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Received: July 16, 2025 **Revised:** August 21, 2025 **Accepted:** September 4, 2025

Citation reference :

Bunkaew B. (2025). The effects of using problem-based learning to promote innovative thinking skills. **International Journal of Industrial Education and Technology**, 7 (2), 14-26.

 **ABSTRACT**

This study aimed (1) to compare the learning achievement of third-year Public Administration students at Prince of Songkla University, Surat Thani Campus, in the topic of public service design and transformation in the digital era before and after the implementation of Problem-Based Learning (PBL), and (2) to examine the development of their innovative thinking skills. The participants were 177 third-year students enrolled in the “Digital Civil Servant Competency Development” course during the first semester of the 2024 academic year. The research instruments included a PBL-based instructional plan, a learning achievement test on designing public services and new public sector operations using digital technology, comprising four essay questions (IOC = 0.82, difficulty = 0.68, IDisc > 0.30), an innovative thinking assessment form covering six aspects—interpretation, generate, collaboration, reflect, representation, and evaluation—using a five-point rating scale (IOC = 0.85), and a rubric for evaluating digital public service design. Data were analyzed using descriptive statistics (mean and standard deviation) and inferential statistics (paired sample t-test). The results showed that post-intervention learning achievement scores were significantly higher than pre-intervention scores at the .05 significance level. Furthermore, students demonstrated a statistically significant improvement in innovative thinking skills, the mean differences across dimensions ranged from 2.10 to 2.65, with correspondingly high t-values (25.40–37.11) and very large effect sizes (Cohen’s $d \approx 1.91$ –2.79). Evaluation of group projects revealed that 42.86 percentage (15 out of 35 groups) achieved a high level of performance in designing digital public services. These findings suggest that problem-based learning is an effective pedagogical approach for fostering innovative thinking and enhancing digital competencies among public administration students, thereby contributing to the capacity building of future civil servants in the digital era.



Keywords: Innovative thinking, Problem-based learning, Public administration students, Digital public service, Higher education

I. INTRODUCTION

The dawn of the Fourth Industrial Revolution, coinciding with the onset of globalization and the transition into the 21st century, has been marked by the pervasive integration of Artificial Intelligence (AI) technologies, the proliferation of data, and profound lifestyle shifts (Sepriyanti et al., 2021, p. 314). While Industry 4.0 is still in its early stages, many industry leaders and technology experts are already anticipating the imminent emergence of Industry 5.0 (Mourtzis, 2021, p. 7). In this rapidly evolving global landscape, one of the most critical demands of the 21st century is the cultivation of a highly skilled workforce—one nurtured by effectively managed educational institutions capable of addressing new challenges and achieving improved outcomes (Ramirez, 2018, p. 1). Contemporary employment increasingly requires individuals who are proficient in operating, producing, and managing new information using advanced technologies. Consequently, educational institutions play a pivotal role in equipping students with the essential thinking skills required in both present and future work environments, particularly by fostering innovative thinking (Miteranifa, 2021, p. 30). The education system thus serves not only as a bridge connecting labor market demands with learning programs but also as a vital mechanism for preparing learners to function effectively within dynamic and diverse workplaces (Khan et al., 2019, p. 223).

The Partnership for 21st-century Skills (P21 Framework), developed through collaboration among educators, education experts, and business leaders, defines and illustrates the knowledge, skills, expertise, and support systems students need to succeed in work, life, and citizenship (Partnership for 21st Century Skills, 2011, p. 5). This framework continues to be employed by thousands of educators and hundreds of schools both nationally and internationally to place 21st-century skills at the heart of teaching and learning. Each component of the framework is essential to ensuring students are prepared for the demands of the modern world. When schools, districts, or states build this foundation by integrating core knowledge and skills with key support systems—such as standards, assessments, curriculum and instruction, professional development, and learning environments—students become more engaged in the learning process and graduate prepared to thrive in today's digitally interconnected and globalized society (Partnership for 21st Century Skills, 2011, p. 5). Project-Based Learning (PBL) stands out as an instructional and curricular approach that empowers students to develop practical solutions by integrating theory and practice, conducting research, and applying acquired knowledge and skills (Rosenbaum et al., 2015, p. 183). This strategy promotes active and engaged learning, encouraging students to take ownership of their educational journey. Well-designed PBL projects enable students to cultivate essential skills such as teamwork, project management and leadership, communication (oral and written), self-awareness, group process evaluation, independent learning, critical thinking and analysis, concept explanation, self-directed learning, application of core content to real-world scenarios, research, data utilization, and cross-disciplinary problem-solving (Nilson, 2010, p. 187).



