

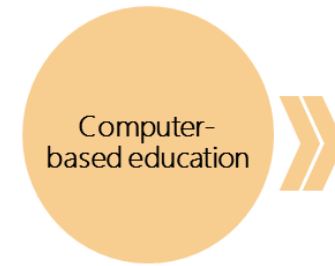
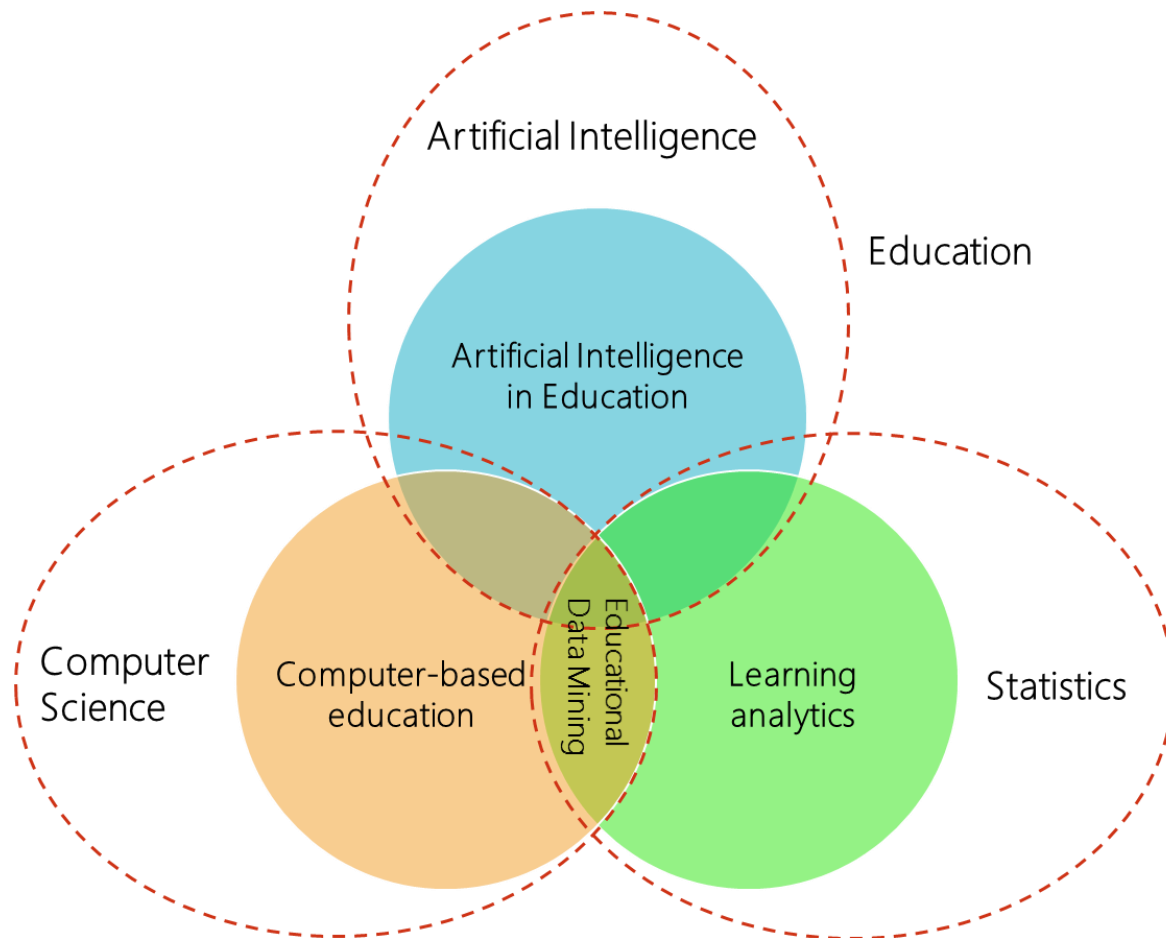


# **Pedagogy-infused AI for Precision Education**

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# Perspective of AI in Education (AIED)



- Using AI techniques to stimulate novel types of adaptive/personalized and intelligent systems for educational purposes.
- For example, ITS, LMS, adaptive hypermedia and multimedia system, test and quiz system, testing and diagnostic system, and ubiquitous learning environment



- Analysis and reporting of data about students' learning for optimizing learning environment.




- Creating specific approach to examine the unique educational data (i.e., tracking students' behaviors to identify their risk at abandoning their studies).

AIED can enable computer programs to perceive, reason, and solve specific problems, and to provide learning supports based on individuals' needs.


# Systematic Reviews about AI-based learning approach

Journal of Computers in Education  
<https://doi.org/10.1007/s40692-023-00276-w>

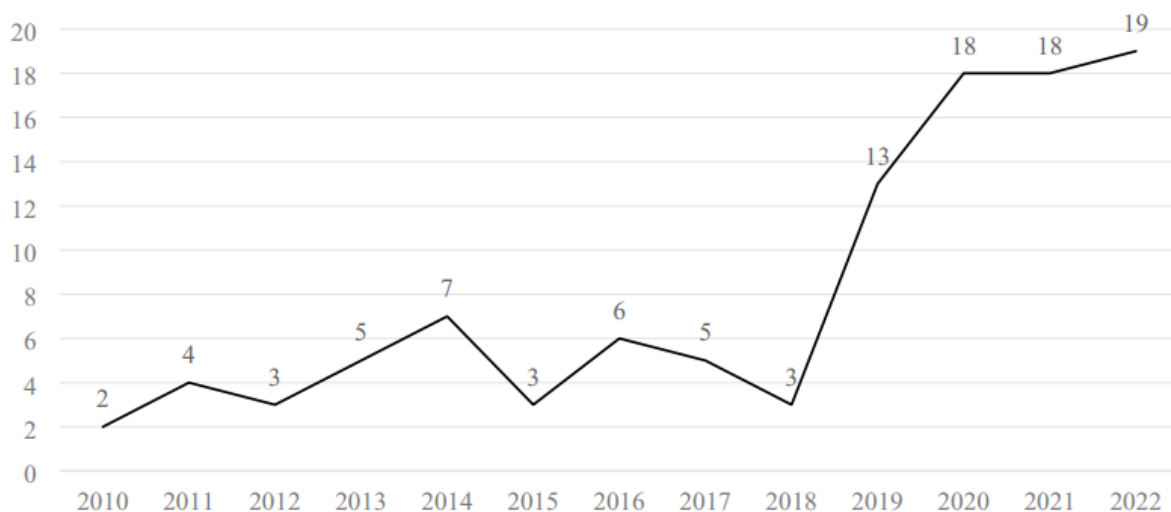
**Trends and development of technology-enhanced personalized learning in science education: a systematic review of publications from 2010 to 2022**

