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Challenge-Based Hybrid Learning Model Using Virtual Board Games Platforms

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Abstract

This study focuses on the development and evaluation of a challenge-based hybrid learning approach utilizing a virtual board games platform to enhance international standard student competency. Our research applies educational management theories to challenge-based learning, providing learners with diverse opportunities for engagement, investigation, and action. Through the integration of virtual board game platforms, students actively participate in learning activities aimed at elevating their skills to international standards. The study underscores the effectiveness of hybrid learning management, blending face-to-face and online elements, including board games as challenges, as the most suitable approach. Experts unanimously advocate for this approach, especially in advancing students' capacities in creative problem-solving and critical thinking at an international level. Notably, scholars emphasize the significance of assessing students' abilities to meet global benchmarks, positioning challenge-based learning as the predominant educational approach at the advanced level. This study provides empirical evidence supporting the efficacy of challenge-based hybrid learning using a virtual board game platform in fostering advanced competencies. And explores the integration of virtual board games in hybrid learning environments, offering a nuanced understanding of how educational management theories can be applied practically. Furthermore, it emphasizes the critical role of assessing students' creative problem-solving and critical thinking abilities in competency evaluation. In conclusion, this study advances the discourse on hybrid learning methodologies, substantiates the effectiveness of challenge-based learning utilizing board games, and underscores the importance of evaluating students' competencies at an international standard.

Keywords: challenge-based learning, hybrid learning, board games, virtual board games platforms

1. Introduction

The utilization of classroom learning management systems, educational content, and learning materials serves to foster students' autonomy by encouraging them to independently pursue knowledge aligned with their personal interests through a di-verse range of sources. These factors can contribute to the development of students' critical thinking skills, their ability to navigate challenges, and their capacity to effectively apply acquired knowledge in problem-solving scenarios. Active learning is also influenced by the evolving nature of contemporary societies, particularly the phenomenon of digital disruption. This encompasses the introduction of novel technology advancements, alterations in platforms, and abrupt shifts in societal behaviors, encompassing both environmental and cultural aspects.

The integration of a challenge-based hybrid learning model, which incorporates both face-to-face and online learning modalities via the internet, has the potential to boost the engagement of learners and instructors, allowing them to participate in activities simultaneously or at different times. The primary emphasis is placed on the educational facility for pupils. Moreover, it serves as a source of motivation for students to engage in problem-solving within authentic contexts through collaborative efforts between students and teachers. This can facilitate the acquisition of knowledge through the utilization of ICT and communication assistance, which serves as a fundamental instrument for exploring significant concepts through the formulation of effective inquiries and navigating the process of resolving complex problems, thereby enabling in-depth study.

In the role of an instructor, he or she assumes the position of a coach who possesses the capability to foster the growth of individuals by equipping them with the necessary information, skills, and abilities to effectively

navigate the dynamic changes known as Competency. Given that competence is a crucial factor in facilitating individuals to succeed in their careers. Therefore, competency is an outcome that arises from the presence of favorable attributes associated with the process of acquiring knowledge and skills. In recent times, it has been observed that cultures across the globe have transitioned into what is commonly referred to as a VUCA World (Volatility, Uncertainty, Complexity, Ambiguity). The economic scenarios and processes of globalization have resulted in significant transformations within the realm of globalization. Therefore, it is imperative to prioritize the development of learners' competency in relation to current and future routines.

Currently, Thailand is engaged in a collaborative effort with the Organization for Economic Co-operation and Development (OECD) to enhance its capabilities and address the challenges posed by transformative competences in the year 2030. The OECD is an international body that uses the Programme for International Student Assessment (PISA) to evaluate the effectiveness of educational systems in equipping individuals with the necessary skills and competences to thrive in an ever-evolving global landscape (OECD, 2019). Virtual board game platforms refer to digital platforms that enable users to play board games using various applications inside a shared online environment.