Problem-Based Learning (PBL) is widely regarded as an effective pedagogical method for fostering innovative thinking skills. It immerses students in real-world problem-solving within complex environments where solutions are not readily available in textbooks. This instructional approach not only enhances critical and creative thinking but also prepares students to navigate the challenges of future work settings by developing adaptable, innovative mindsets.

Given this background and significance, the development of innovative thinking skills is crucial in preparing the workforce for an era characterized by technological change and evolving demands. This aligns with the curriculum development mission of the Public Administration Program at Prince of Songkla University, Surat Thani Campus, which explicitly states in its Program Learning Outcome (PLO2) that students should be able to analyze and create innovations for public administration and affairs appropriately. The Digital Competency Development for Civil Servants course, therefore, plays a vital role in fostering this competency through the design of learning processes conducive to the cultivation of innovative skills. The application of Problem-Based Learning (PBL) is a key approach that provides students with opportunities to develop both content knowledge and the necessary skills for working in the digital age. This will help prepare them to become public sector managers capable of improving internal operations and enhancing the agility of public services. Innovation in the public sector is essential for elevating the quality of services and increasing the efficiency of government agencies in the future. Therefore, this research aims to investigate the impact of problem-based learning on the development of innovative thinking skills, with the research objectives being to compare learning achievement regarding the design of new digital public services and operations before and after PBL implementation and to examine students' innovative thinking skills resulting from PBL in the context of designing digital public services. These studies will equip students with the necessary skills to design new public services and management approaches that are responsive to technological changes and societal needs, thereby enhancing the quality and efficiency of public service delivery in the future. Additionally, the research findings will contribute to evaluating the effectiveness of PBL in teaching and developing innovative thinking skills and will provide data for refining instructional practices for greater efficiency, ultimately preparing students to work effectively in the digital public sector.

II. LITERATURE REVIEW

The development of innovative thinking skills has become a key objective in learning management in the digital age, particularly for learners who play a vital role in driving social and public sector advancement. Research by Rengrad et al. (2022, pp. 338–354) examined strategies for organizing learning activities that foster innovative thinking among junior high school students. The study found that designing activities connected to real-life contexts and learners' personal experiences - such as using hypothetical situations aligned with students' interests and encouraging teamwork- positively influences the development of creative and innovative thinking. Similarly, research by Meenongwah et al. (2020, pp. 295-307), which focused on nursing students, revealed that while educators acknowledged the importance of cultivating health innovators, they faced challenges related to confidence, instructional management, and



resource constraints. This highlights the need to enhance teacher competencies to improve innovation-oriented learning in higher education. In the area of systematic learning model development, Thongthiya et al. (2024, pp. 107-119) introduced a "learning management model based on transformative learning concepts with design thinking," known as the 5D Model (Define, Discover, Discuss, Develop, Diversify). The study showed that this model effectively promotes innovative thinking in students studying to become teachers and can be adapted for use with students in other academic fields as well. At the public sector level, research by Dechpaeng et al. (2022, pp. 706-719) found that knowledge exchange between new and old generation civil servants is an important mechanism that helps reduce the gap in thinking. And promote collaborative learning in the public sector. In addition, good relationships between colleagues and supervisors are also factors that contribute to creating innovation in the context of public administration. And research by Hendarwati et al. (2022, pp. 97-106) presented a "Cooperative Problem-Based Learning Model" by designing learning steps consisting of problem setting, management, group work to solve problems, work presentation, and evaluation. The results of the study confirm that it is an effective approach in producing graduates with skills ready for use in a highly competitive era.

