Hybrid Proactive Learning using Business Intelligence to Promote Critical Thinking Skills

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ABSTRACT: *The study proposes an instructional model entitled Active-Hybrid Learning Using Business Intelligence (BI), which integrates the principles of active learning and hybrid learning with business intelligence technologies to enhance learners' analytical and problem-solving skills. This learning framework encourages learners to engage in critical thinking, analysis, and hands-on activities through both online and face-to-face modes. By utilizing BI tools such as market trend and consumer data analysis, learners gain real-world experience that strengthens their analytical thinking, digital literacy, and strategic decision-making skills, preparing them for the demands of the digital business environment. The research employed an expert evaluation method to examine the appropriateness of the designed Active-Hybrid Learning Platform Using Business Intelligence.*

The findings indicated that the overall suitability of the platform design was rated at the highest level (M = 4.96, SD = 0.08), and the overall implementation suitability was also at the highest level (M = 4.90, SD = 0.15). The results demonstrate that the proposed model is an effective and practical framework for promoting critical thinking and analytical competence among vocational learners. The integration of BI tools within the hybrid active learning environment enhances learners' capacity to analyze, evaluate, and make informed decisions—skills essential for success in future digital-era professions.

Keywords: Hybrid Learning, Active Learning, Business Intelligence, Critical Thinking Skills

1. Introduction

The landscape of contemporary education is undergoing a profound transformation in terms of moving from traditional, lecture-based instruction to active learning approaches, where students assume a central role in the learning process. This student-centered paradigm fosters the construction of knowledge through analytical thinking and problem-solving activities (Bonwell & Eison, 1991; Freeman et al., 2014). In tandem with this shift, the growing emphasis on 21st-century skills has brought hybrid learning to the forefront—an instructional modality that integrates online and offline learning environments in such a way as to enhance flexibility and increase responsiveness to diverse learner needs (Hrastinski, 2019).

Digital technologies, particularly Artificial Intelligence (AI), have increasingly become pivotal in the educational sector, offering the potential to optimize learning outcomes through the deployment of intelligent data analytics systems such as Business Intelligence (BI). These systems enable the analysis of learner behavior patterns and the customization of instructional content to accommodate individual capabilities and learning preferences (Zawacki-Richter et al., 2019). Within this context, AI catalyzes the fostering of higher-order cognitive skills, notably critical

thinking - a core competency required in the digital age, one characterized by vast volumes of information and multifaceted socio-economic challenges (Facione, 1990; Paul & Elder, 2008).

In response to evolving labor market demands, Thailand's vocational education curriculum was revised in 2024 to align with Industry 4.0 and the demands of the digital economy. The revised curriculum emphasizes analytical thinking, problem-solving, and the application of digital technologies in professional contexts (Office of the Vocational Education Commission, 2024). Furthermore, it incorporates the principles of active and hybrid learning to equip students with the critical thinking abilities essential for navigating knowledge-based economies.
The integration of AI into vocational education presents a promising pathway for enhancing learners' analytical and problem-solving skills through authentic, real-world learning scenarios. Such competencies are indispensable for vocational students preparing for the dynamic and technology-driven workforce in the enterprise environment of the future (Luckin et al., 2016). The synergy between AI and Business Intelligence represents a high-potential approach for the development of robust hybrid learning models.

Against this backdrop, the present study aims to design and implement a hybrid active learning model that leverages business-oriented AI to cultivate critical thinking skills on the part of vocational students. This pedagogical approach engages learners in in-depth cognitive processes through business data analysis while offering practical learning experiences applicable to future professional environments (Siemens & Long, 2011). This study seeks to address a gap in the existing literature regarding the integration of AI in active and hybrid learning models within vocational education and to propose an innovative instructional framework that supports the development of the critical thinking competencies essential for success in the digital era.

2. Literature Review

Active learning is an instructional approach that emphasizes student engagement in the learning process through activities that stimulate analytical thinking and problem-solving. Numerous studies have demonstrated that active learning enhances learning outcomes and fosters the development of critical thinking skills (Cambridge, 2019; Brame, 2016). It encourages learners to actively participate through discussion, collaborative group work, and problem-solving tasks (Bonwell & Eison, 1991).