Narisra Komalawardhana<sup>1</sup>  · Patcharin Panjaburee<sup>2</sup> 

Received: 22 January 2023 / Revised: 29 April 2023 / Accepted: 8 May 2023




(1) Distribution of data on personalized learning in science in the Scopus database from 2010 to 2022 (106 included studies)



(2) Proportion of personalized schema in personalized learning studies

Personalized schema	2010–2022 (n = 106) (%)	2010–2015 (n = 37) (%)	2016–2022 (n = 69) (%)
Personalized learning paths	29 (27.36)	6 (16.22%)	23 (33.33%)
Personalized learning content	14 (13.20)	6 (16.22%)	8 (11.60%)
Personalized interfaces	11 (10.38)	9 (24.32%)	2 (2.90%)
Personalized professional learning guidance	11 (10.38)	3 (8.11%)	8 (11.59%)
Personalized recommendations	11 (10.38)	3 (8.11%)	8 (11.59%)
Personalized diagnosis and suggestions	9 (8.49)	2 (5.40%)	7 (10.15%)
Personalized prompts/feedback	9 (8.49)	0	9 (13.04%)
Personalized interfaces/material	3 (2.83)	3 (8.11%)	0
Not specified	9 (8.49)	5 (13.51%)	4 (5.80%)

**Key message:** It is challenging for the researcher to design and develop algorithms of the personalized schema to support the student's learning performance and be relevant to their interest and self-initiation.

# Lens of AI in Education

1. How to employ AI to provide personalized supports or guidance to students?
2. How to implement AI in educational settings?
  - How to use AI to help teachers better manage the classroom?
  - How to integration of AI and other innovative tools for education?
  - What are students' or teachers' perceptions of AI?
3. How AI can be worked with the proper pedagogy (e.g., inquiry-based learning, project-based learning, flipped classroom, self-regulated learning)?
4. How to promote AI literacy or ethics to students and teachers?
5. What are rights, ethical concerns, and equity in the deployment of AI in educational settings?

# Popular AI techniques/algorithms

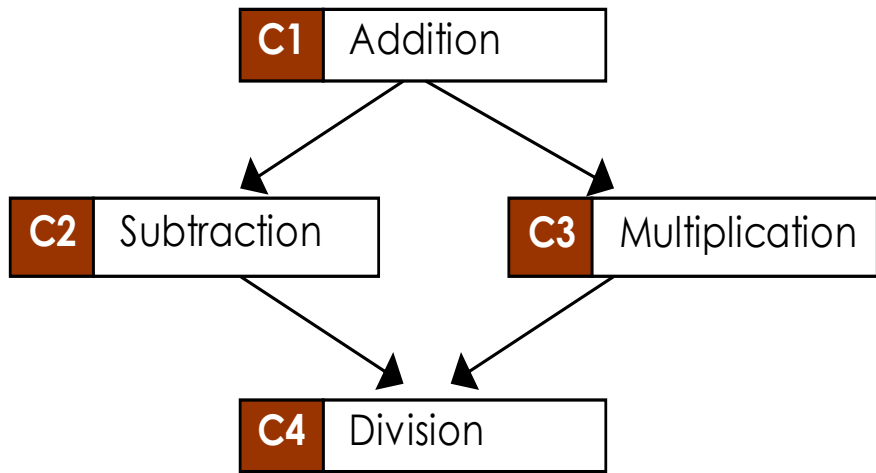
Techniques	Examples
Evolutionary algorithms	Genetic algorithms, ant colony, Tabu
Bayesian inferencing and networks	
Search and Optimization	
Fuzzy set theory	
Deep learning / neural networks	Image or voice recognition systems (e.g., voice-to-text translation)
Case-based reasoning	Making decisions by referring to similar cases provided by domain experts
Data mining	Classification, clustering, association rules
Traditional machine learning approach	Developing a decision tree based on the cases provided by domain experts for classification or decision supports
Statistical learning	Linear regression, polynomial regression for predicting or reasoning
Natural language processing	Chatbots
Knowledge elicitation methods via interviewing domain experts	Repertory grid