From the literature review, it was found that although there is a large amount of research studying approaches to developing innovative thinking skills in various groups of students and vocational students. However, there is still no research that focuses on using problem-based learning management processes to develop innovative thinking skills in public administration students. Although personnel in this field play an important role in improving the efficiency of public services in the digital age, this study therefore aims to address the academic gap. It is hypothesized that "PBL learning management on the topic of "Designing Public Services and New Public Sector Operations Using Digital Technology" will result in a statistically significant increase in learning achievement and innovative thinking skills of public administration students."

III. RESEARCH METHODOLOGY

The research on the effects of problem-based learning management to develop innovative thinking skills, the researcher defined the independent variables as problem-based learning , consisting of (1) problem definition, (2) problem understanding, (3) knowledge formation, (4) knowledge synthesis, (5) summarizing and evaluating the answer, and (6) presenting and evaluating, and dependent variables are innovative thinking skills (Australian National Training Authority, 2001, p. 16-50). (1) Interpret, (2) Generate, (3) Collaborate, (4) Reflect, (5) Represent, and (6) Evaluate as detailed in Figure 1.



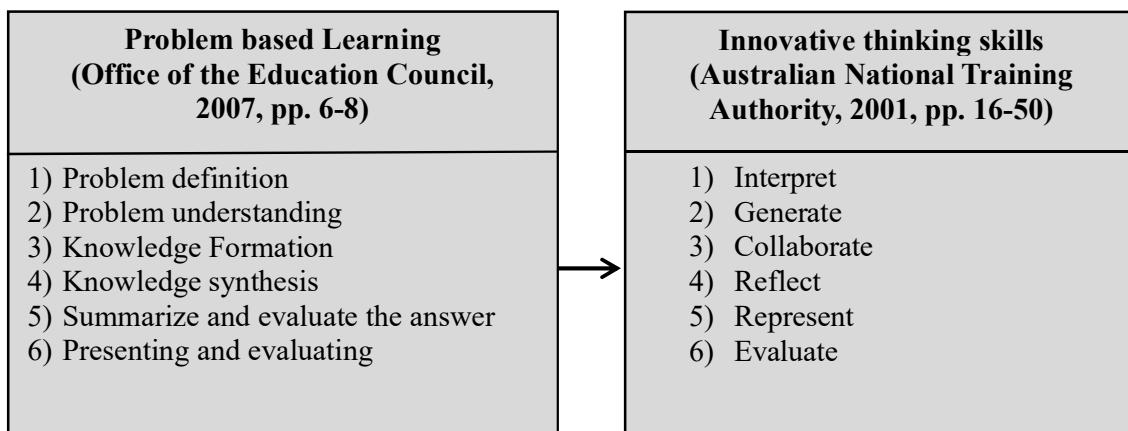


Figure 1: Conceptual framework

This research uses a one-group pretest-posttest design.

Population

The population comprised all third-year Public Administration students at the Faculty of Liberal Arts and Management, Prince of Songkla University, Surat Thani Campus, enrolled in the *Digital Civil Servant Competency Development* course in the first semester of the 2024 academic year. Using purposive sampling with a total population approach, 177 students were included. Eligibility required enrollment in the specified program and course with consent to participate, while students who failed to attend the full learning hours or complete key assessments were excluded. According to Krejcie and Morgan's (1970) sample size table, a population of 180 requires approximately 120–130 participants; thus, the inclusion of 177 students exceeded this threshold, ensuring both statistical power and comprehensive coverage of the accessible population.

Research instruments and quality inspection of instruments

1) A problem-based learning management plan on the topic of designing public services and new public sector operations using digital technology, totalling 26 hours. The content includes modern digital government transformation, government digital service, and important technology trends for digital government. Case studies of success in foreign countries and the service design thinking process. The concepts and principles of using problem-based learning (Office of the Education Council, 2007, p. 6) are used, consisting of 6 steps: (1) Problem definition (2) Problem understanding (3) Knowledge formation (4) Knowledge synthesis (5) Summarize and evaluate the answer and (6) Presenting and evaluating. The learning management plan was presented to 3 experts, consisting of 1 expert in the content of providing services and new public sector operations using digital technology, 1 expert in teaching, and 1 expert in measurement and evaluation. The appropriateness of the learning management plan was evaluated using a 5-level rating scale, with the average score of the learning management plan being 4.23, or at a high level.