Virtual board game platforms offer the opportunity to engage in gameplay within a wide range of thematic and educational contexts, spanning expansive virtual environments. The primary objective of board games is to facilitate user interaction and foster mutual learning. This serves as a guiding principle for the potential development of learners. The board game is a captivating instrument featuring aesthetically pleasing components that align with the game's framework. The game's structure encompasses a player count exceeding two. The objective of any game is readily discernible based on the established rules of the game. The majority of board games are constructed in such a way that necessitates interaction among all participants. Virtual board game platforms provide players with a convenient and comfortable means of accessing a communicative support system.

There are numerous virtual board game platforms available, with a majority of them being regularly built for commercial purposes and designed to facilitate cooperative learning experiences. The learning design has been built to investigate the experiential aspects of engaging in board games that adhere to specified sets of rules. It is imperative for players to engage in a process of studying the mechanics and strategies involved in playing the games. While there exists a wide array of board games, it is noteworthy that the rules governing these games often share similarities, primarily revolving around the objective of achieving victory through competition. As a result, board games that incorporate learning management strategies can be utilized across a wide range of academic areas.

As mentioned earlier, our research distinguishes itself by introducing a novel Challenge-Based Learning (CBL) model utilizing both virtual and physical board games. Our learning model specifically focuses on enhancing international standard student competency and emphasizes experiential engagement in problem-solving scenarios within the context of the VUCA World. Furthermore, the acquired knowledge can be utilized for the purpose of studying in a proper manner.

2. Methodology

The challenge-based hybrid learning model using virtual board games platforms is to develop and evaluate a challenge-based hybrid learning using virtual board games platform to enhance inter-national standard student competency.

2.1 Develop a Challenge-Based Hybrid Learning Model

Firstly, examine and evaluate existing theories and concepts found in various documents and research sources. Then, establish a comprehensive framework for a challenge-based hybrid learning using virtual board games platform to enhance inter-national standard student competency.

The process involves collecting data from many papers and research sources to establish the foundation for a challenge-based hybrid learning using virtual board games platform to enhance international standard student competency.

2.2 Evaluate the Appropriateness of the Model

This study was to evaluate the effectiveness of the challenge-based hybrid learning using virtual board games platform to enhance inter-national standard student competency. This evaluation was conducted by specialists in the field of learning assessment. The study utilized purposive sampling to pick a total of 11 participants who possessed expertise in various areas such as learning design, hybrid learning, learning challenges, virtual board games platforms, and student competency.

The research instrument employed a hybrid learning model utilizing virtual board games platforms, with the objective of improving learners' proficiency in international standard student competency and assessment formats, in line with the challenge-based hybrid learning model utilizing virtual board games platforms. The assessment form was prepared by the researcher using a rating system consisting of five levels.

3. Literature Review

3.1 Challenge-Based Learning

Challenge-based learning (CBL) is an educational approach that centers around the students, with the aim of inspiring them to identify and address real-world problems. Collaborative learning is a pedagogical approach that involves active participation and interaction among students, teachers, and specialists. It encompasses self-guided learning and inquiry-based learning, with the aim of integrating many components of knowledge acquisition. Information and communication technology (ICT) serves as a valuable instrument in this process, enabling students to pose meaningful questions and devise effective strategies to address obstacles. An extensive examination is also encompassed. In the role of an instructor, one assumes the responsibility of serving as a coach, providing guidance to students to facilitate the creation and successful completion of significant projects.

Based on an analysis of challenge-based learning literature and relevant research, it is evident that the descriptions of the learning process exhibit similarities. The process of participation emphasizes debate as a means to attain resolution of the issue at hand. The assignment of facilitating cooperative learning and designing learning activities that involve recommendation and elaboration share certain similarities. In the context of truth inquiry, the current rules for resolution and conclusion in truth investigations primarily emphasize the collection of pertinent facts and sources, as well as the selection of a resolution that poses a significant challenge. The present study aims to do a comprehensive investigation and critical analysis of the various remedies pertaining to the identified issue. In the operational process, emphasis is placed on the evaluation and suggestions, resolution, and conclusion guidelines pertaining to present circumstances, followed by the subsequent implementation of the issue's resolution.

