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Development of Augmented Reality Health Board Game to Encourage Behaviors and Life Skills that Reflect Morals in Late Primary School Students in Phetchaburi Province

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Abstract

The objectives of this research were: 1) to develop an Augmented Reality (AR) health board game set to enhance behaviors and life skills reflecting the moral virtues of upper elementary school students; and 2) to compare students' behaviors and life skills reflecting moral virtues before and after using the AR health board game set. This study employed a Research and Development (R&D) methodology. The sample consisted of 60 upper elementary school students from two schools (30 students per school) selected through purposive sampling. The research was conducted in four phases: Information Analysis (R1): Analyzing fundamental data using document analysis, interview forms, and a needs assessment survey. Product Development (D1): Designing the AR health board game set and an instructional manual. Implementation (R2): Field-testing the board game set using an activity manual. Effectiveness Evaluation (D2): Assessing outcomes using a stress management behavior and life skills assessment form and the Stress Test (ST-5). Data was analyzed using content analysis, mean ($\bar{x}$), standard deviation (S.D.), and dependent samples t-test. The results found that 1. The developed AR health board game set serves as an innovative tool for promoting stress-management skills. The set utilizes Augmented Reality (AR) technology to display exercise animations when scanning exercise cards within the board games. The set consisted of four games: 1) Yoga AR Board Game, 2) The Circle Stretch, 3) Snake Massage Game, and 4) Muay Thai Dance Bingo. 2. After participating in the activities using the AR health board game set, the students' behaviors and life skills reflecting moral virtues were significantly higher than before the intervention at the .01 level of statistical significance. Specifically, students demonstrated a 25% increase in these behaviors and life skills compared to their baseline. Effective facilitator guidance, specifically through student encouragement and rule adaptation, significantly enhances gameplay efficiency. To build upon these results, future studies should apply this augmented reality (AR) health board game to foster alternative life skills, including decision-making and effective communication.

Keywords: Game-Based Learning, Health Education, Moral Development, Augmented Reality

Introduction

Rapid technological, social, and educational changes have transformed the contexts in which children learn and develop, creating new challenges for their psychosocial well-being and academic achievement. In response to

these challenges, education systems worldwide have increasingly emphasized the development of life skills that enable learners to adapt effectively to changing environments, regulate their emotions, solve problems, and build positive interpersonal relationships. Consistent with this global perspective, the Office of the Basic Education Commission (OBEC) of Thailand has incorporated life skills into the Basic Education Core Curriculum, identifying four essential competencies: (1) self-awareness and self-esteem, (2) critical thinking, decision-making, and creative problem-solving, (3) emotional and stress management, and (4) building positive relationships with others.

Life skills are essential competencies that enable individuals to cope effectively with everyday challenges, adapt to changing environments, and maintain psychological well-being. Among these competencies, emotional and stress management has become increasingly important as children face growing academic demands, rapid technological advancements, and increasingly complex social interactions. The World Health Organization identifies stress management as one of the ten core life skills necessary for healthy, psychosocial development. This competency enables individuals to recognize stressors, regulate their emotional responses, and adopt adaptive coping strategies that promote resilience and well-being. However, recent evidence indicates that psychological distress among adolescents is increasing. [García-Moreno et al. \(2024\)](#) reported that stress adversely affects cognitive, emotional, and behavioral functioning, whereas the Department of Mental Health documented rising rates of depression and self-harm risks among Thai adolescents. These findings underscore the urgent need for preventive educational interventions that strengthen life skills and stress management during late primary education in India.

Educational board games have emerged as an effective active learning approach because they encourage interaction, collaboration, problem solving, and sustained learner engagement. Unlike traditional teacher-centered instruction, board games create meaningful learning experiences that actively involve students in constructing knowledge while simultaneously developing their communication

and social skills. The educational potential of board games can be further strengthened through the integration of augmented reality (AR), which overlays interactive three-dimensional digital content onto real-world environments to create immersive and multisensory learning experiences for students. Consequently, AR-supported board games have demonstrated considerable potential for increasing learners' motivation, engagement, and cognitive performance ([Abualrob & Awaad, 2024](#)).