2) A learning achievement test on the topic of designing public services and new public sector operations using digital technology. There are 4 essay questions, 5 points each, measuring learning achievement in terms of knowledge, understanding, application, and analysis. The quality of the instrument was checked by analyzing the validity of the test, presenting it to 3 experts, and then calculating the index of consistency between the objectives and the test. The validity of the entire test was 0.82. Then, the item difficulty index and the average difficulty of the test were analyzed. The learning achievement test was used with 44 students who were not in the sample group, who were 3rd-year public administration students who had studied the topic of designing public services and new public sector operations using digital technology. Then, the test results of each student were checked and scored. The test scores were arranged from highest to lowest. The test takers were divided into 3 groups: high scorers, low scorers, and medium scorers. The item difficulty index of the test was calculated, which was equal to 0.68. Then, the item discrimination index and the average discrimination of the test were analyzed using the formula by Scannell and Tracy (1975, p. 223). All test items had an $IDisc > 0.30$, and then the test was used as a research instrument with the sample group.

3) Innovative thinking skills assessment. The researcher developed it from the Australian National Training Authority (2001, pp. 16-50), consisting of 6 aspects: (1) context interpretation (2) idea creation (Generate) (3) collaboration with others (Collaborate) (4) idea reflection (Reflect) (5) idea presentation (Represent) and (6) success evaluation (Evaluate). The assessment form is a 5-level rating scale, and the innovative thinking skills assessment form was presented to 3 experts to check the content validity and calculate the item objective congruence index (IOC). The IOC value was 0.85.

4) Digital public service design assessment form (Rubrics). It was developed to be used as an instrument to assess students' ability to apply innovative concepts and digital technology in public service design. Important elements of service design in the public sector were assessed, including creativity and innovation, appropriateness to the context of government agencies, user-centric focus, appropriate use of digital technology, and ability to present work. The assessment criteria are divided into 4 levels: excellent (90-100 points), good (70-89 points), fair (50-69 points), and poor (0-49 points). In terms of checking the quality of research instruments, the researcher checked the content validity by presenting the assessment form to 3 experts to assess the consistency between the objectives and the assessment items. The assessment results showed that the IOC values were in the range of 0.67 - 1.00, which is within the acceptable. Furthermore, the instrument has also been checked for its feasibility in the actual teaching and learning context. The evaluators were able to spend appropriate time scoring each piece of work and analyzing the results in each aspect.

Data collection

1) Pre-experiment phase Before proceeding, details of the research were explained, including the objectives, operating procedures, and data collection methods. Students who were willing to participate in the research were asked to sign their names to consent to participate in the research. Then, students took a learning achievement test and an innovative thinking skills assessment before learning management.



2) Experiment phase Learning management was carried out according to the designed plan. Using the research instruments that were prepared in advance. Teaching was carried out by the researcher, which had problem-based learning management steps. Details in Table 1.

Table 1: Learning management steps on the topic of designing public services and new public sector operations using digital technology using problem-based learning

Steps	Activities
1) Problem definition (3 hours)	1) The instructor lectures on the topic of modern digital government transformation, Government Digital Service, and key technology trends for digital government (2 hours). 2) Students receive case studies of current public services and related problems, such as service delays, lack of convenience in accessing information, and the use of outdated technology. They then engage in a discussion to identify the main question requiring an answer: "How can we improve the efficiency of public service delivery using digital technology?" (1 hour).
2) Problem understanding (3 hours)	1) The instructor lectures on case studies of successful digital governments in foreign countries (Estonia and Singapore) (1 hour). 2) Students study case examples of successful digital governments and analyze their advantages and disadvantages. They then synthesize information from the case studies to understand the nature of the problems and the challenges in transforming government operations. Students are divided into groups of 5 to discuss and summarize approaches for implementation in Thailand. (2 hours)
3) Knowledge Formation (7 hours)	1) Each group of students conducts research on appropriate technologies to use in developing and improving digital public services. 2) Students interview individuals with experience in the public sector or experts to gather additional information (5 people). 3) Students survey the needs of citizens regarding access to digital public services (30 people).
4) Knowledge synthesis (3 hours)	1) The instructor lectures on the service design process (1 hour). 2) Students synthesize the information obtained from their research and analyze the feasibility of developing digital public services (1 hour). 3) Students brainstorm to find approaches for developing and designing services that meet the needs of public service users and create personas (user representatives) and user journeys to understand user behavior and test ideas (1 hour).
5) Summarize and evaluate the answer (3 hours)	1) Students summarize the results from the design process and present approaches for improving digital public services (1 hour). 2) Students discuss the advantages and limitations of their group's service design (1 hour). 3) Students review approaches that can be realistically applied to improve public services (1 hour).