To fully implement active learning in modern educational settings, the integration of hybrid learning is essential. Hybrid learning combines traditional face-to-face instruction with online learning to create a more flexible and effective learning experience. Research indicates that hybrid learning promotes flexibility in both teaching and learning, allowing students to access learning content at their own convenience and pace (Owl Labs, 2025; NEA, 2021).

Active-hybrid learning, which merges the principles of active and hybrid learning, has been recognized as an effective and engaging educational approach. Studies have shown that active-hybrid learning increases student engagement and effectively enhances critical thinking skills (Smith & Ragan, 1999). This approach is particularly well-suited for the instruction of Business Intelligence (BI), which plays a vital role in improving business processes and increasing organizational efficiency. Research supports the notion that the integration of AI in business settings accelerates task completion, improves accuracy, and creates opportunities for innovation (McKinsey, 2025; Forbes, 2023).
Critical thinking is a fundamental cognitive skill that involves objective analysis, evaluation, and the synthesis of information. It is essential for making sound decisions and solving problems creatively. Studies have consistently shown that the development of critical thinking skills empowers learners to approach problems logically and make well-informed decisions (Indeed, 2025; Coursera, 2024).

Based on the review, analysis, and synthesis of relevant literature, a conceptual framework has been developed to guide the design of a hybrid active learning model that integrates Business Intelligence in such a way as to enhance critical thinking skills. This framework is illustrated in Figure 1.

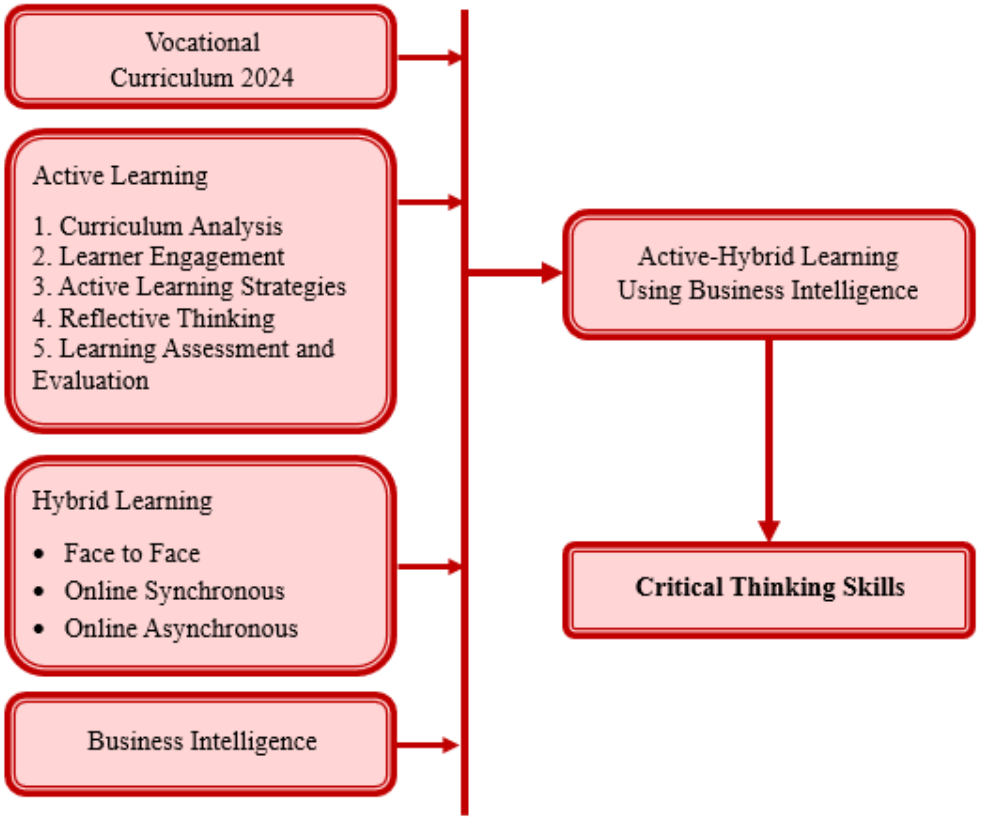

Figure 1. Research Conceptual Framework

3. Purpose of the Research

3.1 To investigate synthesize and analyze the process of Active-Hybrid Learning using Business Intelligence to enhance critical thinking skills.
3.2 To design an Active-Hybrid Learning model utilizing Business Intelligence to promote critical thinking skills.
3.3 To evaluate the effectiveness of the designed Active-Hybrid Learning model using Business Intelligence in terms of enhancing critical thinking skills.

