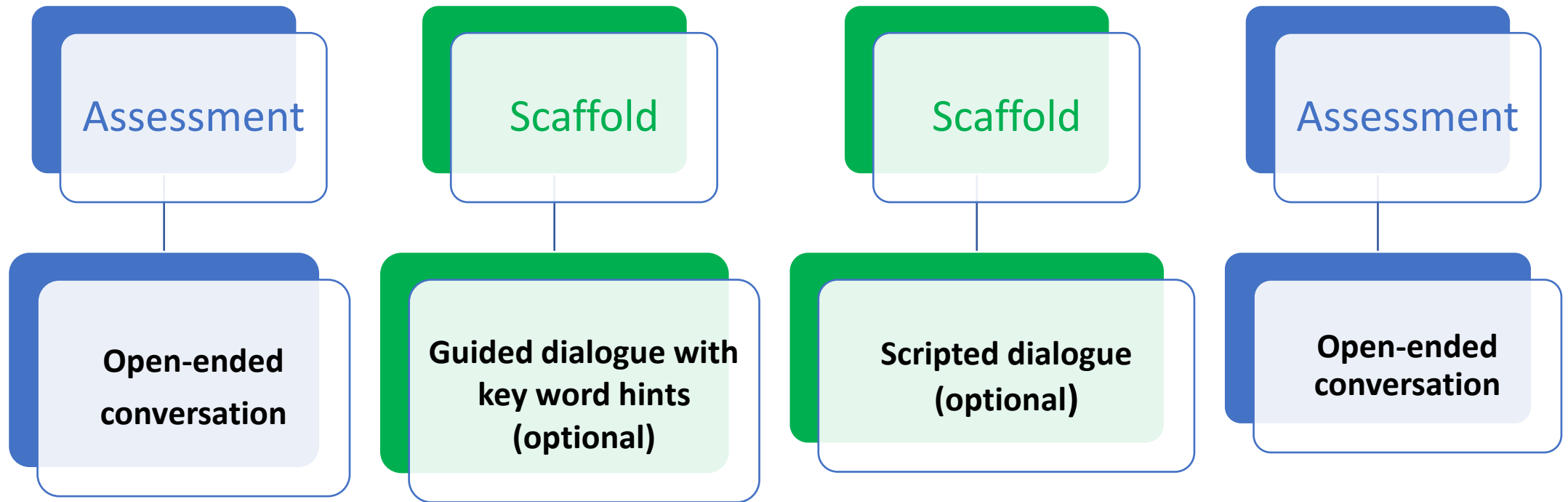
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