Table 1: (Continued) Learning management steps on the topic of designing public services and new public sector operations using digital technology using problem-based learning

Steps	Activities
6) Presenting and evaluating (7 hours)	<p>1) Each group of students presents their developed digital public service design, 10 minutes per group, followed by a 5-minute question and answer session.</p> <p>2) The committee and instructors evaluate the designs in terms of appropriateness, feasibility, and potential impact.</p> <p>3) Students revise and develop their approaches based on the feedback from the committee and instructors, and the revisions are reviewed.</p>

3) Post-Experimental Phase: After the instructional activities, students completed a learning achievement test and an innovative thinking skills assessment. These instruments were used to evaluate the outcomes of the experimental learning intervention.

Data analysis

1) Learning Achievement: The pre-test and post-test scores were analyzed using the mean and standard deviation. A paired sample t-test was employed to compare the differences in learning achievement before and after the instructional intervention to determine the effectiveness of the learning activities.

2) Innovative Thinking Skills: The innovative thinking skills assessment was conducted before and after the learning activities. The analysis included the calculation of the mean, standard deviation, mean difference, and effect size. A paired sample t-test was used to examine whether there was a statistically significant improvement in students' innovative thinking skills after the implementation of problem-based learning (PBL). The effect size was interpreted to determine the magnitude of the instructional impact.

IV. RESULTS

The research findings are presented in accordance with the research objectives as follows:

1) Comparison of pre-test and post-test Scores

The results of the pre-test and post-test scores of 177 public administration students are in Table 2.

Table 2: Results of the Comparison between pre-test and post-test scores

Test	\bar{x}	SD	Mean difference	t	p-value
Pre-test	10.25	3.05			
Post-test	17.60	3.65	7.35	27.16	.00*

*p<.05

As shown in Table 2, the mean score before the learning intervention was 10.25 ($SD = 3.05$), while the mean score after the intervention was 17.60 ($SD = 3.65$). The mean difference between the pre-test and post-test scores was 7.35, with a t-value of 27.16 and a P-value of 0.00, indicating a statistically significant difference at the 0.05 level.

These findings suggest that the problem-based learning (PBL) approach used in the instructional plan on "Designing Digital Public Services and Government Operations" effectively enhanced students' learning achievement.



2) Comparison of innovative thinking skills before and after the learning activity

The results of innovative thinking skills before and after the learning activity are in Table 3.

Table 3: Comparison of innovative thinking skills before and after the learning activity

Innovative thinking skills	Paired differences					t	Sig (2 tailed)
	\bar{x}	SD	SD error mean	Lower	Upper		
1. Interpret	2.40	1.09	0.08	2.94	3.26	29.29	0.00**
2. Generate	2.10	1.10	0.09	3.07	3.43	25.40	0.00**
3. Collaborate	2.65	0.95	0.07	3.26	3.54	37.11	0.00**
4. Reflect	2.20	1.00	0.08	3.04	3.36	29.27	0.00**
5. Represent	2.15	1.05	0.08	2.99	3.31	27.24	0.00**
6. Evaluate	2.34	1.05	0.08	2.94	3.26	29.65	0.00**

*p<.05

As shown in Table 3, the results of the paired sample t-test comparing pre- and post-intervention scores across six dimensions of innovative thinking skills (1) Interpret, (2) Generate, (3) Collaborate, (4) Reflect, (5) Represent, and (6) Evaluate-demonstrated significant improvements in all areas. The mean differences for each dimension ranged from 2.10 to 2.65, indicating consistent and comprehensive progress among participants. The t-values were notably high, ranging from 25.40 to 37.11, with 2-tailed significance levels (Sig.) of 0.00 across all dimensions, clearly below the conventional significance threshold of $p < .05$.