The relevance of this study lies in the work of Nichols, Cator, and Torres (2016), who provided an explanation of challenge-based learning. They argued that the integration of information and communication technology (ICT) in the learning process can effectively boost students' cooperative learning and problem-solving abilities, particularly in relation to real-world issues. Cooperative learning refers to a collaborative approach wherein students, teachers, or professionals engage in discussions pertaining to the subjects they are studying. Within the paradigm of challenge-based learning, there exist three distinct processes: Engagements, Investigation, and Act. In each of the phases, there exist novel activities aimed at providing support and preparing pupils for subsequent stages. The activities associated with each procedure are outlined as follows:

Phase 1 Engagements. Engagement refers to a cognitive process when learners delve into profound concepts by employing questioning techniques, hence encouraging a transformation of abstract thinking into tangible difficulties and facilitating practical application. The utilization of Essential Questioning has the potential to facilitate learners in comprehending the various contexts and adapting their ideas in a comprehensive manner. This process ultimately results in the crystallization of concepts and the subsequent emergence of difficulties. Moreover, the alteration of fundamental inquiry can serve as a catalyst for learners' engagement in their studies, fostering the development of problem-solving skills and decision-making abilities.

Phase 2 Investigation. The process of investigation commences with the formulation of Guiding Questions, which serve as a means for learners to acquire fundamental knowledge necessary for resolving various difficulties. By organizing and reconfiguring these significant questions, learners can engage in exploratory learning experiences. Subsequently, guiding activities and resources are employed during the procedure. The utilization of guiding activities and resources, in conjunction with various procedures and tools, can facilitate the development of problem-solving skills in learners when confronted with authentic scenarios. During the analysis process, the information obtained from guiding activities serves as the foundation for determining the appropriate solutions.

Phase 3 Act. The act serves as a method for addressing issues by utilizing observable evidence and analyzing the resulting outcomes. The initial step involves addressing issues arising from the investigative process. The utilization of the learning cycle aims to facilitate student development, resulting in the progression from prototyping to testing and self-adjustment to achieve resolution. The implementation of the resolution with learners can be carried out in authentic contexts. Following the completion of the assessment process, it culminates in the attainment of efficacy in problem-solving endeavors, hence facilitating the generation of evaluation outcomes that contribute to the refinement and augmentation of knowledge pertaining to the subject matter.

The findings from the investigation into the outcomes of challenge-based learning indicate that this instructional

model has the potential to enhance students' essential competences, namely problem-solving (at the highest level), creativity/creative thinking, critical thinking, and teamwork in sequential order (Yáñez, & Gómez-Trigueros, 2022; van den Beemt, van de Watering & Bots, 2022; Nizami et al., 2023; Vilalta-Perdomo et al., 2022). The possession of many competences is necessary for individuals to thrive in contemporary global cultures characterized by constant change.

3.2 Hybrid Learning

Hybrid learning is an educational setting that combines the advantages of traditional face-to-face classroom instruction with online learning platforms. This approach aims to facilitate simultaneous or asynchronous engagement between learners and instructors, allowing for activities such as online presentations, virtual communication, and collaborative interactions. In the context of online presentation, the proportion of classes delivered online ranges from 30% to 79%. This study aims to examine the effectiveness of student-centered instruction **(**Allen & Seaman, 2013; Bixler et al., 2021) in facilitating simultaneous learning using both online platforms and face-to-face interactions within the classroom setting. It is recommended to implement the following three items in act. The preparation of students as individuals plays a significant role in the context of online training. Learners are required to possess the readiness to engage in individual study and actively contribute to collaborative work with their classmates. This has the potential to boost students' acquisition of knowledge and facilitate collaborative learning. Research has substantiated the efficacy of online cooperative learning, wherein small groups of students engage in discussions, share ideas, and encourage one another to communicate their perspectives. Online learning encompasses two main modes: synchronous and asynchronous, facilitated by the use of information and communication technology (ICT). Cooperative learning facilitates the development of students' critical thinking abilities through the utilization of comprehensive scientific methodologies, hence fostering the acquisition of advanced skills in this domain. In terms of assessment, it may be challenging to assign accurate scores in a big class when short replies are necessary. As a result, it may be beneficial to consider alternate methods, such as opinion polls, to gain a deeper understanding of group work, etc.