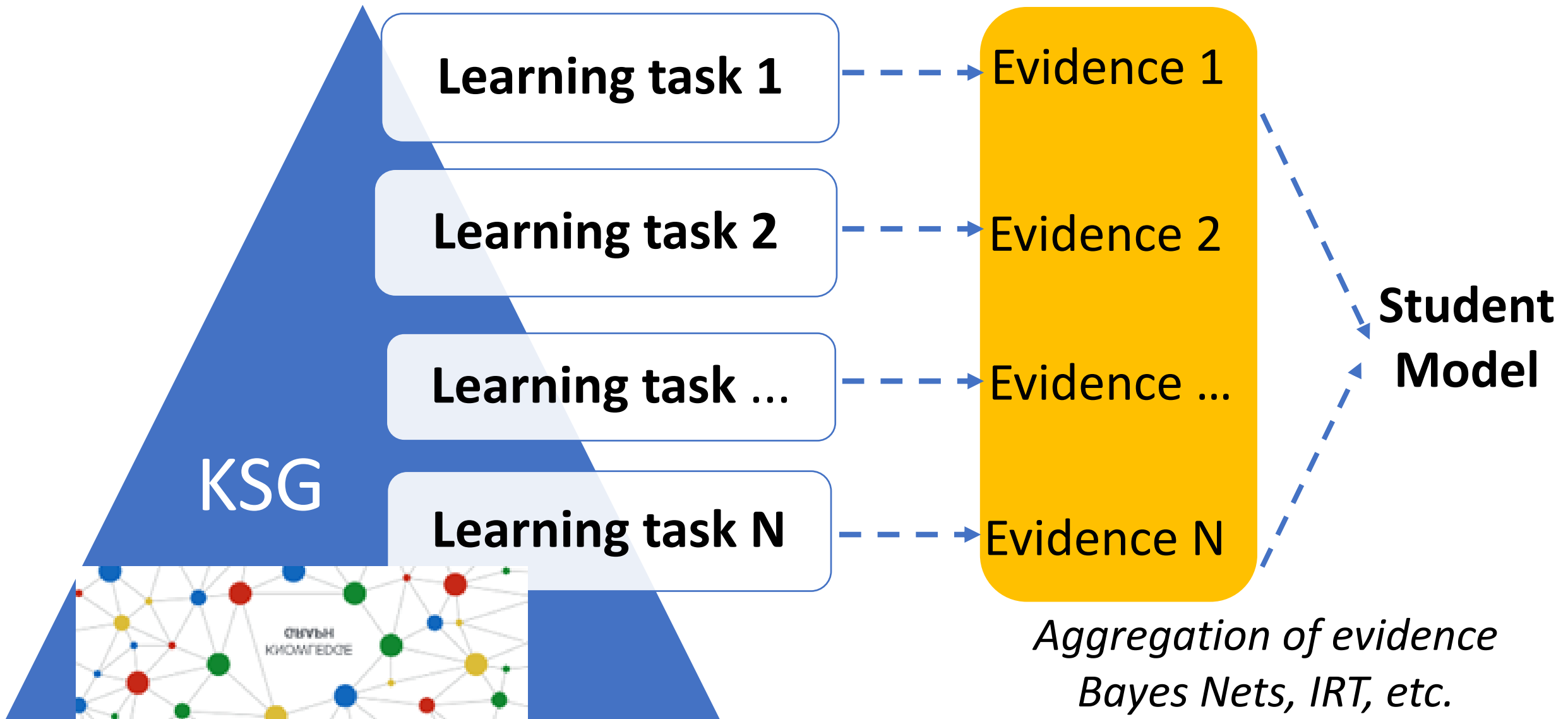