4. Methodology

This study was conducted based on the Systems Approach theoretical framework (Khemmani, 2018; Utranan, 1982), which conceptualizes instructional design through the integration of five core components: input, process, control, output, and feedback. The research methodology consisted of the following elements:
4.1 Scope of the study: The study involved five experts in instructional systems design and development from various academic institutions. These participants were selected based on their recognized expertise in instructional innovation and learning technologies.

4.2 Research Instruments: Two primary research instruments were employed in this study: (1) The Active-Hybrid Learning Model Using Business Intelligence to Enhance Critical Thinking Skills, and (2) An evaluation form assessing the appropriateness of the developed model. The evaluation form was constructed using a 5-point rating scale. Descriptive statistics, including mean and standard deviation, were used to analyze the data collected from the expert evaluations.

4.3 Research Process: The research design followed the principles of the Systems Approach (Khemmani, 2018; Utranan, 1982), serving as the foundation for the development of the model. The overall research process was structured into three phases aligned with the research objectives. These were as follows:

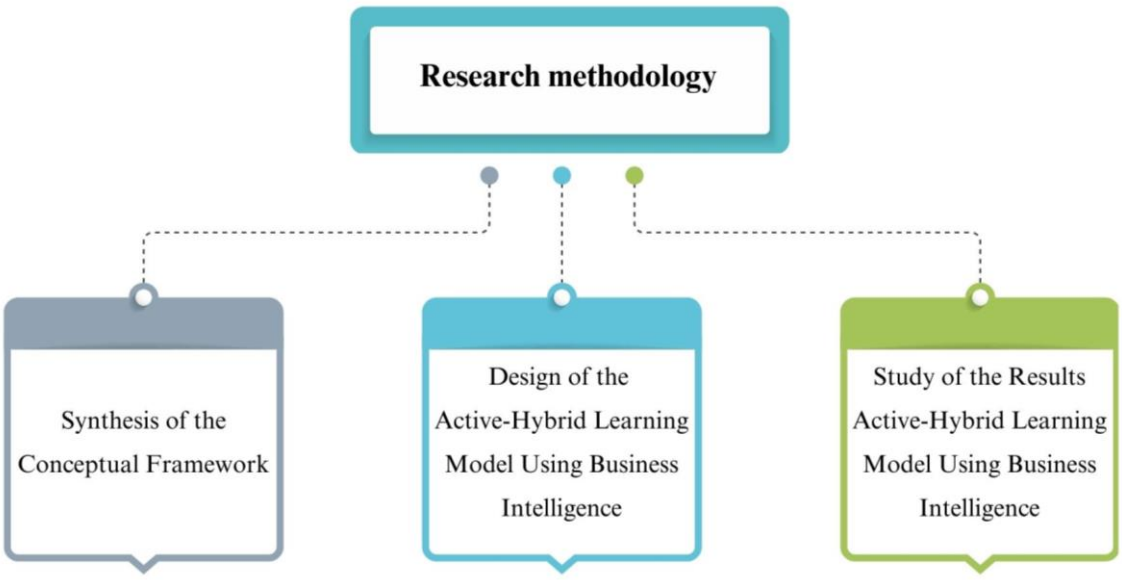

Figure 2. Research methodology

The research process was organized into three sequential phases, aligned with the research objectives and based on the Systems Approach framework. The details of each phase are as follows:

Step 1: Literature Review and Conceptual Framework Development

This phase involved the review, analysis, and synthesis of the academic literature and previous studies related to the design of an Active-Hybrid Learning model using Business Intelligence. The review focused on four core components: Active Learning, Hybrid Learning, Business Intelligence, and Critical Thinking Skills. The outcomes of this phase were used to develop the conceptual framework guiding the model design.

Step 2: Model Design

In this phase, the Active-Hybrid Learning model using Business Intelligence was systematically designed. The researchers applied the Systems Approach in conjunction with the Systems Development Life Cycle (SDLC) methodology (Robert et al., 2013). The model was structured around four key components:

1. Input – foundational elements including learner characteristics, content, and learning objectives;
2. Learning Process – instructional strategies and learning activities integrating active and hybrid methods;
3. Technology – tools and platforms that support Business Intelligence and facilitate learning;
4. Output – learning outcomes, specifically the enhancement of critical thinking skills.