The integration of learning management systems with the benefits of face-to-face classroom instruction, diverse content delivery, and collaborative online learning aims to facilitate simultaneous or asynchronous collaboration between learners and instructors. The percentage of hybrid learning, which integrates face-to-face instruction in the classroom with online learning, ranges from 30% to 79%. This approach allows for a combination of different content delivery methods and promotes cooperative learning through online platforms. Additionally, some instances of hybrid learning enable students to interact and coordinate their learning activities within the physical classroom setting. When considering the components of hybrid learning, numerous scholars have provided explanations and emphasized the significance of devices, such as mobile or desktop technologies. The utilization of application software is contingent upon the availability of an internet connection. Online learning may be categorized into two main types: face-to-face/on-site and synchronous/asynchronous (Aminah et al, 2022; Xiao & Evans, 2022; Setiawan et al., 2022; Vidergor, 2023, Yudaparmita et al, 2023). These types of learning can be implemented using various learning platforms that adhere to different theoretical frameworks, such as self-directed learning, problem-based learning, game-based learning, cooperative learning, and others.

3.3 Board Games and Virtual Board Games Platforms

The topic of interest pertains to board games and tabletop activities. Games are a recreational activity that can be played either on a table or in a vast area. The primary focus of the game is to engage in interactive communication with fellow players, facilitating the exchange of ideas among participants. Typically, the number of players exceeds two. The objective is to participate in each game in accordance with the established rules. Currently, board games have the potential to be transformed into serious games that can effectively facilitate learning in authentic contexts related to science, environment, and sustainability (Castronova & Knowles, 2015; Orduña Alegría et al., 2020; Sousa, 2021; Tsai et al., 2021).

Virtual board game platforms are digital adaptations of physical board games that may be accessed and utilized through internet-based applications. The majority of virtual board game platforms are created for commercial purposes, however a few of them are available at no cost. In addition to this, both players and ordinary persons possess the ability to generate novel games. The outcome of this situation is contingent upon the policies established by the developers. At present, virtual board games platforms bear resemblance to their physical counterparts, offering potential benefits for both practice and learning purposes. Additionally, it engages in social interactions with others of similar age or familial relations residing in various geographical locations. Furthermore, it can be implemented within the context of academic education, namely in the cultivation of cooperative learning skills for collaborative teamwork. Research indicates that most board games necessitate the utilization of critical

and creative thinking abilities. Consequently, the examination of the outcomes of board game utilization indicated its potential to enhance learners' competencies. Students generally appreciated the integration of game elements into their lessons, thereby improving their experiences and engagement (Zourmpakis, Kalogiannakis, & Papadakis, 2023). This enhancement was particularly evident in the areas of creativity, creative thinking, and problem-solving, as supported by scholarly sources (Hsu, Chang, & Liang, 2023; Pinedo et al., 2022; Zhang et al., 2021). The topics of interest for this discussion include critical thinking, flow state, and social skills. Mathematics and computational thinking are both crucial disciplines (Treffinger, 1995; Bugg & Dewey, 1934; Cottrell, 2011). Various elements have an impact on the constituents of competences, such as the learning management process, applicable technology, and the background of learners, among others.

3.4 The International Standard Student Competency

The competencies of students refer to their capacity to effectively apply acquired knowledge, skills, attitudes, and traits in order to successfully navigate work-related tasks and problem-solving situations, ultimately leading to personal and professional achievement. Problem solving encompasses a range of behaviors and actions that are influenced by societal and cultural factors in various contexts. The term "competencies" was introduced by the organization for economic co-operation and development (OECD) in reference to the abilities of students in relation to the national standard. These competencies encompass the capacity to perform tasks efficiently and in a manner that aligns with the associated responsibilities, encompassing skills, knowledge, and strategies.

Competencies within a social context pertain to the ability to effectively engage and interact with individuals, while also comprehending and responding to their expectations, all with the aim of attaining desired objectives within an appropriate setting. In other terms, the concept of Learners' Competencies aligned with national standards encompasses the amalgamation of learners' attitudes, skills, and knowledge, which are essential for their ability to adapt and thrive in various aspects of life and apply them across diverse domains of learning. These competencies encompass a wide range of areas, including but not limited to communication, critical thinking, problem-solving, mathematics, interpersonal relationships, self-regulation, creativity and innovation, proficiency in information and communication technology, cultural awareness and global citizenship, self-development, and overall well-being.