# Integrating AI Algorithms in Educational Pedagogy

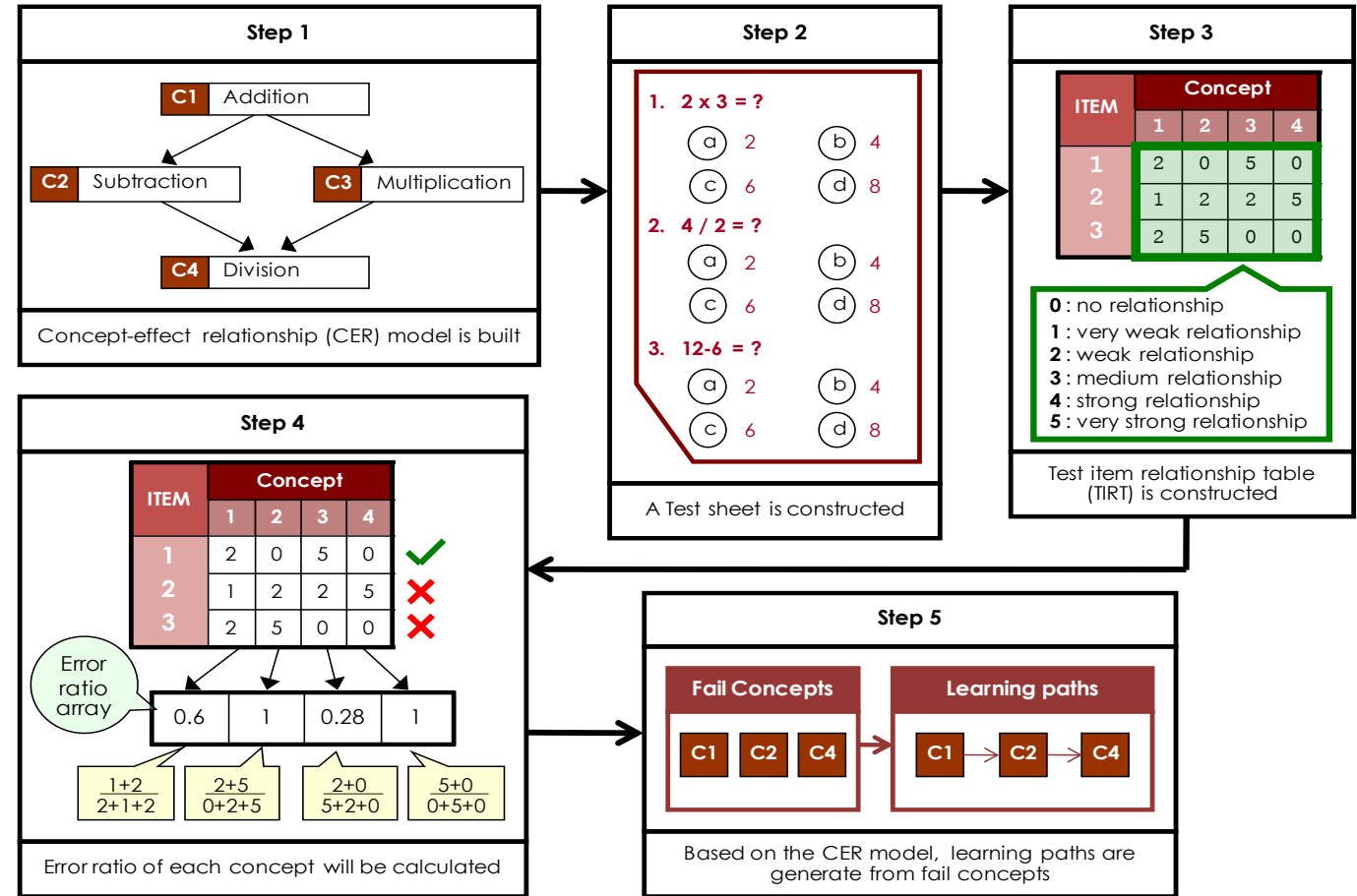
1. Using **concept-effect relationship model** to present knowledge for developing expert systems
2. Using **fuzzy rules** to make decisions based on individual students' status
3. Using **IF-THEN rules** to represent experience for making decisions based on individual students' status
4. Using **decision trees** to represent knowledge for making decisions based on individual students' status

# Adopted AI approaches in web-based learning

(1) Concept-effect relationship (CER) model



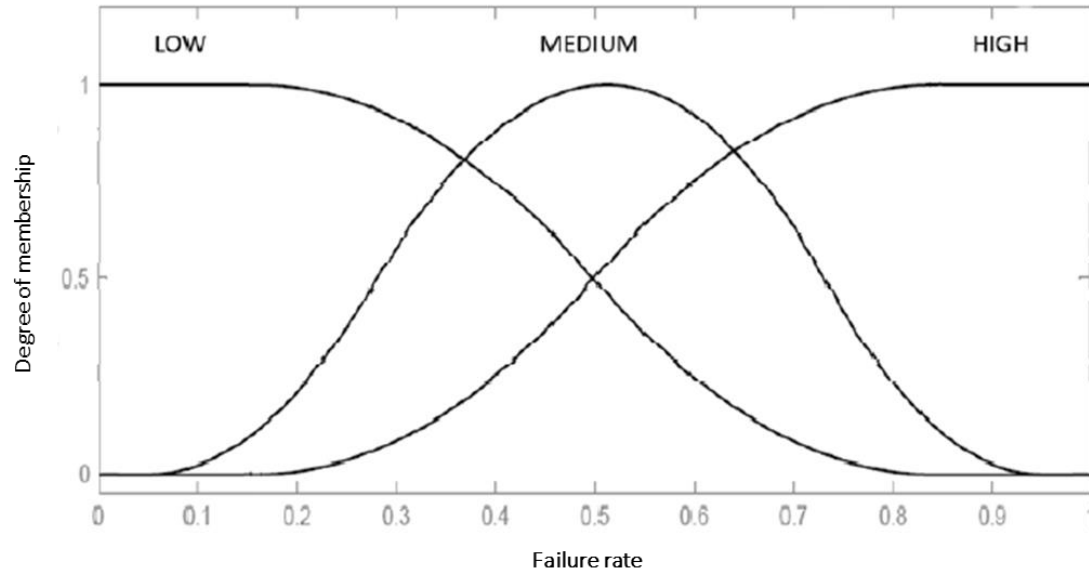
(2) Development of testing and diagnostic system



Reference: Wanichsan, D., Panjaburee, P\*, Laosinchai, P., Triampo, W., & Chookaew, S. (2012). A majority-density approach to developing testing and diagnostic systems with the cooperation of multiple experts based on an enhanced concept-effect relationship model. *Expert Systems with Applications*, 39(9), 8380-8388. (SCI, SSCI, SCOPUS, Q1)