Step 3: Model Evaluation

In the final phase, the model was evaluated by five purposively selected experts with recognized expertise in instructional systems design and development from various institutions. The research instruments were applied to assess the appropriateness and potential effectiveness of the developed model.

To ensure that learners achieved the intended learning objectives, the researchers conducted a comprehensive synthesis of the relevant literature and previous studies. The synthesis process was organized into five key areas, as summarized in the following analytical tables:

1. Table of synthesized processes in Active Learning

Table 1. Synthesis of the learning process of Active Learning

Learning Process Active Learning	Supatra Phusitratnavali et al. (2017)	Kamol Phothiyen (2021)	Nittaya Nakhin (2024)	Jirapha Attaporn (2014)	Sajeetip Talphan (2023)	Johnson et al. (1991)	Fink (2003)	**Authors selected**
1) Learner Preparation Stage							✓	
2) Research Stage				✓	✓			
3) Course Content Analysis	✓		✓		✓	✓		✓
4) Stimulating Attention		✓						✓
5) Encourage remembrance of previous knowledge	✓			✓				
6) Showing challenging situations		✓			✓			
7) Reflective discussion stage		✓		✓	✓			✓
8) Organize learning activities.	✓	✓	✓			✓	✓	✓
9) Provide Feedback	✓	✓		✓				
10) Collaborate with others			✓		✓			
11) Summary of the content at the end of the period	✓		✓			✓	✓	
12) Evaluate learning outcomes	✓				✓			✓
13) Adapt and continue planning					✓			

Based on Table 1, the synthesis of Active Learning processes reveals that the instructional process can be categorized into five key stages:

1. Content Analysis and Course Planning: This stage involves systematically analyzing and organizing course content by clearly defining learning objectives aligned with students' capabilities. Effective planning at this stage enables instructors to design targeted activities that support the learning goals and connect new knowledge with students' prior experiences.

2. Stimulating Interest: The learning process begins with engaging students' attention. Instructors may use problem-based questions, thought-provoking information, or real-life examples to create relevance. This initial motivation enhances learners' readiness to participate in subsequent learning activities.

3. Facilitating Learning Activities: At this stage, learners are encouraged to express opinions, ask questions, and share perspectives on relevant topics. Instructors facilitate interactive activities that promote communication, collaboration, and analytical thinking, helping students link theoretical knowledge to real-world applications.

4. Discussion and Reflective Thinking: Learners engage in hands-on experiences through tasks such as collaborative group work or real-time problem-solving. These activities enhance essential skills such as critical thinking, decision-making, and teamwork through experiential learning and reflection.

5. Assessment and Feedback: This final stage involves a comprehensive evaluation, including teacher assessment, student self-assessment, and peer reflection. Assessment not only measures learners' achievement but also provides valuable feedback that fosters continuous self-improvement and encourages deeper learning.

2. Table of synthesized components in Hybrid Learning

Table 2. Hybrid Learning Synthesis

Hybrid Learning	Sivapat, Bumrunsetpong, et al. (2020)	Sudaporn Panyapruek (2023)	Chawin Chukuson (2023)	Lestari et al., (2021)	Wongyai & Pattaphol (2020)	Kamolwan Kerdpunya (2024)	Cheerapakorn et al. (2024)	**Authors selected**
1. Face to Face	✓	✓	✓	✓	✓	✓		✓
2. Online Synchronous	✓	✓	✓	✓	✓	✓	✓	✓
3. Online Asynchronous		✓	✓		✓	✓	✓	✓

Based on Table 2, the synthesis of Hybrid Learning reveals that this instructional approach involves the integration of face- to- face and online learning modalities, incorporating both synchronous and asynchronous formats. This combination enhances flexibility, enabling learners to select learning methods that best align with their individual needs and preferences.

The hybrid model emphasizes meaningful interaction between instructors and students, as well as among peers, facilitated through the use of digital technologies and internet-based platforms. The primary objective is to foster active learning, stimulate effective cognitive engagement, and support adaptive learning pathways in response to diverse learner characteristics and varying educational contexts.