Previous studies have consistently shown that educational board games improve students' executive functioning, academic achievement, and learning motivation ([Vita-Barrull et al., 2024](#); [Ding & Yu, 2024](#); [Pan et al., 2024](#)). Similarly, research on AR-supported educational board games has primarily examined learning achievement, motivation, engagement, emotional experiences and flow. For example, [Lin et al. \(2020\)](#) and [Lin and Hou \(2024\)](#) demonstrated that AR-supported educational board games improve students' learning outcomes, motivation, flow, and emotional experiences while reducing learning anxiety. However, evidence regarding their effects on broader psychosocial competencies, including life skills, stress management, and behaviors reflecting moral values remains limited.

Recent systematic reviews further substantiate this gap by showing that research on AR-enhanced educational board games has focused predominantly on knowledge acquisition and academic performance, whereas their potential to promote behavioral, affective, and psychosocial development remains insufficiently understood ([Tarasak & Komalawardhana, 2026](#)). Likewise, reviews of educational game-based learning have recommended expanding future research beyond academic achievement to include social-emotional development, life skills, and authentic classroom implementation ([Giannakoulas & Xinogalos, 2024](#)).

Despite growing evidence supporting the educational value of board games and AR technology, few studies have integrated these approaches to simultaneously promote life skills, stress management, and behaviors that reflect moral values among late primary school students, particularly in the Thai educational context. Therefore, there is a

need to develop and evaluate innovative learning media that integrate AR technology with board game-based learning to promote these competencies in authentic classroom settings.

Accordingly, this study developed an Augmented Reality Health Board Game to encourage behaviors and life skills that reflect morals in late primary school students in Phetchaburi Province. The game was designed as an interactive learning medium that integrates board game mechanics with AR technology to promote enjoyable learning while developing students' emotional regulation, stress management, creative thinking, and moral life skills

The Objective of this Research

- To develop an Augmented Reality (AR) health board game set to enhance behaviors and life skills reflecting the moral virtues of upper elementary school students
- compare students' behaviors and life skills reflecting moral virtues before and after using an AR health board game.

Review of Literature

Board Games are structured play-based activities involving defined rules, objectives, and interactive mechanisms that require players to make decisions, apply strategies, and engage with others. Unlike digital games, board games emphasize face-to-face interaction, providing opportunities for communication, collaboration, negotiation, and social and emotional development. In educational contexts, board games represent a form of game-based learning that integrates cognitive, motivational, affective, and social processes to create meaningful learning experiences ([Plass et al. 2015](#)). Effective educational board games require alignment between the learning objectives and game components, including the rules, challenges, feedback, and player interactions. [Echeverría et al. \(2011\)](#) emphasized that successful educational games should balance instructional purposes with engaging gameplay, whereas [Tangpakdee \(2022\)](#) highlighted the importance of integrating learning objectives, content, learners, game mechanics, rules, and evaluation in the design process. Recent studies have demonstrated that educational board games can

enhance students' executive functioning, academic achievement, motivation, and engagement ([Vita-Barrull et al., 2024](#); [Ding & Yu, 2024](#); [Pan et al., 2024](#)).

Therefore, board games should not be regarded merely as recreational activities but as innovative educational media that promote cognitive skills, problem-solving abilities, social-emotional learning, ethical development, and life skills when appropriately designed and implemented.

Augmented Reality (AR) is an interactive technology that integrates digital content, such as three-dimensional models, images, animations, and multimedia elements, into real-world environments through digital devices while maintaining users' awareness of their physical surroundings. Unlike virtual reality, AR enhances real-world experiences by enabling interactions between physical and virtual components ([Akçayır & Akçayır, 2017](#); [Ibáñez & Delgado-Kloos, 2018](#)).