# Adopted AI approaches in web-based learning

## (3) Fuzzy rules to report learning status

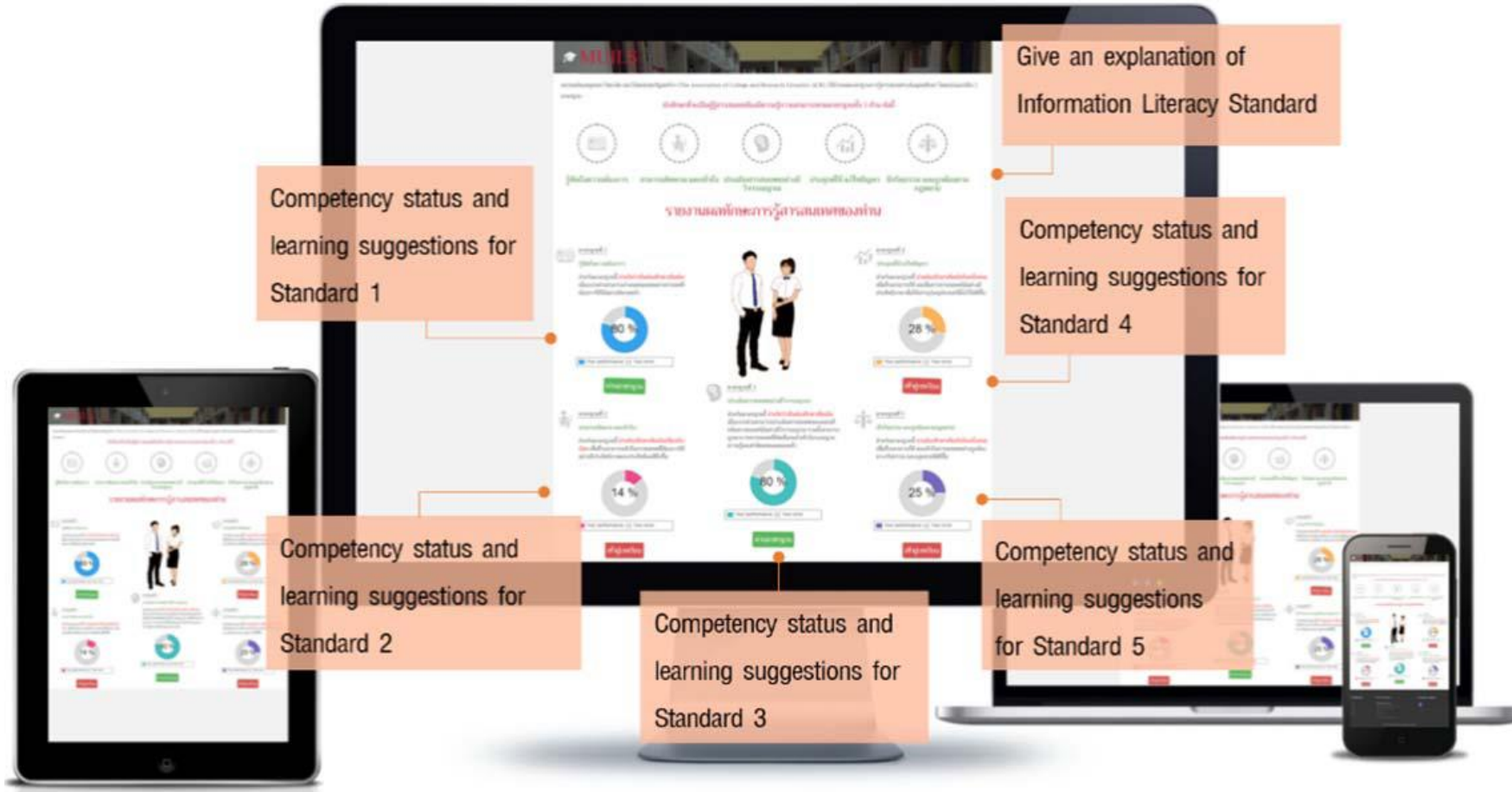


Concepts	Learning performance level of the concept
C <sub>1</sub> Pattern and Relation	You have learned the concept well.
C <sub>2</sub> Equation	You more or less understood this concept.
C <sub>3</sub> Number and Operation	You more or less understood this concept.
C <sub>4</sub> Solution of the Equation	You misunderstood this concept.
C <sub>5</sub> Properties of Equalities	You misunderstood this concept.
C <sub>6</sub> Constructing Linear Equations with One Variable	You more or less understood this concept.
C <sub>7</sub> Solving Linear Equations with one Variable	You misunderstood this concept.
C <sub>8</sub> Least Common Multiple	You more or less misunderstood this concept.
C <sub>9</sub> Ordered Pair and Graph	You seriously misunderstood this concept.
C <sub>10</sub> Word Problems of Linear Equations with One Variable	You more or less misunderstood this concept.
C <sub>11</sub> Solving Linear Equations with Two Variables	You seriously misunderstood this concept.
C <sub>12</sub> System of Linear Equations	You misunderstood this concept.
<b>All remedial learning paths:</b>	
PATH1: C <sub>5</sub> C <sub>7</sub> C <sub>10</sub> C <sub>12</sub> (0.83)	
PATH2: C <sub>5</sub> C <sub>7</sub> C <sub>11</sub> C <sub>12</sub> (0.87)	
<b>Critical remedial learning path:</b>	
PATH2: C <sub>5</sub> C <sub>7</sub> C <sub>11</sub> C <sub>12</sub> (0.87)	
<b>Comment for the student:</b>	
<ol style="list-style-type: none"> <li>According to the DRLS, we found that you did not understand the following concepts: <ul style="list-style-type: none"> <li>Properties of Equalities</li> <li>Solving Linear Equations with one Variable</li> <li>Word Problems of Linear Equations with One Variable</li> <li>Solving Linear Equations with Two Variables</li> <li>System of Linear Equations.</li> </ul> </li> <li>The critical learning problem is the misunderstanding of the concept "Properties of Equalities" which affects the learning of other concepts.</li> <li>To improve learning performance, you should study in the sequence: "Properties of Equalities" → "Solving Linear Equations with one Variable" → "Solving Linear Equations with Two Variables" → "System of Linear Equations".</li> </ol>	

**Reference:** Chookaew, S., Wanichsan, D., Hwang, G.J., & Panjaburee, P.\* (2015). Effects of a personalised ubiquitous learning support system on university students' learning performance and attitudes in computer-programming courses. *International Journal of Mobile Learning and Organisation*, 9(3), 240-257. (SCOPUS, Q2)