3. Table of the integration between Active Learning and Hybrid Learning

Table 3. Integration of Active Learning with Hybrid Learning

Active Learning	Hybrid Learning		
	Face to Face	Online Synchronous	Online Asynchronous
1) Curriculum Analysis	✓	✓	
2) Learner Engagement	✓	✓	
3) Active Learning Strategies	✓	✓	✓
4) Reflective Thinking	✓	✓	
5) Learning Assessment and Evaluation	✓	✓	✓

Based on Table 3, the integration of Active Learning with Hybrid Learning demonstrates a flexible and adaptive instructional approach. Active- Hybrid Learning combines the core principles of Active Learning, emphasizing authentic student engagement, with the structural flexibility of Hybrid Learning, which blends face-to-face instruction, real-time online learning, and self-paced online learning.

This integrated model aims to promote flexibility, learner participation, and deep learning by offering diverse pathways tailored to individual learning styles and situational contexts. The approach fosters readiness and adaptability on the part of learners, equipping them with the necessary skills to thrive in dynamic educational and professional environments.

4. Instructional steps of Active-Hybrid Learning using Business Intelligence

Table 4. Instructional Procedures of Active-Hybrid Learning Using Business Intelligence

Active Learning Process	Instructor's Role	Learner's Role
1) Curriculum Analysis	**1.1 Face-to-Face** Explain course content and learning objectives; administer pre-test via Google Form. **1.2 Online Synchronous** Present via slides or video call; administer pre-test. **1.3 Online Asynchronous** Upload video and materials; upload pre-test.	**1.1 Face-to-Face** Listen, take notes, and complete the pre-test. **1.2 Online Synchronous** Listen and ask questions via chat or microphone; complete the pre-test. **1.3 Online Asynchronous** Watch videos, read documents, and complete the pre-test.
2) Learner Engagement	**2.1 Face-to-Face** Use problem-based questions, case studies, and storytelling; encourage experience sharing. **2.2 Online Synchronous** Use polls or chat questions. **2.3 Online Asynchronous** Upload interesting articles/ videos, post guiding questions on the discussion board, and assign exploratory tasks.	**2.1 Face-to-Face** Participate in discussions and activities. **2.2 Online Synchronous** Respond to polls or chat questions. **2.3 Online Asynchronous** Watch, read, and comment in the forum; participate in discussion board activities.
3) Active Learning Strategies	**3.1 Face-to-Face** Facilitate group discussion; teach Power BI AI usage guide, data analysis using AI. **3.2 Online Synchronous** Use breakout rooms, conduct Power BI AI workshops via Google Meet, and share data analysis examples. **3.3 Online Asynchronous** Create forum topics, upload tutorials, and assign analysis tasks.	**3.1 Face-to-Face** Engage in group discussions and use Power BI AI for analysis and reflection. **3.2 Online Synchronous** Collaborate in breakout groups, analyze real-time data using Power BI AI, and share findings. **3.3 Online Asynchronous** Post analysis using Power BI AI in the forum; reflect and submit insights via LMS.
4) Reflective Thinking	**4.1 Face-to-Face** Facilitate hands-on problem-solving or case studies; guide students in analyzing and presenting using Power BI. **4.2 Online Synchronous** Assign group tasks via Google Meet; support real-time analysis using Power BI. **4.3 Online Asynchronous** Assign mini-projects; submit analytical reports using Power BI AI.	**4.1 Face-to-Face** Collaborate with peers, analyze data with Power BI, and present results. **4.2 Online Synchronous** Collaborate in real-time analysis and discussion. **4.3 Online Asynchronous** Complete mini-projects and submit findings.
5) Learning Assessment and Evaluation	**5.1 Face-to-Face** Use rubrics to assess reports and presentations, facilitate reflective discussion, and administer post-tests. **5.2 Online Synchronous**	**5.1 Face-to-Face** Present learning outcomes; reflect on learning experience; complete post-test. **5.2 Online Synchronous**

	Use Google Forms for exit tickets; facilitate group learning reflection. **5.3 Online Asynchronous** Require e-portfolio submission and self-assessment.	Complete exit ticket; engage in reflective discussion; complete post-test. **5.3 Online Asynchronous** Create an e-Portfolio and complete self-assessment.

Based on Table 4, presents the instructional framework of Active-Hybrid Learning using Business Intelligence, which integrates active and hybrid learning approaches across face-to-face, online synchronous, and asynchronous modes. The process consists of five key stages—curriculum analysis, learner engagement, active learning strategies, reflective thinking, and learning assessment. Instructors act as facilitators guiding learners through interactive and data-driven activities using BI tools like Power BI, while learners actively participate in analysis, discussion, and reflection. This model enhances flexibility, digital competence, and critical thinking skills essential for the digital business era.