In education, AR has gained increasing attention as an innovative learning technology because it provides interactive and contextualized representations of complex concepts that are difficult to achieve using conventional instructional materials. Previous studies have demonstrated that AR-based learning environments can enhance students' learning achievements, motivation, engagement, and emotional experiences, particularly when integrated with appropriate pedagogical approaches ([Ibáñez & Delgado-Kloos, 2018](#); [Garzón & Acevedo, 2019](#)). Empirical studies in school contexts have shown that AR interventions support learners' conceptual understanding and active participation by creating immersive and multisensory learning experiences.

Furthermore, integrating AR with board games represents a promising approach that combines digital visualization with physical interaction and strategic gameplay. [Lin et al. \(2020\)](#) found that an AR-supported health education board game improved students' learning outcomes and positive emotional experiences, while [Lin and Hou \(2024\)](#) reported improvements in learning effectiveness, motivation, flow, and reduced learning anxiety through AR educational board games. However, existing AR studies have predominantly focused on cognitive and affective outcomes, with limited

evidence regarding their potential to promote broader psychosocial competencies, including life skills, stress management, and behaviors that reflect moral values.

Life skills refer to a set of psychosocial competencies that enable individuals to cope effectively with challenges, adapt to changing environments, and make appropriate decisions in daily life. Based on the synthesis of concepts proposed by [Markmee and Wannasri \(2024\)](#), life skills comprise knowledge, attitudes, and behavioral abilities developed through continuous learning and personal experience. These competencies are not innate characteristics but can be strengthened through educational processes and social interactions, enabling individuals to understand themselves and others, solve problems, regulate their emotions, and establish positive relationships. This conceptualization is consistent with international perspectives that emphasize life skills as essential psychosocial abilities that support emotional regulation, adaptive coping, interpersonal competence, and responsible decision-making among children and adolescents ([Compas et al., 2017](#); [WHO, 2023](#)). According to the framework of the Office of the Basic Education Commission (OBEC), life skills consist of four major components: (1) self-awareness and self-esteem, (2) critical thinking, decision-making, and creative problem-solving, (3) emotional and stress management, and (4) building positive relationships with others.

Therefore, educational interventions that provide opportunities for active participation, reflection, collaboration, and problem-solving may contribute to the development of students' life skills, particularly during late primary education, when children begin to encounter increasingly complex academic and social challenges.

Stress Management refers to the ability to recognize, regulate, and cope with stress responses arising from challenging situations or environmental demands. The World Health Organization (2023) has identified stress management as an essential life skill for maintaining psychological well-being. According to [Lazarus and Folkman \(1984\)](#), stress occurs when individuals perceive that environmental demands exceed their coping resources, resulting in

emotional, cognitive, behavioral, and physiological responses. Effective stress management involves adaptive coping strategies and emotion-regulation processes that support psychological balance and resilience. For children and adolescents, these competencies are particularly important because they help individuals manage academic pressure, social challenges, and emotional difficulties ([Compas et al., 2017](#)). Therefore, educational interventions incorporating relaxation techniques, physical activities, mindfulness, and emotional regulation strategies may contribute to the development of students' stress-management abilities.

Based on these concepts, this study integrates stress management activities into the AR Health Board Game through relaxation yoga, stretching exercises, relaxation massage, and dance exercise, supported by mindfulness, self-talk, and emotion regulation strategies. Students' stress levels were assessed using the Stress Test Questionnaire (ST-5) developed by the Department of Mental Health, which evaluates emotional and stress-related experiences over the previous 2–4 weeks prior to the survey. These integrated activities aim to enhance students' ability to effectively recognize, regulate, and manage stress.

Methodology

The study of Development of Augmented Reality Health Board Game to Encourage Behaviors and Life Skills that Reflect Morals in Late Primary School Students in Phetchaburi Province was a research and development (R&D) study. This study adopted mixed methods of research with an embedded design and employed quantitative methods, supplemented by qualitative methods, to answer the research questions and address all research objectives. Details of research procedures comprised

Step 1 Research: R_1 (Analysis: A) This step involves examining fundamental information through a review of relevant documents and research studies, conducting interviews with experts, and assessing the needs of the target group.