Stealth assessment

Stealth assessment

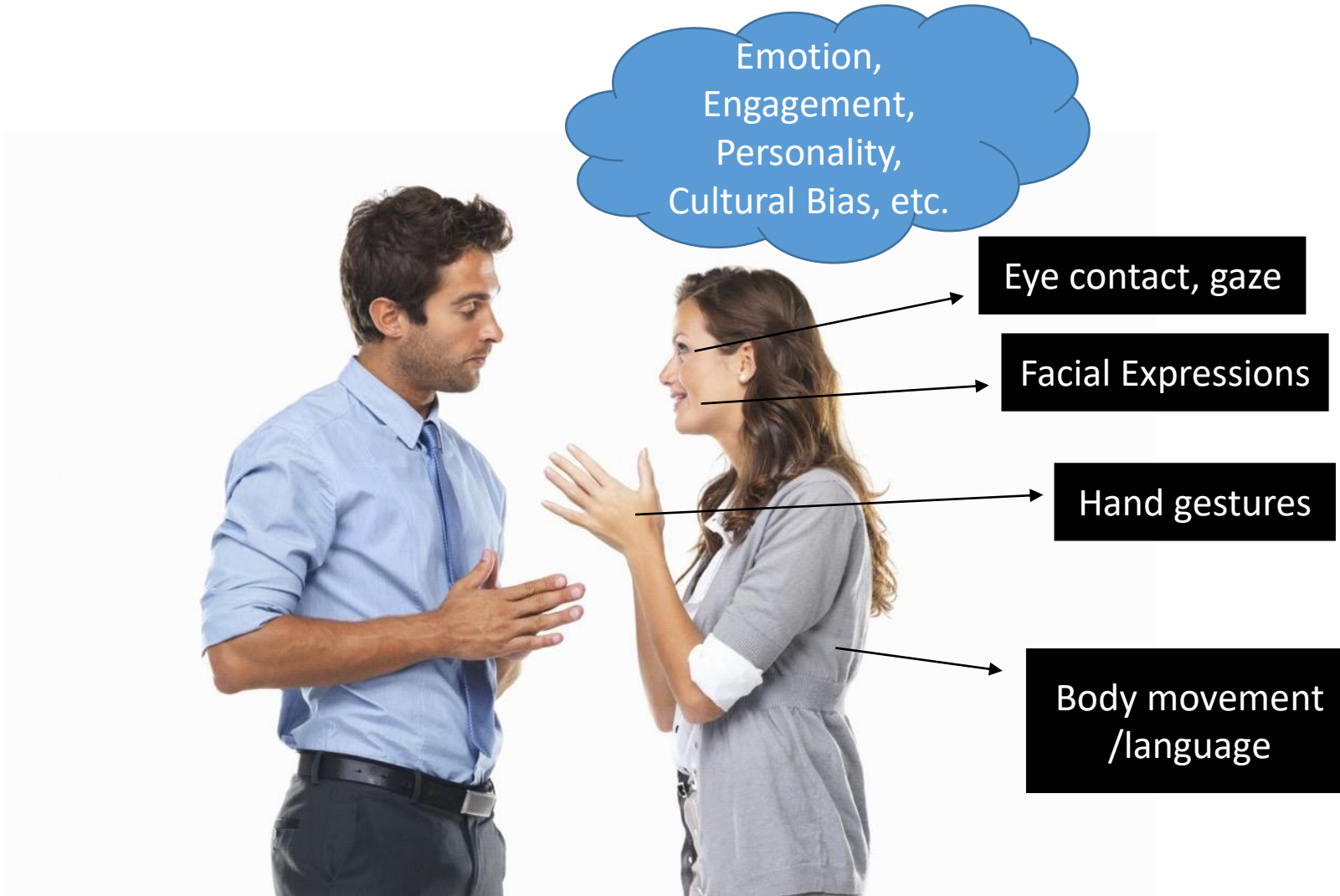
- Typically used in educational games
- Focus is on providing an immersive learning experience while gathering evidence about a learner's knowledge, skills and abilities

Extraction and aggregation of evidence guided by KSG



Multi-modal assessment

Multimodal Assessment



Level placement

- Efficient
- Discriminating
- Full range of levels or adaptive

End-of-learning stage

- Full content coverage
- No need to use highly discriminating items

Diagnostic

- Used for diagnosing possessed sub-skills
- No need to use highly discriminating items
- May use items focusing on enabling skills
- Use AI to provide diagnostics of constructed response outputs

Dynamic

- Used for diagnosing fine-grained emerging skills
- Embedded in complex tasks
- Design customized mediation for individual learners
- Use AI to evaluate output of first attempt to determine mediation needed for each learner