5. Table of synthesized elements in Critical Thinking Skills

Table 5. Critical Thinking Skills

Critical Thinking Skills	Lia Agustina & Umi Anis Ro'isatin (2024)	Ying Guo & Daniel Lee (2023)	Vera Dewi Susanti & Ika Krisdiana (2021)	Rossella Suriano et al, (2024)	Christopher P. Dwyer (2023)	Facione P. (1990)	**Authors selected**
Interpretation			✓			✓	✓
Analysis	✓	✓	✓	✓		✓	✓
Evaluation	✓	✓	✓	✓		✓	✓
Synthesis	✓						
Reasoning	✓	✓					
Problem-solving	✓		✓	✓			
Effective Communication	✓	✓	✓	✓	✓		
Engagement and Knowledge Acquisition				✓	✓		
Cognitive Flexibility	✓				✓		
Reflective Thinking		✓	✓	✓	✓		
Creativity		✓	✓				
Self-Regulation				✓	✓	✓	✓
Inference			✓			✓	✓
Explanation						✓	✓

Based on Table 5, the researcher concurs with the components of Critical Thinking Skills as conceptualized by Facione (1990). These components serve as the foundation for the present study's synthesis, reflecting the researcher's agreement with Facione's theoretical framework and its relevance to the development of critical thinking, includes the following components: (1) Interpretation: The ability to understand and explain information, such as reading and summarizing key concepts. (2) Analysis: The ability to discern the structure of information and identify relationships

between ideas. (3) Explanation: The ability to present ideas using reasoning and supporting evidence. (4) Evaluation: The ability to assess the accuracy, credibility, and logical coherence of information. (5) Self-Regulation: The ability to reflect on and improve one's thinking processes. (6) Inference: The ability to use available information to draw conclusions or predict outcomes.

5. Results

The design of the Active-Hybrid Learning model using Business Intelligence to enhance critical thinking skills yielded the following results:

5.1 Results of the Active-Hybrid Learning Using Business Intelligence Design

The design of the Active-Hybrid Learning model using Business Intelligence was developed as a framework for promoting critical thinking skills. These skills are essential for students in terms of developing analytical thinking, evaluation, reflection, and creativity, while also fostering teamwork and time management. Additionally, this approach enhances students' ability to think systematically, empowering them to tackle complex problems confidently and effectively. The model consists of four key components: inputs, learning processes, outputs, and feedback, as shown in Figure 3.