These findings confirm that there were statistically significant differences in innovative thinking skills before and after the intervention, across all dimensions. This indicates that the learning activities implemented in this study were highly effective in fostering students' innovative thinking abilities in a multidimensional and holistic manner.

3) Results of the assessment of public service design projects in the digital era (Rubrics)

A total of 177 students were divided into groups to participate in collaborative learning activities. The grouping resulted in 35 teams, with most groups consisting of five members (35 groups \times 5 students = 175 students), and the remaining two students were assigned to two groups of six members each, ensuring full participation of all students. Throughout the learning process, students collaboratively designed public service delivery models tailored to the digital era. The final presentations were evaluated using a rubric-based assessment with a maximum score of 100 points. The assessment results are presented in Table 4.

Table 4: Results of the evaluation of public service design projects in the digital era

Scoring levels for public service design project evaluation (Total Score: 100 points)		Number of groups	Percentage (%)
1)	Excellent: 90–100 points	12	34.29
2)	Good: 70–89 points	15	42.86
3)	Fair: 50–69 points	6	17.14
4)	Poor: 0–49 points	2	5.71
Total		35	100



As shown in Table 3, the evaluation results were categorized into four performance levels: Excellent (90–100 points), Good (70–89 points), Fair (50–69 points), and Poor (below 50 points). The results revealed that most student groups performed at a satisfactory level. Specifically, 12 groups (34.29%) achieved scores in the excellent range, followed by 15 groups (42.86%) in the good range. Together, these two categories accounted for 77.15% of all groups, indicating a strong understanding and skill in designing public service solutions that are potentially applicable in real-world contexts. Meanwhile, 6 groups (17.14%) fell into the fair category, and only 2 groups (5.71%) were assessed as poor. Although these latter groups represent a minority, the evaluation outcomes provide valuable feedback that can be used to inform and enhance future learning activities.

V. CONCLUSION AND DISCUSSION

The research aimed to evaluate the effectiveness of a Problem-Based Learning (PBL) approach on public administration students' learning achievement and innovative thinking skills, and to assess their public service design projects. The findings consistently demonstrate the positive impact of this intervention. Firstly, a comparison of pre- and post-intervention scores for public administration students revealed a statistically significant improvement in learning achievement, indicating that the PBL approach effectively enhanced students' learning outcomes. Secondly, the study found statistically significant improvements across all dimensions of innovative thinking skills - Interpret, Generate, Collaborate, Reflect, Represent, and Evaluate - after the learning activity, which confirms the effectiveness of the implemented learning activities in fostering students' innovative thinking abilities in a multidimensional and holistic manner. Finally, the assessment of public service design projects, undertaken by numerous student groups, demonstrated a high level of performance, with a substantial majority of groups achieving scores indicating good to excellent understanding and practical application of skills in designing public service solutions relevant to the digital era; only a minority of groups scored lower, providing valuable insights for future instructional refinement. In summary, the problem-based learning intervention significantly improved public administration students' learning achievement and innovative thinking skills across all measured dimensions and resulted in high-quality public service design projects. The learning intervention yielded statistically significant improvement in learning outcomes at the 0.05 level, affirming the effectiveness of the problem-based approach. These findings are consistent with Chachiyo and Chachiyo (2024, pp. 97-106), who demonstrated that PBL effectively enhances critical thinking skills among university students. Similarly, Chaimanee and Nuchprayoon (2024, pp. 54 - 65) reported that undergraduate students enrolled in a programming course exhibited significantly higher post-test scores following PBL instruction. The present study also revealed statistically significant improvements ($p < .05$) in six dimensions of innovative thinking: (1) Interpret, (2) Generate, (3) Collaborate, (4) Reflect, (5) Represent, and (6) Evaluate. This aligns with findings by Yawai et al. (2024, pp. 188-202), who integrated PBL with authentic work experiences to enhance teacher trainees' innovative thinking. Their research showed significant gains in post-intervention scores compared to pre- and mid-intervention levels. Similarly, Kardoyo et al. (2020, pp. 1141-1150) demonstrated that PBL strategies positively influence both analytical and