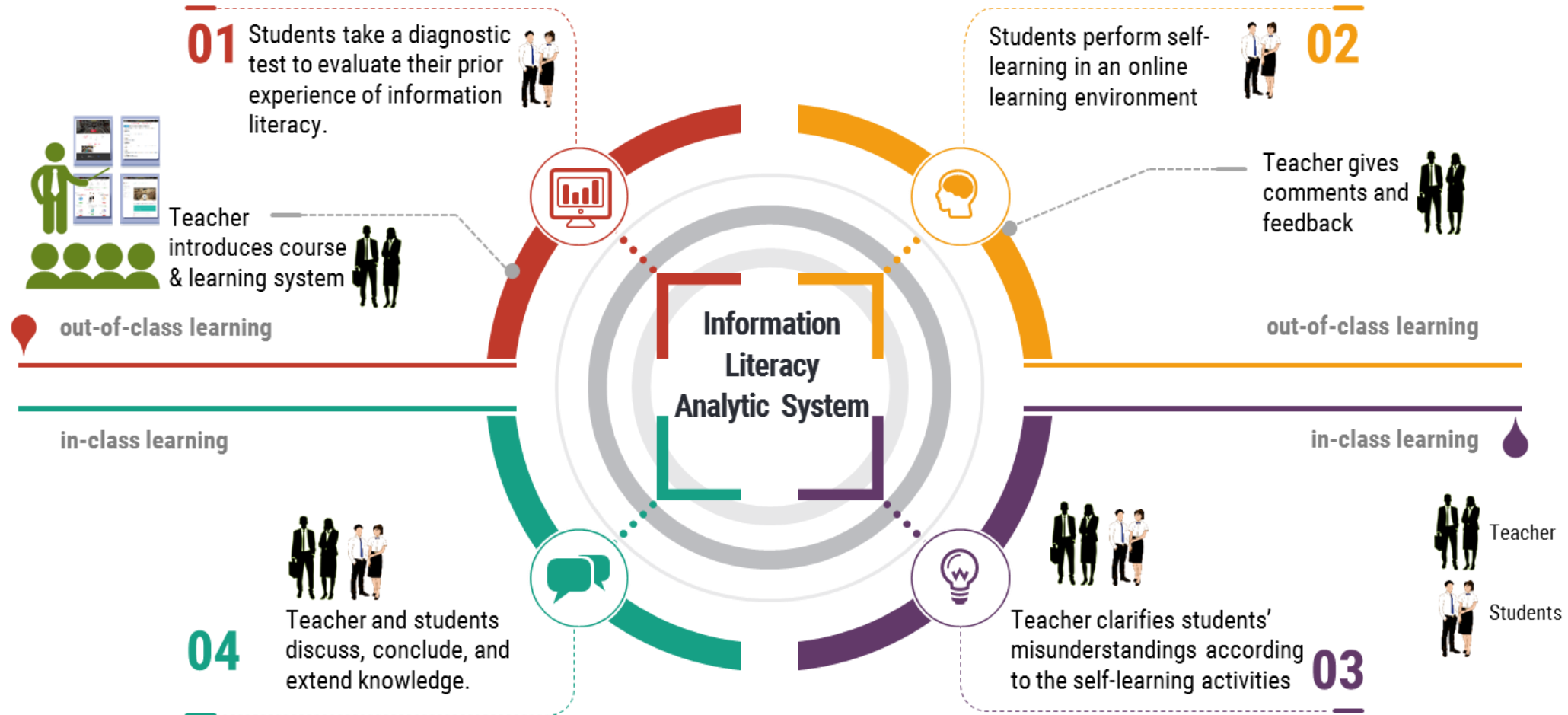


# Adopted AI approaches in information literacy analytics



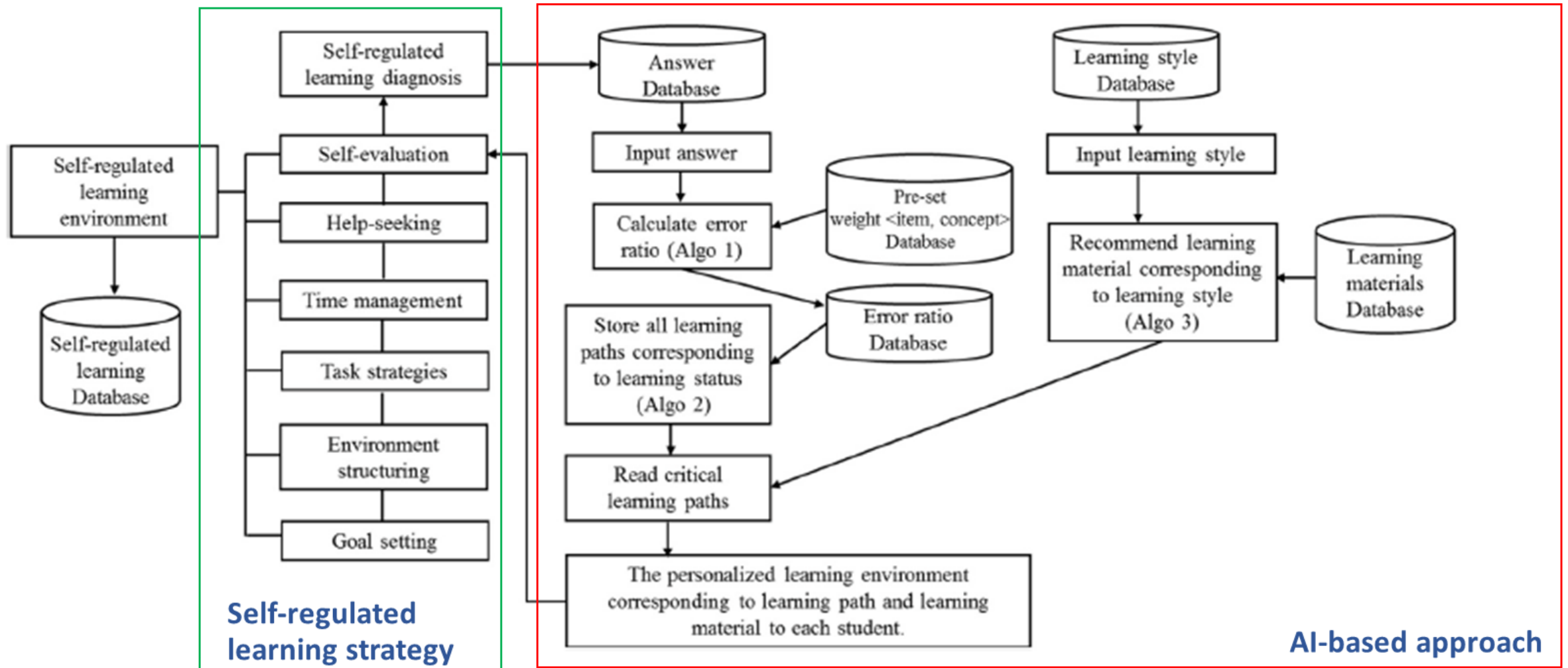
- ❑ Information Literacy Course
- ❑ Analyzing difficult ability of pre-learning information literacy for individual students to arrange learning resource in the self-learning mode at the out-of-class
- ❑ Flipped classroom with personalized ubiquitous learning support system (Information Literacy Analytic System)
- ❑ Better information literacy performance, self-efficacy, career motivation, and grade motivation by comparing it to the traditional teaching method in the usual university setting