In terms of the essential competencies required by global citizens who are prepared to compete on the international stage, it is evident that problem-solving and decision-making skills are the primary emphasis of many countries when considering the total competence of its citizens. The competencies of creative thinking, critical thinking, and analytical thinking were assessed and evaluated accordingly. The hierarchy of knowledge and global awareness places global citizens or multiple citizens in a falling order. In alternative sections, it adopts distinct focal points. The relevance of learners' competencies to government policy is taken into consideration. As a result, the researcher focused on examining thinking competencies and expressed a keen interest in conducting future research on the competency of creative problem solving and critical thinking abilities.

3.4.1 The Process of Creative Problem Solving

The process of creative problem solving involves the development of proficient conceptions based on theories and related research. This process is guided by five important principles, one of which is the recognition that creativity is everywhere in our surroundings. Creativity can be manifested through diverse means. The manifestation of creativity is contingent upon an individual's personal inclinations, preferences, and distinctive attributes. Individuals have the capacity to produce a diverse range of significant works. The concepts of personal value assessment (PVA) and reflective thinking are derived from the framework of training sessions or instructional settings. However, it has been suggested that self-confidence may have a positive impact on creativity, particularly in the areas of generating innovative ideas, producing high-quality work, and facilitating a state of calm that fosters creative thinking (Ennis & Millman, 1985). Creative issue solving is a problem-solving approach that involves cognitive processes such as thinking, imagination, and deliberation. It goes beyond conventional problem-solving methods by incorporating the outcomes of previous problem-solving efforts that have been informed by proactive action.

Upon further examination of the research, it became evident that problem solving and creative problem solving were interconnected with key principles. These principles encompassed the clarification of problems, investigation into the causes of problems, establishment of goals to address the problems, formulation of guidelines or resolutions, implementation of said resolutions, and evaluation of the outcomes of the resolutions. When examining resolutions, it is important to note that issue solving and creative problem-solving exhibit distinct differences in their respective approaches and methodologies. Creative issue solving involved the inclusion of supplementary information. This distinction delineates the contrast between innovative issue solution and

conventional problem solving.

3.4.2 Critical Thinking

The role of critical thinking in the 21st century is significant in the context of learning and is recognized as a key competency for students according to national standards. It has the potential to enhance learners' critical thinking skills and their ability to examine information effectively. Critical thinking is a cognitive process characterized by the analysis and evaluation of information, employing factual evidence and logical reasoning to substantiate concepts and provide deeper insights. Furthermore, it is beneficial to reorganize the information by formulating suitable inquiries, which can contribute to improving the process of decision-making. Critical thinking can be enhanced by integrating many competences, including data analysis, logical thinking, and reasoning (Minnameier & Hermkes, 2020; Setiana, Purwoko, & Sugiman, 2021; Heard et al., 2020; Lynch & Wolcott, 2001; Facione, 1998). These competencies play a crucial role in the development and use of critical thinking skills.

The analysis of critical thinking as it pertains to scholarly theories indicates that a majority of experts place significant emphasis on the importance of critical thinking and engaging in debate and discussion. The academic process involves several key steps, including evaluating the credibility of sources and selecting appropriate ones, identifying any potential problems or limitations, refining definitions, making observations, assessing data based on predetermined criteria, drawing conclusions through deductive reasoning, evaluating the outcomes of inductive reasoning, establishing criteria for evaluating alternative options, providing clear definitions and indicating underlying assumptions, testing hypotheses and anticipating results, making decisions and considering alternative courses of action, and engaging in interactions with others. The process involves formulating difficult inquiries, conducting factual investigations, incorporating applicable concepts, scrutinizing assumptions, and engaging in self-regulation (Heard et al., 2020; Lynch & Wolcott, 2001; Facione, 1998; Watson, & Glaser, 1980; Ramos et al., 2023; Ennis, 1989; Almås, Pinkow, & Giæver, 2023). Most of these are pertinent to the development of critical thinking skills.