creative thinking among economics students at Universitas Negeri Semarang, Indonesia. Students were able to interpret cases accurately, propose feasible solutions, and express that PBL made learning more engaging and participatory. Furthermore, Ainthaphuk et al. (2025, p. LEADRU0201e1233) found that teachers in the Sukhothai Primary Educational Service Area 1 developed high levels of innovative thinking following targeted interventions. Liangaumnuay et al. (2024, pp. 11-21) emphasized that innovative thinking is essential to driving educational reform in Thailand's digital era, especially in science education, which requires adaptability and systemic problem-solving. Their proposed five-stage innovation process—problem identification, data collection, idea generation, development and testing, and implementation—can be effectively cultivated through experiential and problem-based learning. Such approaches foster key innovator traits, including initiative, leadership, integrative thinking, curiosity, and collaboration. In addition to aligning with prior studies, the findings can be interpreted through the lens of constructivist learning theory, which posits that learners actively construct knowledge through problem-solving and collaboration. The statistically significant improvements observed across all six dimensions of innovative thinking are consistent with this theoretical perspective, as PBL requires students to integrate prior knowledge, engage in reflective inquiry, and generate creative solutions in authentic contexts. An alternative explanation for these results may lie in the role of peer collaboration and group dynamics, which can stimulate idea generation and critical reflection beyond the effects of the PBL structure itself. Moreover, students' pre-existing familiarity with digital technologies may have amplified their ability to design innovative public service projects, suggesting that digital literacy acted as a moderating factor. These considerations highlight that while PBL was central to the observed improvements, other contextual and learner-related factors likely contributed, underscoring the importance of integrating multiple perspectives when interpreting the findings.

In summary, this research generates new knowledge in three important dimensions. First, it confirms the pedagogical effectiveness of Problem-Based Learning (PBL) in enhancing both learning achievement and innovative thinking skills of students in the field of public administration. Second, the findings contribute to the theoretical development of innovative thinking by providing a multidimensional framework (Interpret, Generate, Collaborate, Reflect, Represent, and Evaluate) that can serve as a reference for designing curricula in higher education. Third, this study expands the academic value of PBL by demonstrating its applicability to digital public service design, thereby offering new insights into how higher education can prepare students to become innovative citizens capable of addressing contemporary challenges in public sector contexts.

SUGGESTION

Based on the findings of this study, it is recommended that the problem-based learning (PBL) approach be systematically integrated into other courses within the Public Administration curriculum and related disciplines, particularly those emphasizing analytical thinking, systems thinking, and policy decision-making - such as Public Policy, Strategic Planning, and Public Sector Technology Management - to enhance students' comprehensive competencies. Learning activities should emphasize active student participation throughout the entire learning process,



including question formulation, data exploration, synthesis of innovative alternatives, and presentation of policy recommendations to relevant agencies, thereby fostering communication, teamwork, and leadership skills. Assessment results of students' skills and digital public service design outputs should be utilized as constructive feedback for ongoing instructional improvement, with targeted support mechanisms - such as focused workshops or structured mentoring -for students needing further development. Moreover, learning outcomes should be connected to real-world practices by encouraging universities to collaborate with local government units, enabling students to translate their classroom innovations into practical policy or service applications, thus contributing to tangible social impact and enhancing students' applied public administration competencies.

ACKNOWLEDGEMENT

This research was successfully completed with the kind cooperation of undergraduate students in the Public Administration Program, Faculty of Liberal Arts and Management Sciences, Prince of Songkla University, Surat Thani Campus. The researcher has also received a certificate of completion for human research ethics training from the National Research Council of Thailand, issued on October 19, 2024, and valid until October 19, 2026. The researcher would like to express sincere gratitude and appreciation for all the support received.

REFERENCES

Ainthaphuk, N., Thippawan, D., Buathong, T., Chan-ngern, T., & Chaowachai, S. (2025). Guidelines for promoting teacher's innovative thinking skill under the jurisdiction of Sukhothai Primary Educational Service Area Office 1. *Leadership Educational Administration Development Journal, Ramkhamhaeng University*, 2(1), LEADRU0201e1233–LEADRU0201e1233.

Australian National Training Authority (ANTA). (2001). *Innovation: Ideas that work for trainers of innovation at work skills*. Brisbane: Australian National Training Authority.