Peer assessment

- Use easy-to-use instruments
- Accessible
- Encourage collaboration among peers

Self assessment

- Use easy-to-use instruments
- Accessible
- Encourage self-efficacy

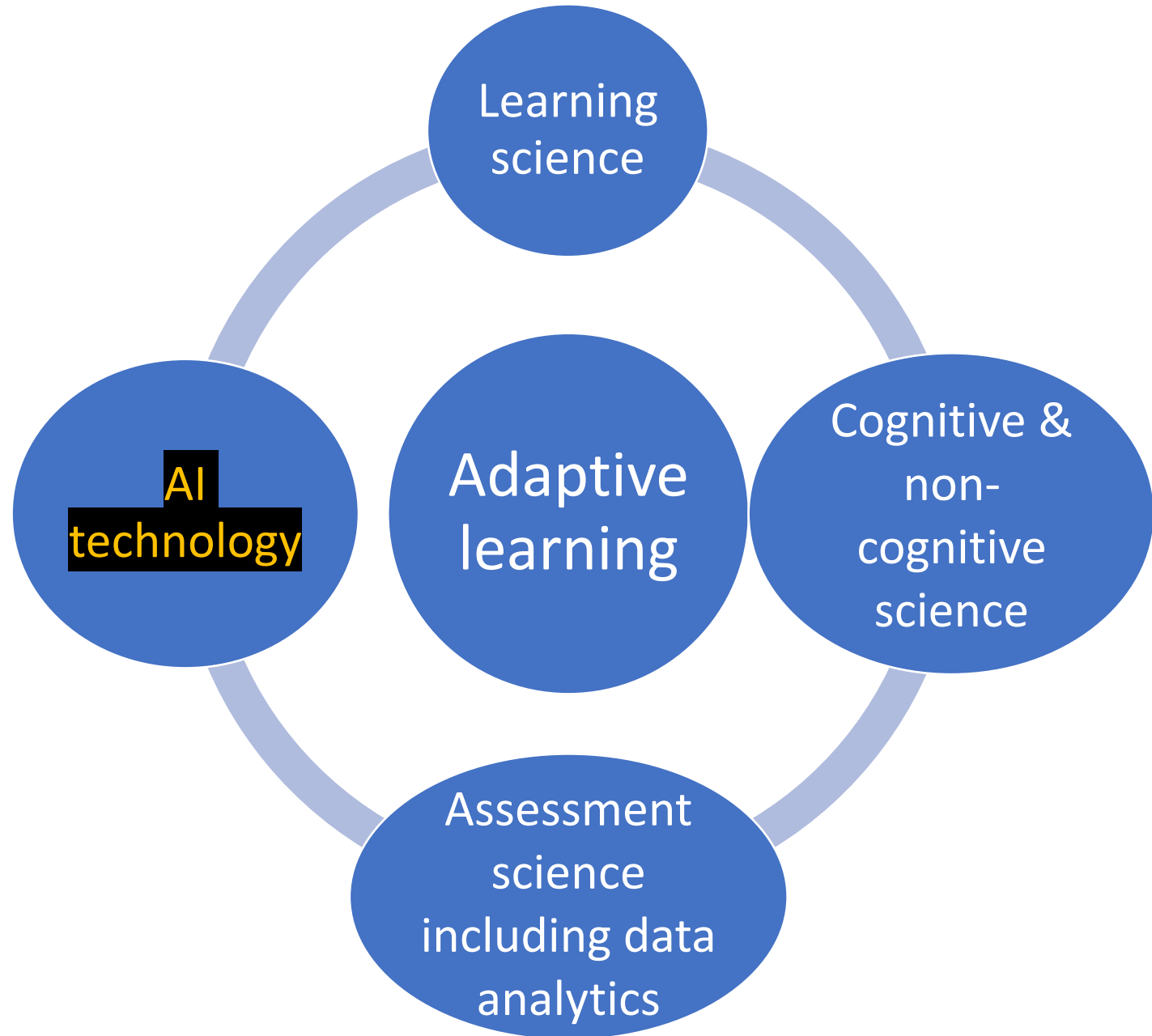
Stealth

- Driven by the KSG
- Requires strong support for how evidence is aggregated within/across learning exercises