# Flipped classroom-infused AI-based approach



Reference: Srisuwan, C & Panjaburee, P. \* (2020). Implementation of flipped classroom with personalised ubiquitous learning support system to promote the university student performance of information literacy. *International Journal of Mobile Learning and Organisation*, 14(3), 370 - 397. (SCOPUS, Q1)

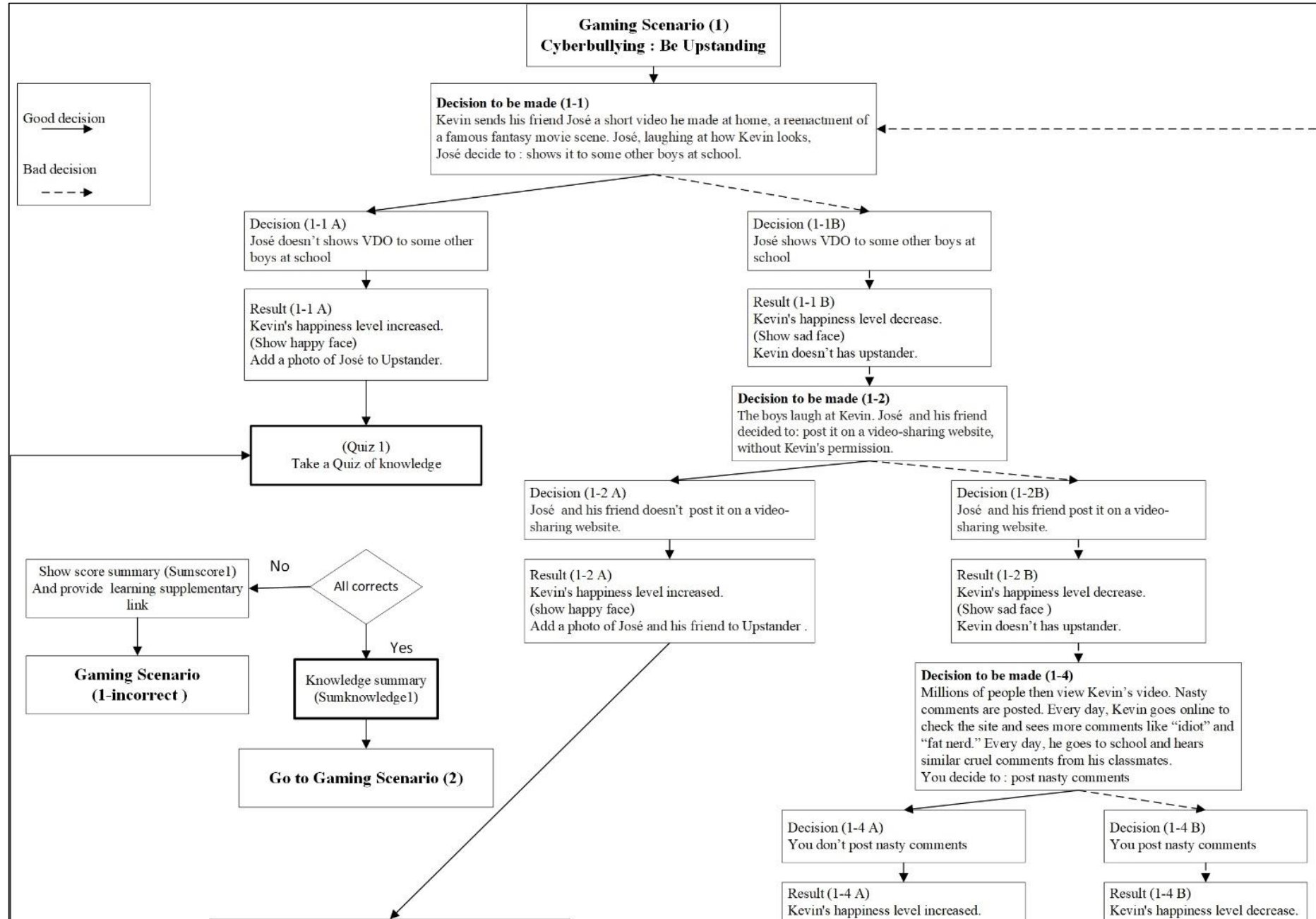
# Self-regulated learning-infused AI-based approach



Reference: Ingkavara, T., Panjaburee, P\*, Srisawasdi, N., & Sajjapanroj, S. (2022). The use of a personalized learning approach to implementing self-regulated online learning. *Computers and Education: Artificial Intelligence*, 3, 100086. (SCOPUS, Q1)