Chachiyo, M., & Chachiyo, W. (2024). The effects of using problem-based learning to promote critical thinking skills. *Journal of Industrial Education*, 23(3), 97–106.

Chaimanee, M., & Nuchprayoon, N. (2024). The effects of learning management using problem-based learning to promote analytical thinking subject computer programming. *Journal of Nakhonratchasima College (Humanities and Social Sciences)*, 18(1), 54-65.

Dechpaeng, W., Suvannin, W., & Rittiboonchai, W. (2021). Antecedents of knowledge management on the innovation performance of government officials at the Revenue Department in Thailand. *Journal of MCU Peace Studies*, 10(2), 706-719.

Hendarwati, E., Nurlaela, L., & Bachri, B. S. (2022). The collaborative problem-based learning model innovation. *International Proceeding of Community Services*, 2(1), 97-106.

Kardoyo, Nurkhin, A., Muhsin, & Pramusinto, H. (2020). Problem-based learning strategy: Its impact on students' critical and creative thinking skills. *European Journal of Educational Research*, 9(3), 1141-1150.

Khan, H., Jumani, N. B., & Gul, N. (2019). Implementation of 21st-century skills in higher education of Pakistan. *Global Regional Review*, 4(3), 223-233.



Liangaumnuay, W., Kangkawisut, T., & Areekul, C. (2024). Innovative thinking to develop science education in Thailand. *Journal of Wisdom and Morality*, 1(3), 11-21.

Meenongwah, J., Kotta, P., & Sarakarn, K. (2020). Situations of innovative learning method for nursing students in nursing college under the Praboromarajchanok Institute in the Northeast of Thailand. *Journal of MCU Peace Studies*, 8(Suppl.), 295-307.

Miterianifa, M., Ashadi, A., Saputro, S., & Suciati, S. (2020). Higher order thinking skills in the 21st century: Critical thinking. In *Proceedings of the 1st International Conference on Social Science, Humanities, Education and Society Development, ICONS* (Vol. 30, pp. 30-11).

Mourtzis, D. (2021). Towards the 5th industrial revolution: A literature review and a framework for process optimization based on big data analytics and semantics. *Journal of Machine Engineering*, 21(3), 5-39.

Nilson, L. B. (2010). *Teaching at its best: A research-based resource for college instructors* (2nd ed.). San Francisco, CA: Jossey-Bass.

Office of the Education Council. (2007). *Problem-based learning*. Bangkok: Office of Educational Standards and Learning Development.

Partnership for 21st Century Skills. (2011). *Ohio Department of Education*, One Massachusetts Avenue NW, Suite 700, Washington, DC 20001. <https://www.p21.org>.

Ramirez, F. A. R. (2018). *Analysis of 21st century skills in a graduate program for educators concerning linked learning* [Doctoral dissertation]. California State University, Long Beach.

Rengrad, A., Patphol, M., & Jamjuree, D. (2020). A study of learning management approaches enhancing innovative thinking skills for junior high school students. *Journal of Humanities and Social Sciences Nakhon Phanom University*, 12(3), 338-354.

Rosenbaum, M. S., Otalora, M. L., & Ramirez, G. C. (2015). Promoting problem-based learning in retailing and services marketing course curricula with reality television. *Journal of Education for Business*, 90(4), 182-191.

Scannell, D. P., & Tracy, D. B. (1975). *Testing and Measurement in the Classroom*. Boston: Houghton Mifflin Company.

Sepriyanti, N., Nelwati, S., Kustati, M., & Afriadi, J. (2022). The effect of 21st-century learning on higher-order thinking skills (HOTS) and numerical literacy of education and science students in Indonesia in the term of gender. *Journal Pendidikan IPA Indonesia*, 11(2), 314-321.

Thongthiya, K., Yamrung, R., & Langka, W. (2024). *Developing a learning management model using transformative learning with design thinking to enhance the creative learning innovation competency for student teachers*. *Journal of Social Science and Cultural*, 8(6), 107-119.

Yawai, A., Vongchavalitkul, A., & U-thong, N. (2024). Developing innovative thinking skill by integrating knowledge with the work of students in the Graduate Certificate Program in Teacher Profession. *Sikkha Journal of Education*, 1(1), 188-202.

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