The researcher in the study titled "challenge-based hybrid learning model using virtual board games platforms with the aim to foster learners' competency to international standard" focused on the theoretical concepts pertaining to learners' competence and emphasized the importance of thinking skills, particularly creative thinking, and critical thinking, in the research process. Creative problem solving encompasses five key competencies: problem understanding, clear definition, interpretation and translation, resolution selection and assumption testing, process planning, operational and challenging creation, and conclusion drawing and result tracking. Critical thinking encompasses six key components: drawing conclusions through deductive reasoning, offering precise definitions, scrutinizing the credibility of information and observations, evaluating the outcomes of inductive reasoning, identifying underlying assumptions, testing hypotheses, and predicting results, and making informed decisions while considering assumptions. As illustrated in the accompanying image:

The outcome of the advancements in challenge-based hybrid learning model using virtual board games platforms to cultivate learners' proficiencies in accordance with international standards.

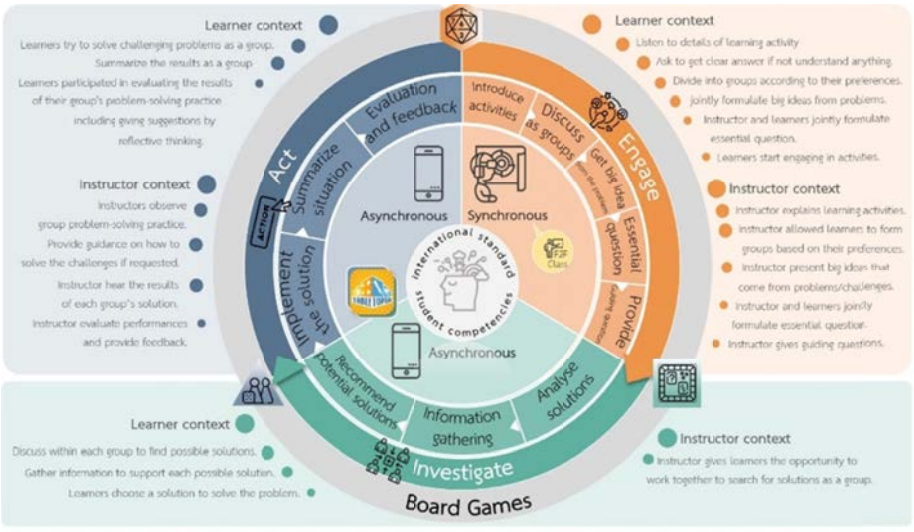

Figure 1. Challenge-based hybrid learning model using virtual board games platforms

As seen in Figure 1, there exists a connection between the theoretical principle, challenge-based learning, challenge-based hybrid learning, Virtual board games platforms, and learners' competencies in accordance with international standards:

Challenge-based learning management (CBLM) is now implementing a hybrid learning model that combines both face-to-face and online learning. This approach emphasizes the integration of many components of hybrid learning, such as the use of mobile or desktop devices, application software, and reliable internet connectivity. The topic of discussion is to online learning, specifically focusing on the distinctions between face-to-face/on-site instruction and synchronous/asynchronous modes of learning. These components possess adaptability in accommodating learners through both face-to-face and online learning modalities, with a blended proportion ranging from 30% to 79%. Challenge-based learning management offers opportunities for students, teachers, and experts to engage in collaborative learning, self-guided learning, and inquiry-based learning. This approach utilizes information and communication technology (ICT) as a crucial tool to explore significant concepts, formulate insightful questions, identify effective problem-solving strategies, and facilitate in-depth learning.

As a teacher, one fulfills the role of a guiding facilitator who assists students in the creation of substantial tasks and the attainment of their final project. Challenge-based learning can be categorized into three distinct stages: engagement, investigation, and act. The instructional process involved the implementation of many activities at each stage, aimed at equipping learners with the necessary skills and knowledge to progress to subsequent stages. These activities were designed based on the principles of challenge-based learning, which may be categorized into three primary steps, namely:

Step 1 Engagement in academic settings encompasses various components, including offering recommendations and explanations for learning activities, organizing collaborative groups, engaging with concept-based difficulties and challenges, highlighting significant questions, and facilitating guided and demanding activities.