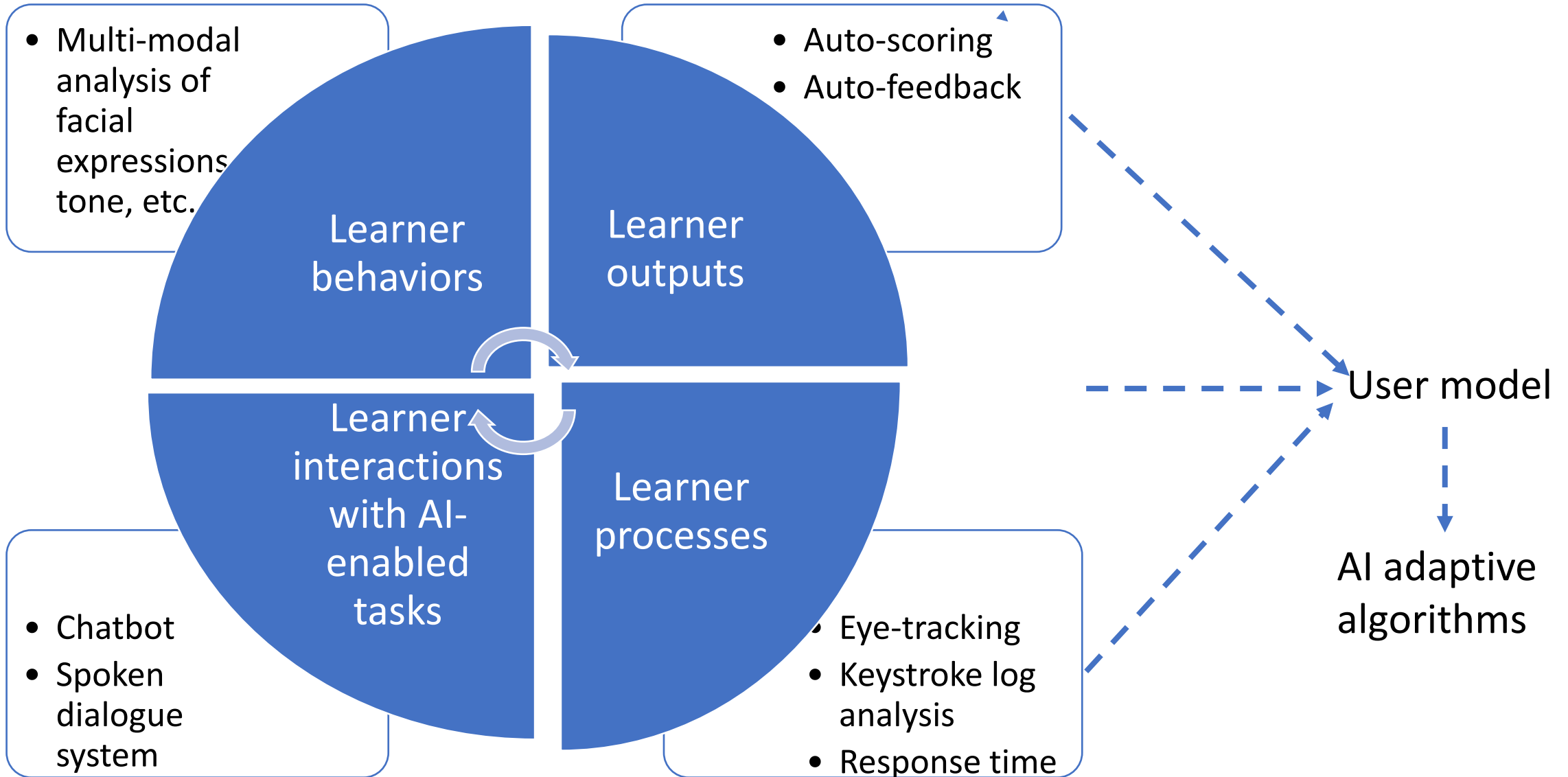
Multi-modal

- Use multi-modal technology that yields accurate estimates of individuals' emotional and affective states