Step 2 Development: D_1 (Design and Development: D&D) This involves the design and development of an Augmented Reality (AR) health board game package, including supporting tools for

its implementation and instruments for evaluating effectiveness. The process began with the creation and development of the AR health board game, its accompanying materials, and evaluation instruments. Subsequently, the quality of the research instruments was assessed by three experts using the Index of Item-Objective Congruence (IOC). Based on the

evaluation results, revisions and improvements were made. The final outputs included a complete AR health board game package, user manual, activity plans, and effective evaluation instruments. The details of the AR health board game package consist of four games, as shown in Table 1.

Table 1 The AR Health Board Game Package

Details of the AR health board game package	Examples of the AR health board game package		
1. Yoga AR Board Game: a square board game which players are required to achieve all the missions to win.			
2. The Circle Stretch: a circle board game which players are required to achieve all the missions to win.			
3. Snake Massage game: a snake shape board game which players are required to achieve all the missions to win.			
4. Muay Thai Dance Bingo: a bingo game which players are required to achieve all the missions to win.			

Step 3 Research: R_2 (Implementation: I) The Augmented Reality (AR) health board game package was implemented to promote behavior and life skills reflecting moral attributes among late primary school students. This study adopted a pre-experimental design. A one-shot case study design was employed to assess the effectiveness of activity

implementation using an AR health board game package. Additionally, a one-group pretest–posttest design was used to compare students' behaviors and life skills in stress management before and after the intervention.

Step 4 Development: D_2 (Evaluation: E) The Development of an Augmented Reality (AR) Health

Board Game Package to Promote Behaviors and Life Skills Reflecting Moral Attributes among late Primary School Students

Research Sample

The sample consisted of Grade 6 students in the second semester of the 2025 academic year from Saint Joseph School, Mueang District, Phetchaburi Province, under the Office of the Private Education Commission, and Anuban Phetchaburi School, Mueang District, Phetchaburi Province, under the Phetchaburi Primary Educational Service Area Office 1. The participants were selected using purposive sampling, comprising two schools with 30 students from each school (total: 60 students). However, during the data collection phase, five participants were excluded from the study because they failed to meet the attendance threshold of at least 80% of the total activity sessions. Consequently, the final sample used for the data analysis comprised 55 participants.

Results

The result of development of augmented reality health board game to encourage behaviors and life skills that reflect morals in late primary school students presented

The results of the interviews with late primary school teachers and relevant experts, conducted using a structured interview format and a formal interview method, with open-ended questions, can be summarized that the development of augmented reality health board game was highly appropriate for 9–12-year-old-student since it is the stage of self-control and reasoning skill development. Augmented Reality (AR) has a greater impact on motivating and inspiring learners than on delivering instructional explanations, including content and games. Experts suggested that the content should be aligned with the learning standards of the Health and Physical Education subject area, with a focus on health

care behaviors, nutrition, and exercise. It should be integrated into simulated situations that reflect ethical decision-making in real-life contexts, such as personal responsibility, rule-following honesty, and teamwork. An appropriate game format may involve mission-based activities with a certain level of challenge, taking approximately 30–40 min per session. The design should feature bright colors, modern graphics, and a symbolic reward system to enhance the user's motivation. In addition, regarding the application of AR technology, it should be used as a supplementary tool to enhance the learning experience, such as by displaying 3D simulations of correct exercise postures or illustrating the effects of inappropriate health behaviors. However, experts emphasized that its use should be well-balanced, with the board game serving as the core component to prevent excessive screen dependency among the students. It is also important to ensure the ease of use of the equipment available in schools. For the highest effectiveness, it is recommended that development align with the curriculum and include a clear teacher's manual. This will enable teachers to effectively implement classroom activities and systematically assess students' behavioral developments.

The results of the organizing activity need questionnaire were highest in the physical domain, with a needs index of 0.41. This was followed by the mental health (0.38), social (0.33), and behavioral (0.31) domains. These results are consistent with the criteria for evaluating the needs index, where values of 0.30 and above are considered to indicate a significant level of necessity.