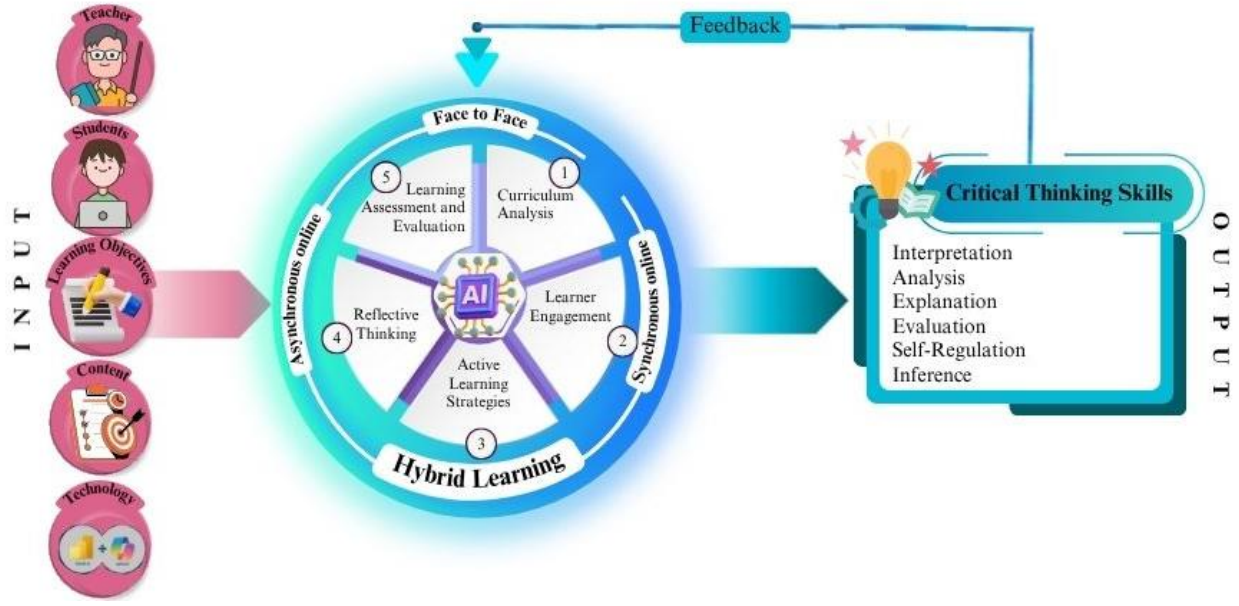

Figure 3. The Active Learning Model: Active-Hybrid Learning Using Business Intelligence

Based on Figure 3, the Active-Hybrid Learning Using Business Intelligence to Enhance Critical Thinking Skills consists of four key components:

1. Input

1.1 Students: Refers to learners who are interested in participating in the Active-Hybrid Learning process.

1.2 Teacher: Refers to the instructor responsible for designing, facilitating, and supporting the Active-Hybrid Learning process.

1.3 Learning Objectives: Refers to clearly-defined goals for the learning process, aimed at ensuring that learners achieve the intended outcomes.

1.4 Content: Refers to the information, knowledge, and skills designed to help learners acquire and develop an understanding of the relevant topics, integrated to align with the learning method.

1.5 Technology: Refers to the tools used in the course, including both hardware and software, to facilitate the teaching and learning process.

2. Integration of Active-Hybrid Learning

This component represents a flexible learning process that adapts to different situations. Active-Hybrid Learning integrates Active Learning principles focused on active student participation with Hybrid Learning, combining face-

to-face instruction, real-time online learning, and self-paced online learning. The model emphasizes flexibility, engagement, and deep learning, preparing students to adapt and develop essential skills.

3. Output

The output is the enhancement of Critical Thinking Skills (as referenced from Facione (1990)). These skills can be measured based on specific characteristics as outlined in Table 6.

Table 6. Characteristics of Critical Thinking

Features of critical thinking	explanation
Interpretation	The ability to understand and explain information such as reading and summarizing key concepts.
Analysis	The ability to distinguish the structure of information and identify relationships between ideas.
Explanation	The ability to present ideas using reasoning and by providing supporting evidence.
Evaluation	The ability to assess the validity, credibility, and reasoning of concepts or information.
Self-Regulation	The ability to reflect on and improve one's own thinking process.
Inference	The ability to use available information to draw conclusions or predict outcomes.

4. Feedback

Feedback refers to reflection with regard to outcomes from the activities conducted within the learning process. This feedback is derived from the analysis and evaluation of the use of the Active-Hybrid Learning platform using Business Intelligence. The results obtained are then assessed and fed back into the learning process to improve instructional effectiveness.

5. 2 Results of the Appropriateness of the Active-Hybrid Learning Platform Using Business Intelligence

The evaluation of the design of the Active-Hybrid Learning platform using Business Intelligence, conducted with the support of the research participants, involved a purposive sample of 5 experts. These experts were selected for their knowledge and expertise in instructional design and the development of teaching systems across various institutions. The results are presented in Tables 7 and 8.

Table 7. Evaluation of the Appropriateness of the Design of the Active-Hybrid Learning Platform Using Business Intelligence (Overall Components)

Assessment List	Results of the Assessment Items		Interpretation
	Mean	**SD**	
1. To what extent are the principles and concepts used as the basis for the learning design appropriate?	5.00	0.00	highest
2. To what extent is the composition of the learning design appropriate? ** Consider the aspect of comprehensiveness according to the main elements of general teaching and learning.			
2.1 Input	4.80	0.40	highest
2.2 Active-Hybrid Learning Using Business Intelligence	5.00	0.00	highest
2.3 Output	5.00	0.00	highest
2.4 Feedback	5.00	0.00	highest
Overall	4.96	0.08	**highest**

Based on Table 7, the evaluation results of the appropriateness of the design of the Active-Hybrid Learning using Business Intelligence (Overall Components) indicate that it achieves the highest appropriate overall level (Mean = 4.96, SD = 0.08). This suggests that the design of the Active-Hybrid Learning using the Business Intelligence model is comprehensive and can serve as a guide for the development of Active-Hybrid Learning platforms aimed at

enhancing critical thinking skills. These skills are essential for learners to engage in effective critical thinking through the use of technology.