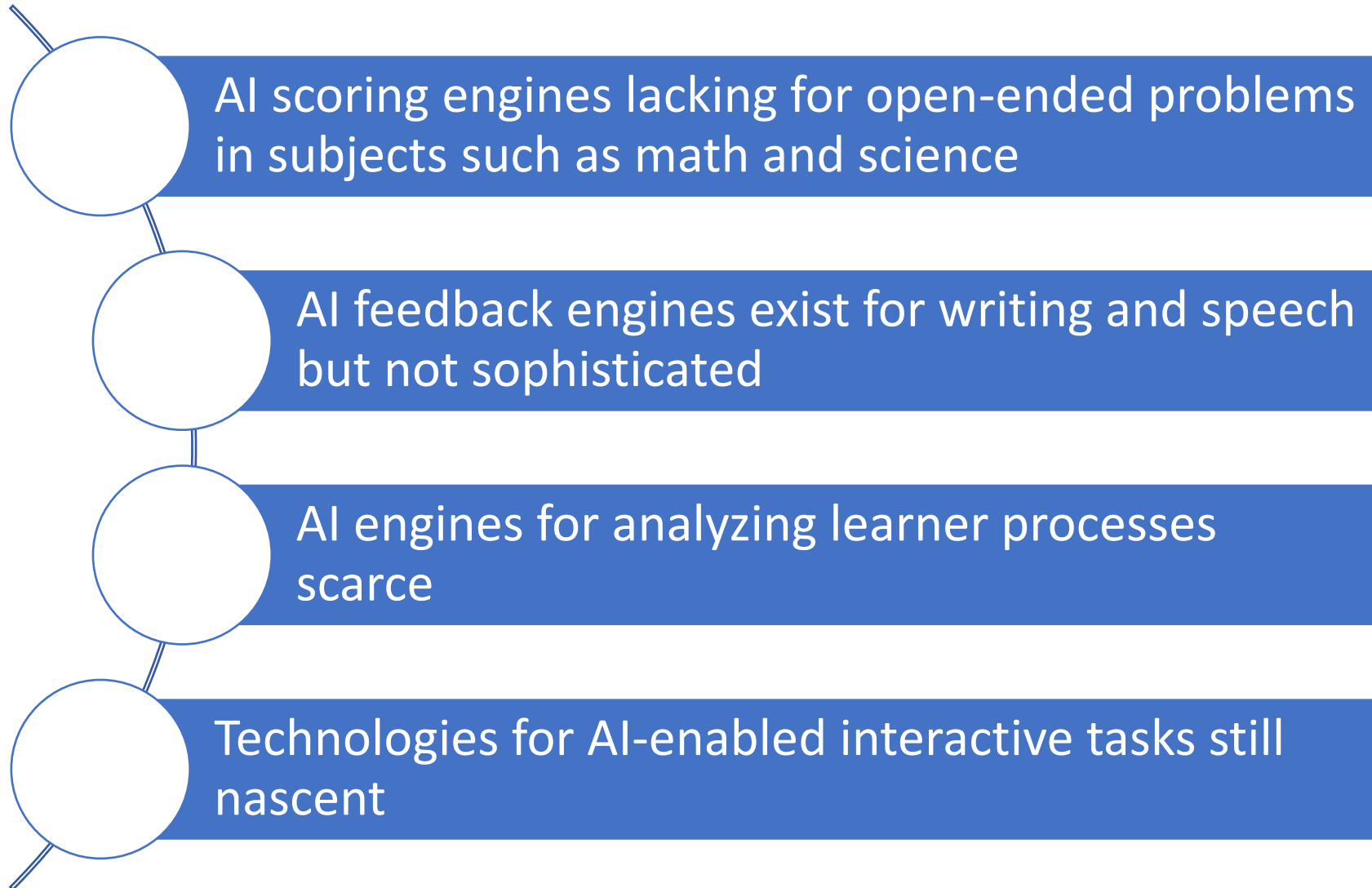
AI adaptive algorithms
Automated scoring and
feedback engines
Multi-model analysis
tools



AI technology is required throughout to facilitate an adaptive learning experience



Lack of sophisticated AI technologies leads to systems that focus on selected response tasks