# Game-based learning-infused AI-based approach

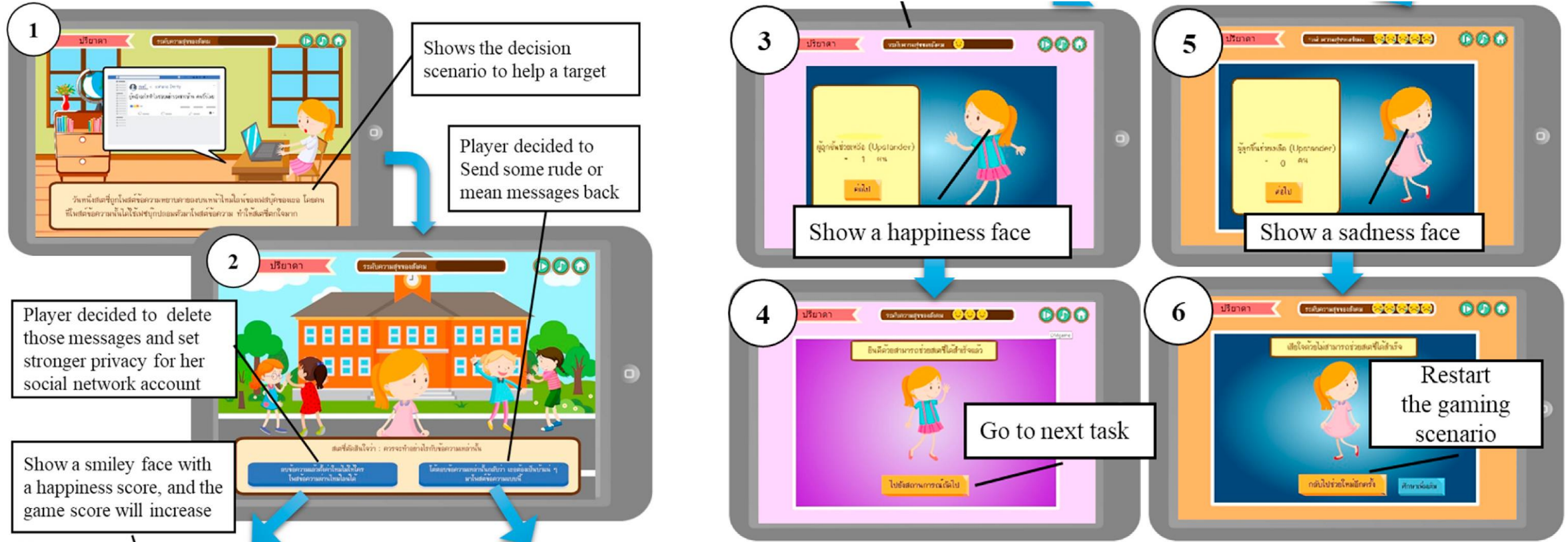
(1) Using decision tree approach





# Game-based learning-infused AI-based approach

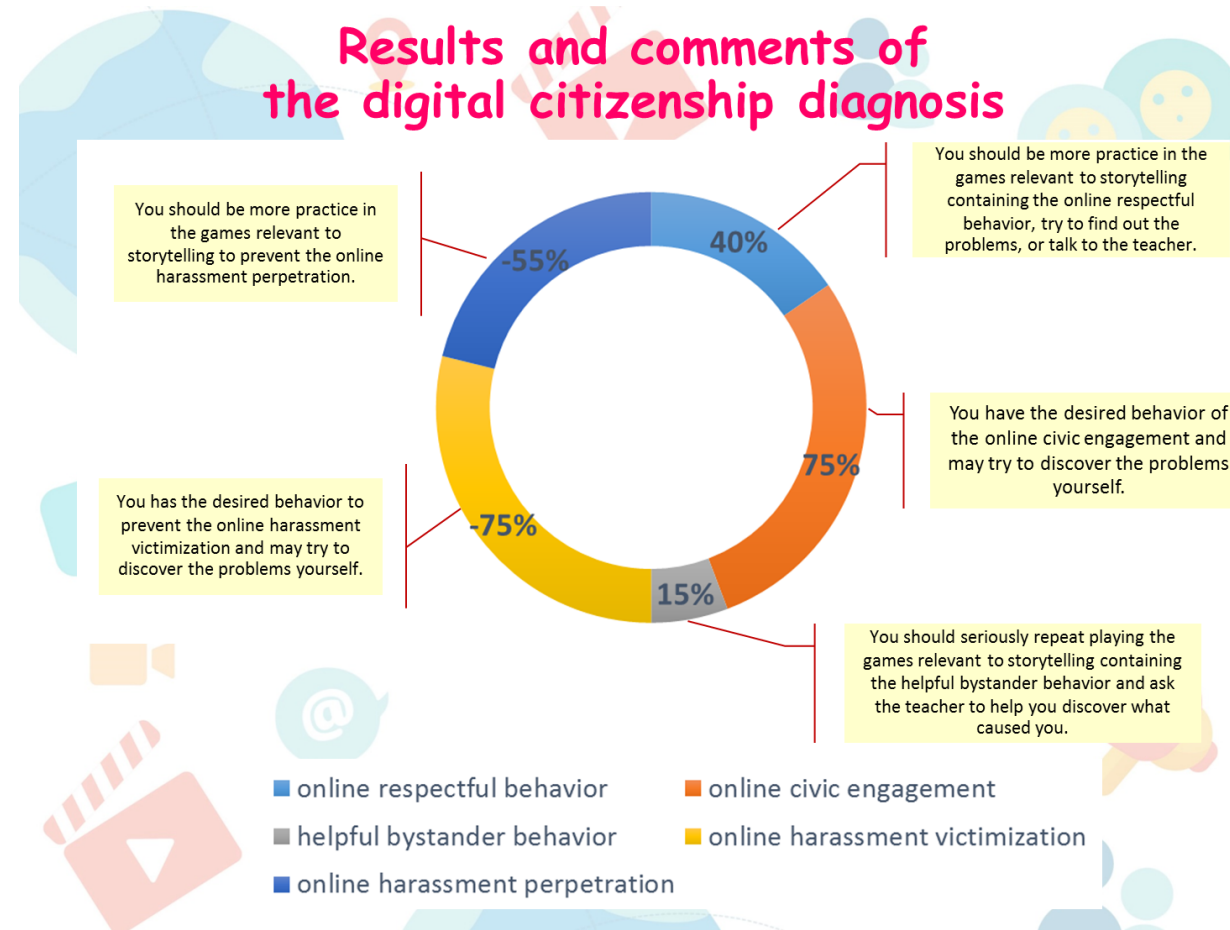
(2) Setting contextual game for cultivating good digital citizenship behaviors