The result of the behavior and life skill comparison between before and after using augmented reality health board game was presented that

The behaviors and life skills reflecting moral values among late primary school students are detailed in Table 2.

Table 2 Comparison of Behaviors and Life Skills Reflecting Moral Values among Late Primary School Students

Evaluation	numbers (N)	Full scores (score)	mean ($\bar{x}$)	Standard Deviation (S.D.)	t-test	sig
Before using	55	9	6.49	0.63	19.25	.000*
After using	55	9	8.10	0.68		

*Statistically significant at the .01 level

Table 2 shows that the behaviors and life skills reflecting moral values among late primary school students after using augmented reality health board games were higher than before at the .01 level of statistical significance. The mean score of behaviors and life skills reflecting moral values among late primary school students after the activity ($\bar{x} = 8.10$,

S.D. = 0.68) was higher than the mean score before the activity ($\bar{x} = 6.49$, S.D. = 0.63).

Changes in behaviors and life skills reflecting moral values among late primary school students who participated in activities using the augmented reality (AR) health board game, which were classified by each domain, are presented in Table 3.

Table 3 Changes in Behaviors and Life Skills Reflecting Moral Values among Late Primary School Students

Behaviors and Life skills reflecting moral values	Before experiment		After experiment		Changes	Percentage of changes
	$\bar{x}$	S.D.	$\bar{x}$	S.D.		
Emotional self-awareness	2.20	0.40	2.69	0.46	0.49	22.27
Self-control under stress	2.09	0.29	2.76	0.42	0.67	32.05
Creative solving problem	2.20	0.40	2.65	0.47	0.45	20.45
Total mean	2.16	0.36	2.70	0.45	0.54	25.00

Table 3 shows that the behaviors and life skills reflecting moral values of late primary school students who participated in activities using the augmented reality (AR) health board game increased by 25.00% compared to their baseline behaviors. When considered by domain, the highest increase was found in emotional regulation under stress,

which increased by 32.05%. This was followed by emotional self-awareness and self-control under stress at 22.27% and creative problem-solving at 20.45%, respectively.

The result of Stress Test Questionnaire (ST-5) comparison as demonstrated in table 4.

Table 4 The Result of Stress Test Questionnaire (ST-5) Comparison

Evaluation	numbers (N)	Full scores (score)	mean ($\bar{x}$)	Standard Deviation (S.D.)	t-test	sig
Before activity	55	15	7.47	1.13	-32.67	.000*
After activity	55	15	3.23	0.76		

*Statistically significant at the .01 level

Table 4 shows that the Stress Test Questionnaire (ST-5) results after the activity were lower than those before the activity at the .01 level of statistical significance. The mean score of the stress assessment using the Stress Test Questionnaire (ST-5) after the activity ($\bar{x} = 3.23$, S.D. = 0.76) was lower than the mean score before the activity ($\bar{x} = 7.47$, S.D. = 1.13).

Discussion

The findings demonstrate that the AR Health Board Game effectively enhanced students' life skills and stress management. This improvement may be attributed to game-based learning, which promotes active engagement through rules, challenges, decision-making, and social interaction, thereby supporting cognitive, motivational, and emotional

development (Plass et al., 2015). These findings are consistent with previous studies showing that educational board games improve learning outcomes, engagement, motivation, and executive functioning (Kiattisaksopon & Songsang, 2024; Vita-Barrull et al., 2024; Ding & Yu, 2024). The integration of AR may further enhance learning experiences through interactive visualization and multisensory engagement, as AR-based educational interventions have been shown to improve motivation, learning outcomes, and emotional experiences (Ibáñez & Delgado-Kloos, 2018; Garzón & Acevedo, 2019; Lin et al., 2020; Lin & Hou, 2024).

Furthermore, improvements in life skills and stress management align with the importance of psychosocial competencies, including self-

awareness, problem-solving, emotional regulation, and coping skills ([Compas et al., 2017](#)). The reduction in stress levels may be explained by the integration of relaxation activities and emotional regulation strategies, which support adaptive coping and psychological well-being ([Lazarus & Folkman, 1984](#); [WHO, 2023](#)).