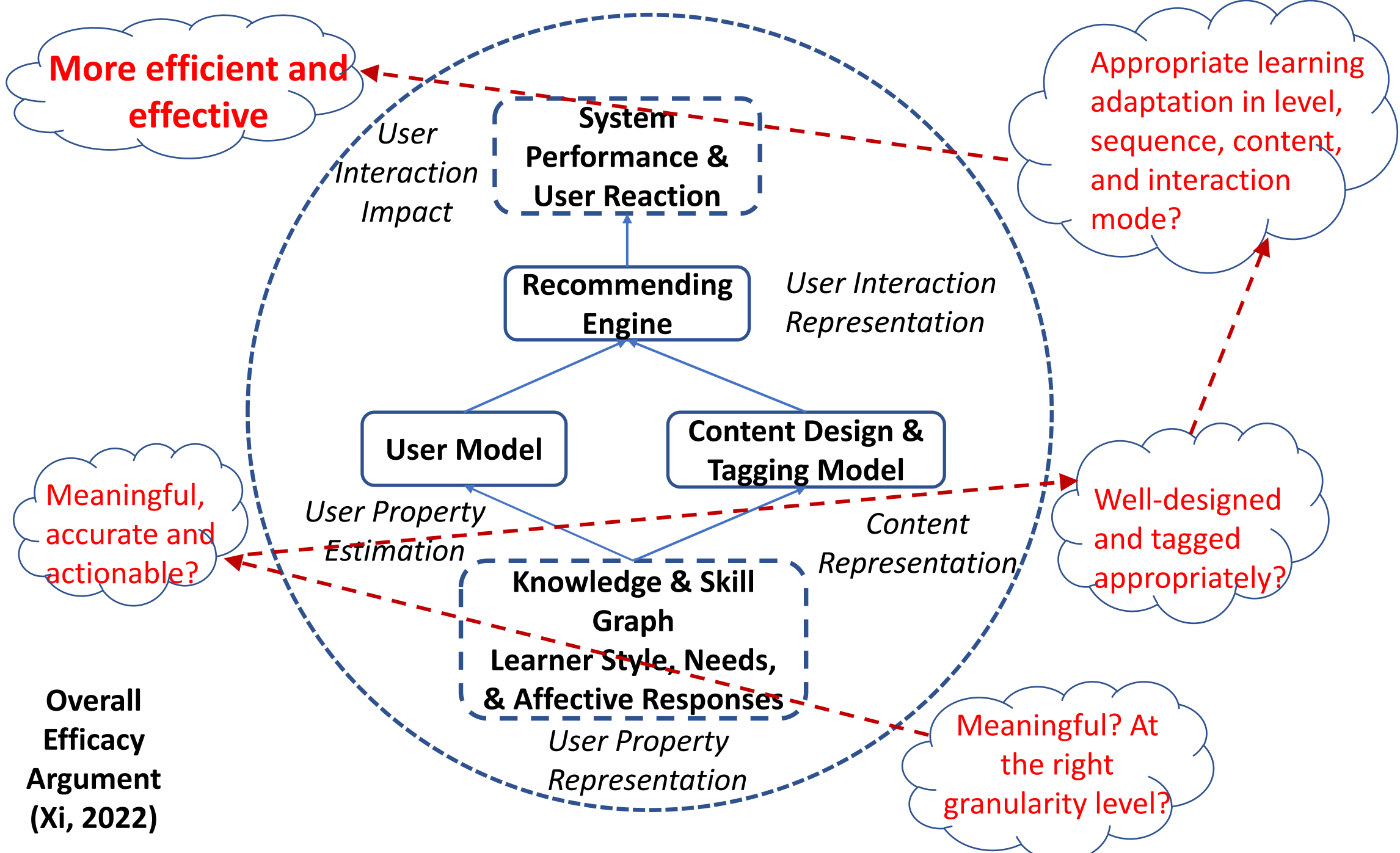
Evaluation of adaptive learning

Holistic

Evaluating a system in terms of the overall system performance or user perception (Chin, 2001)

Componential

Decomposing adaptive learning, unpacking the key decisions involved in each component, and investigating their impact on learning (Weibelzahl, 2002; Brusilovsky et al., 2004).



Overall Efficacy Argument (Xi, 2022)