Step 2 The process of investigating truth involves engaging in investigation and analysis to identify potential resolutions, collecting relevant knowledge and resources, and ultimately selecting and pursuing intellectually demanding resolutions.

Step 3 The process of engaging with resolutions involves the ongoing effort to address and solve problems, offering guidance and solutions in current circumstances. This is achieved through the utilization of both virtual and physical board games [26, 28, 31]. The ultimate goal is to enhance learners' abilities in creative problem-solving and critical thinking, which are essential competencies aligned with international standards. The abilities pertaining to creative problem-solving can be categorized into five distinct sub-competencies. In the realm of academic discourse, the process can be divided into several key stages: comprehending the challenge and evaluating the available evidence, clarifying any uncertainties; selecting and testing the hypothesis; planning the approach to be taken; and finally, implementing and formulating one or more creative challenges. In the last stage of the research process, the formulation of conclusions and the subsequent monitoring and reflecting on the findings are crucial steps.

The competencies of critical thinking, as identified by sources, can be categorized into six components (Lynch & Wolcott, 2001; Lin & Cheng, 2022). These components encompass the ability to draw conclusions through deductive reasoning, provide clear definitions, evaluate the credibility of sources and observations, draw conclusions through inductive reasoning, analyze results obtained from testing hypotheses, and anticipate and articulate assumptions.

4. Results

The evaluation appropriateness results of the model.

The researcher defined the interpretation of the mean scores as follows: Average scores between 4.21-5.00 means very high, 3.41-4.20 means high, 2.61-3.40 means moderate, 1.81-2.60 means low and 1.00-1.80 means very low.

Table 1. The evaluation appropriateness results of the model

Model	$\bar{X}$	*SD*	Feasibility
1. Principles, concepts, and theories related to the hybrid-based learning model			
1) hybrid-based learning	4.64	0.64	very high
2) the process of challenge-based learning	4.55	0.55	very high
3) virtual board games/physical board games platforms	4.36	0.64	very high
2. International standard competency			
1) creative problem-solving	4.73	0.45	very high
2) critical thinking	4.64	0.48	very high
Overall	4.58	0.54	very high

Table 1 presents evidence indicating that the utilization of virtual board games platforms in challenge-based hybrid learning has the potential to improve learners' proficiency in ideas and theories associated with challenge-based hybrid learning, aligning with international standards. The appropriateness was evaluated by experts at the highest level, with a mean score of 4.58 and a standard deviation of 0.54. When examining each component, it was determined that the level of International standard competency was highest for creative problem-solving ($\bar{X}$ = 4.73, SD = 0.45) and critical thinking ($\bar{X}$= 4.64, SD = 0.48). This was followed by principles, concepts, and theories associated with the hybrid-based learning model ($\bar{X}$ = 4.64, SD = 0.64), principles, concepts, and theories associated with the process of challenge-based learning ($\bar{X}$ = 4.55, SD = 0.55), and concepts and theories related to virtual board games/physical board games ($\bar{X}$ = 4.36, SD = 0.64) respectively.

Table 2. The evaluation appropriateness results of the learning environment

The learning environment	$\bar{X}$	*SD*	Feasibility
1) Hybrid learning, which combines online and face-to-face instruction	4.64	0.64	very high
2) The process of challenge-based learning (Engagement, Investigation, Act)	4.73	0.45	very high
3) Learning activities regarding board games (physical/virtual board games)	4.45	0.50	very high
4) The utilization of social media platforms for communication purposes	4.18	0.72	very high
5) Supportive Learning Resources on the internet	4.36	0.64	very high
6) The evaluation of students' abilities in achieving international standard competency (creative problem-solving and critical thinking)	4.73	0.45	very high
Overall	4.52	0.57	very high