Table 8. Results of Evaluation of the Suitability of Active-Hybrid Learning using Business Intelligence Design

Assessment List	Results of the Assessment Items		Variable
	M	***SD***	
1. Input			
1.1 Students	4.60	0.49	highest
1.2 Teacher	5.00	0.00	highest
1.3 Learning objectives	4.80	0.40	highest
1.4 Content	4.60	0.49	highest
1.5 Technology	5.00	0.00	highest
2. Active-Hybrid Learning Using Business Intelligence			
2.1 Active Learning			
2.1.1 Curriculum Analysis	5.00	0.00	highest
2.1.2 Learner Engagement	5.00	0.00	highest
2.1.3 Active Learning Strategies	5.00	0.00	highest
2.1.4 Reflective Thinking	4.80	0.40	highest
2.1.5 Learning Assessment and Evaluation	5.00	0.00	highest
2.2 Hybrid Learning			
2.2.1 Face-to-Face	5.00	0.00	highest
2.2.2 Online Synchronous	5.00	0.00	highest
2.2.3 Online Asynchronous	4.80	0.40	highest
3. Output			
3.1 Critical Thinking Skills			
3.1.1 Interpretation	5.00	0.00	highest
3.1.2 Analysis	5.00	0.00	highest
3.1.3 Explanation	4.80	0.40	highest
3.1.4 Evaluation	5.00	0.00	highest
3.1.5 Self-Regulation	5.00	0.00	highest
3.1.6 Inference	5.00	0.00	
4. Feedback			
4.1 Results of evaluation on Critical Thinking Skills	5.00	0.00	highest
Overall	**4.90**	**0.15**	**highest**

Based on Table 8, the evaluation of the appropriateness of the design of the Active-Hybrid Learning using Business Intelligence reveals that it is highly suitable in that it is deemed to have achieved the most appropriate overall level ($M = 4.90, SD = 0.15$). IS THIS WHAT YOU MEAN? This indicates that the Active-Hybrid Learning using the Business Intelligence model includes well-suited components that can serve as an effective framework for learning through problem-solving processes. It promotes the development of systematic analytical thinking and practical application, encouraging learners to identify and address issues through structured thinking, while utilizing technology efficiently.

6. Conclusion & Discussion

The results of this study demonstrate that Active-Hybrid Learning using Business Intelligence to enhance critical thinking skills is an effective approach for developing learners' critical thinking skills. The practical implementation of this approach with students revealed that the use of AI in business data analysis, such as Power BI, significantly improved the learners' ability to analyze and make decisions based on complex data. Furthermore, the learners showed increased participation in the learning process and were able to apply the concepts learned to real-world business problem-solving situations effectively.

These findings align with the work of Luckin et al. (2016), which indicated that AI in education can help students develop analytical skills through personalized learning. The study also supports the ideas of Siemens & Long (2011),

who stated that technology-driven learning enhances student engagement and provides experiences that apply to future endeavors. Additionally, this study highlights the need for designing learning management systems that incorporate AI to optimally support the development of students' skills in the digital age.

6. Conclusions

Student Relations Management (SRM) constitutes a critical component of higher education institutions, emphasizing the importance of the cultivation and maintenance of positive student relationships to enhance satisfaction, engagement, retention, and overall success. The integration of Adaptive AI with SRM represents a transformative advancement, offering personalized and proactive support tailored to the unique needs and preferences of individual students.

Bibliometric analysis serves as a pivotal research methodology, enabling scholars to systematically identify and evaluate the existing literature on the application of Adaptive AI in SRM. This analytical approach facilitates the exploration of diverse perspectives and methodologies, thereby enriching the current body of knowledge and fostering the development of novel insights and findings. Through bibliometric analysis, researchers can pinpoint research gaps and areas necessitating further investigation.

The integration of SRM with AI and Adaptive AI presents significant opportunities for enhancing student engagement, retention, and personalized learning experiences. The use of data mining, predictive analytics, and decision support systems can support informed decision-making and strategic planning in higher educational institutions. As educational leaders and policymakers embrace these technologies, it is essential to address ethical considerations and ensure that data privacy and security are maintained. Future research should continue to explore the impact and challenges of AI-driven SRM systems to fully realize their potential in transforming higher education.

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