Most systems out there fall short of expectations of being learner-first

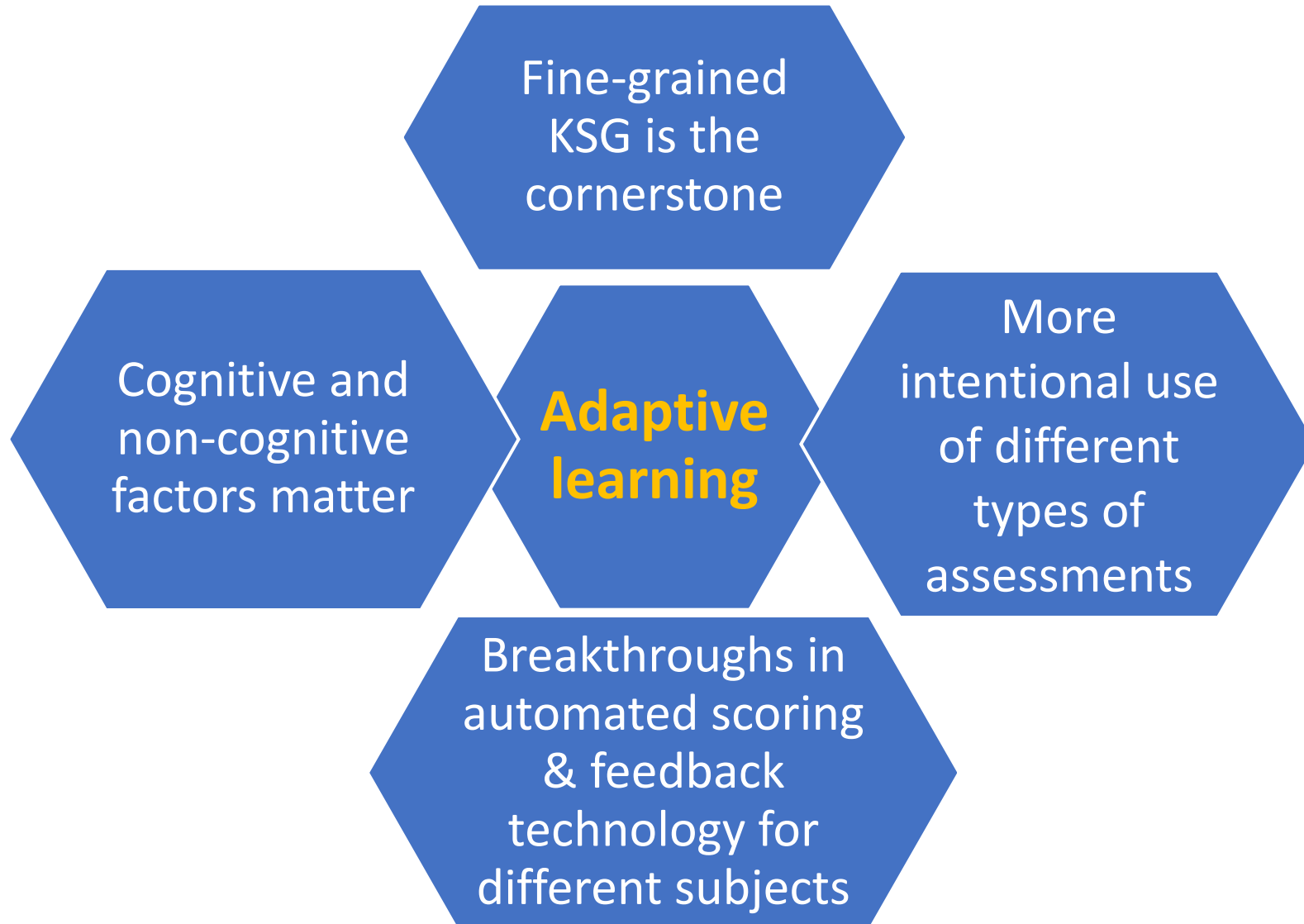
Learner-first assessment experience

- Short
- Precise
- Unobtrusive
- Provides actionable information
- Positive experience

Learner-first learning experience

- Meets my unique learning needs
- Tailored to my level
- Customized to my knowledge & skill profile
- Matches my cognitive/learning style
- Adapts to my affective state
- Gives me the most efficient and effective pathway

Delivering real promise for adaptive learning requires concerted efforts of interdisciplinary experts



Adaptive learning, as it currently stands, is far from being a panacea for solving learning problems around the world. Many adaptive learning systems use simple adaptive algorithms on a bank of selected response questions on discrete skills. If poorly designed and implemented, adaptive learning would stand in the way of good learning rather than facilitate it.

Questions?
Comments?