According to the findings shown in table 2, it was observed that the implementation of a challenge-based hybrid learning using virtual board games platform to enhance international standard student competency. According to expert analysis, the evaluation of suitability was conducted by highly qualified professionals, ($\bar{x}$ = 4.52, SD = 0.57). Upon careful examination of each individual component, it is evident that the learning environment component achieved the highest rating. Specifically, the challenging learning process, which consists of the Engage, Investigate, and Act steps, along with international standard student performance assessments (creative problem solving and critical thinking), was equally appropriate at a very high level ($\bar{x}$ = 4.73, SD = 0.45). In the context of hybrid learning, which involves a combination of online and face-to-face instruction, the following factors were examined: learning environment ($\bar{X}$ = 4.64, SD = 0.64), learning activities involving board games (physical/virtual) ($\bar{X}$= 4.45, SD = 0.50), availability of supportive learning resources on the internet ($\bar{X}$ = 4.36, SD = 0.64), and the use of social media platforms for communication ($\bar{X}$ = 4.18, SD = 0.72).

5. Conclusion and Discussion

The challenge-based hybrid learning model has been evaluated by professionals, and the assessment results indicate its effectiveness. According to experts, the utilization of virtual board game platforms within the context of the challenge-based hybrid learning model demonstrates a high level of appropriateness in relation to principles, concepts, and theories. CBL can help develop learners' desired competencies beyond the specified indicators, encompassing both creative abilities and positive human relations (Md. Khambari, 2019). This aligns with the broader goal of nurturing learners with the necessary skills for living in the present and future, preparing them to confront the Transformative Competencies for 2030. Furthermore, utilizing a hybrid problem-based teaching model can aid in developing students' critical thinking skills and fostering continuous joy in learning (Marnita et al., 2020). When analyzing the various components, ideas, and theories related to learners' competencies in

reaching international standards, with a specific emphasis on creative problem-solving and critical thinking, experts have opined that the most appropriate approach at the advanced level is the challenge-based hybrid learning model. Following the development of various conceptions and theories surrounding Hybrid Learning, there has been subsequent attention focused specifically on the challenge-based hybrid learning model. Additionally, there has been a parallel exploration of conceptions and theories related to virtual and physical board game platforms.

According to experts, the appropriateness of utilizing virtual board game platforms in a challenge-based hybrid learning model to fulfill international standards was assessed at the highest level. Upon careful examination of each component, it was found that the highest-rated level of learning in the environment-based context was the process of challenge-based learning, which encompasses engagement, investigation, and action. Additionally, the assessment of learners' competencies against international standards, specifically in creative problem-solving and critical thinking, was also identified as a significant aspect. In addition to environmental management in the context of hybrid learning, the implementation of learning activities through board game platforms (both physical and virtual), environmental management in relation to the availability of supportive learning resources on the internet, and communication facilitated by online social media are also noteworthy.

During the process of engagement, it is customary to analyze and comprehend the issues that are currently taking place. During the investigative process, the utilization of information and communication technology (ICT) is employed to facilitate guidance and resolution in real-life scenarios (Xiao & Evans, 2022). Hence, the utilization of principles, conceptions, and theories pertaining to virtual and physical board game platforms was employed to foster learners' acquisition of problem-solving skills in authentic contexts, thereby augmenting their essential competencies, including creativity and creative thinking, as supported by previous studies (Facione, 1998; Watson, & Glaser, 1980; Ramos et al., 2023).

The study's findings underscore the importance of challenge-based learning utilizing board games. Moving forward, the next phase of this research will involve implementing the developed model in actual educational settings. Data will be collected from students to further assess its impact on critical thinking, problem-solving, and other essential competencies. This iterative process aims to refine and validate the model's efficacy in enhancing learners' abilities, contributing to the ongoing scholarly investigation of utilizing board games as a means of educational advancement. Additionally, board games at higher levels of complexity are diverse and can promote the development of multiple competencies. Due to the variety of systems and mechanisms, if you aim for students to gain a deeper understanding of investing and route building, you may choose games in the 18XX genre. Alternatively, if you wish to foster ideas about resource management and negotiation skills, a game like Sidereal Confluence would be a suitable choice.

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Chawin Chukusol was responsible for the study design and data collection. Professor Dr. Prachyanun and Professor Dr. Panita supervised the research. Chawin Chukusol drafted the manuscript. All authors read and approved the final manuscript.

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