Reference: Tapingkae, P., Panjaburee, P\*, Hwang, G. J., & Srisawasdi, N. (2020). Effects of a formative assessment-based contextual gaming approach on students' digital citizenship behaviours, learning motivations, and perceptions. *Computers & Education*, 159, 103998. (IF = 8.538, SCOPUS, Q1)

# Game-based learning-infused AI-based approach

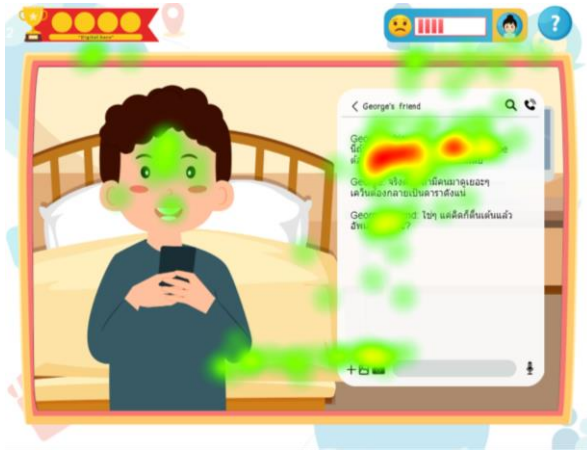
(3) Providing personalized feedback for adjusting digital citizenship behaviors



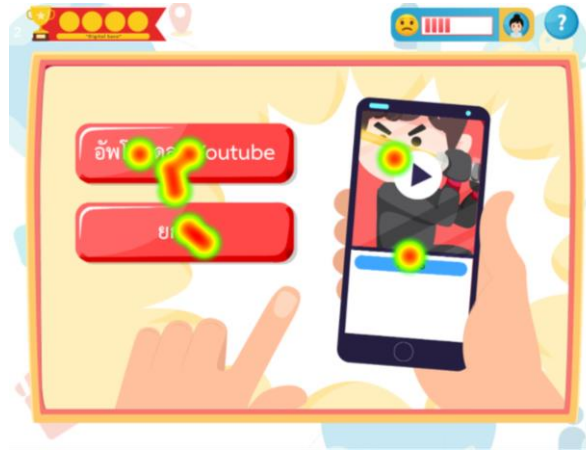
Reference: Panjaburee, P\*, Srisawasdi, N., & Chaipidech, P. (submitted). A Fuzzy Logic and Decision Tree-based Personalized Gaming Approach for Enhancing Digital Citizenship Learning: A Study on Student Affections and Eye-Tracking. *Computers and Education: Artificial Intelligence*, (SCOPUS, Q1)

# Game-based learning-infused AI-based approach

(4) Analyzing visual attention with eye-tracking technology to ensure self-report affection questionnaire



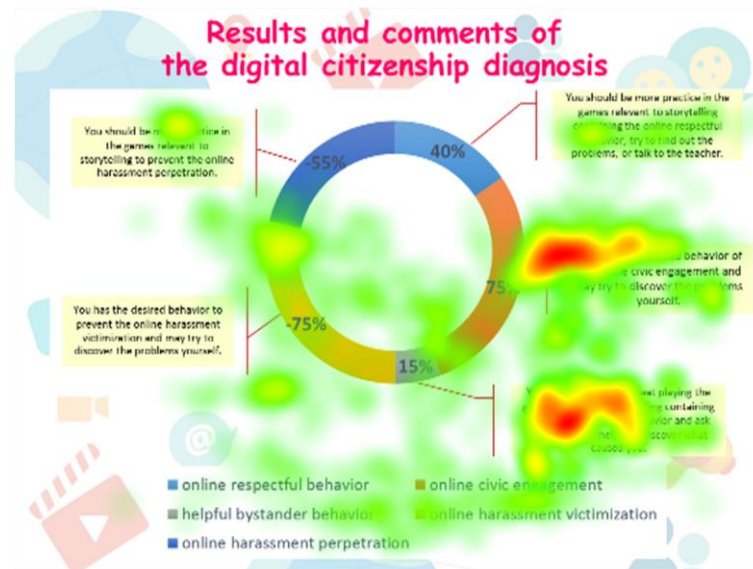
(a) Storytelling



(b) Decision making



(c) Facial Emotion



**Key message:** AI-driven contextual gaming environment achieved a balance between cognitive engagement and attention through personalized feedback.

(d) Personalized feedback

# To sum up findings

## Integrating AI Algorithms in Educational Pedagogy

- › Using **concept-effect relationship model** to present knowledge for developing expert systems
- › Using **fuzzy rules** to make decisions based on individual students' status
- › Using **IF-THEN rules** to represent experience for making decisions based on individual students' status

- › Using **decision trees** to represent knowledge for making decisions based on individual students' status

## Learning Performance

Regarding **flipped classroom and self-regulated learning approaches**, the students, who were provided with personalized learning materials and environments corresponding to their preferences, demonstrated higher performance in Math, Science, and information literacy, as well as increased motivation, self-efficacy, and self-regulated ability, compared to those not using AI in educational pedagogy.

Students using a decision tree in a **contextual game-based learning** improved good behaviors of digital citizenship and greater cognitive engagement..



# Practical Implications of AI in Education

1. To develop AI educational systems with **compatible educational pedagogies**.
2. To use **quasi-experimental designs** to compare AI learning outcomes with traditional methods, focusing on learning performance, not just algorithm speed and accuracy.
3. To assess AI learning systems' impacts on **students' achievements and perceptions**, beyond self-reported satisfaction.
4. For small samples, to analyze learning behaviors (**logs**) and visual attention (**eye tracking**), along with questionnaires.

# Acknowledgements

1. EdTech Fund, Ministry of Education, Thailand
2. Thailand Research Fund
3. National Research Council of Thailand
4. Network Strengthening Fund of the Program Management Unit for Human Resources & Institutional Development, Research and Innovation (PMU-B), Office of National Higher Education Science Research and Innovation Policy Council, Thailand
5. SPIRIT – Swiss Programme for International Research by Scientific Investigation Teams (Collaboration Project between Switzerland and Thailand investigating Gender and Cultural Factors)



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# Thank You



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