The behaviors and life skills reflecting moral values among late primary school students who participated in activities using the augmented reality (AR) health board game were significantly higher after the intervention than before the intervention at the .01 level of statistical significance. The post-activity mean score was 8.10, corresponding to a rating score of 2.70, which was higher than the pre-activity mean score of 6.49, corresponding to a rating score of 2.16. Based on the criteria for interpreting mean scores, the post-activity mean of 2.70 indicated a high level of ability, whereas the pre-activity mean of 2.16 indicated a moderate level.

Regarding stress assessment, the Stress Test Questionnaire (ST-5) developed by the Department of Mental Health, Thailand, consists of five items evaluating stress-related feelings and emotional experiences during the previous 2–4 weeks. The comparison of ST-5 scores showed that students' stress levels after participating in the AR health board game activities were significantly lower than those before the intervention at the .01 level of statistical significance. The mean score decreased from 7.47 before the intervention to 3.23 after the intervention. This finding indicates that the students experienced reduced stress levels and improved stress regulation. This result is consistent with [Unruean and Jantakoon \(2023\)](#), who found that mindfulness enhancement programs combined with yoga improved primary school students' concentration, learning interest, positive emotions, and empathy, and reduced stress. Similarly, [Suraseth and Wintachai \(2022\)](#) reported that stress management strategies, including meditation, yoga, and dancing, are effective approaches for reducing stress, anxiety, and depressive symptoms.

Conclusion

The development of an augmented reality (AR) health board game set to promote behaviors and life

skills reflecting moral values among late primary school students in Phetchaburi Province represents an innovation designed to enhance students' stress management skills and their ability to cope with unexpected problems, events, or situations that may lead to stress. This approach emphasizes problem confrontation for stress management and focuses on managing negative emotions. The developed health board game set was presented through AR technology using a scanning application with exercise cards displaying various postures in motion. This increases students' excitement and engagement with the content of the course. The AR health board game set consists of four games 1) Yoga AR Board Game 2) The Circle Stretch 3) Snake Massage game 4) Muay Thai Dance Bingo

The behaviors and life skills reflecting moral values among late primary school students who participated in activities using the AR health board game were significantly higher after learning than before learning, at the .01 level of statistical significance.

The findings demonstrated that the augmented reality (AR) health board game significantly improved students' behaviors and life skills, reflecting moral values while reducing stress levels ($p < .01$). Students' moral life skills increased from a mean score of 6.49 to 8.10, representing a 25.00% improvement. The greatest gain was observed in emotional regulation under stress, followed by emotional self-awareness, self-control under stress, and creative problem-solving. In addition, the Stress Test Questionnaire (ST-5) scores decreased significantly after the intervention, indicating improved stress management. These results suggest that integrating AR-based educational games into classroom instruction can foster students' moral development, emotional regulation, and stress management while creating a more engaging and interactive learning environment.

However, this study had several limitations. First, the sample consisted of 55 Grade 6 students, which limits the generalizability of the findings to broader educational settings. Second, although the intervention produced significant improvements, the findings should be interpreted with caution because of the relatively small sample size and specific

study context. Future research should include larger and more diverse samples, multi-site studies, and longitudinal research designs to confirm these findings and evaluate the long-term effectiveness of AR health board games.

Suggestions

Instructors play a key role in the successful implementation of this approach. Effective facilitation, encouragement, and flexible management of game rules can enhance student engagement and learning outcomes.

Future studies should compare the effectiveness of the AR health board game with other instructional approaches, including traditional teaching methods and alternative game-based learning strategies, to determine its advantages.

Future studies should include larger and more diverse samples from different schools or educational settings to improve the generalizability of these findings.

Longitudinal studies are recommended to examine the long-term effects of AR health board games on students' health behaviors, learning outcomes, and broader life skills, including decision-making, problem-solving, communication, teamwork, and leadership.

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