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Lecturers' Perspectives on Undergraduate Students' Innovative Thinking Skills and Creative Problem-Solving Skills: A Comparative Needs Analysis

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This study aimed to identify the gap between undergraduate students' actual and expected levels of innovative thinking skills (ITS) and creative problem-solving skills (CPSS), as perceived by faculty lecturers. Specifically, it examined lecturers' perspectives to prioritize areas for enhancing students' ITS and CPSS within computer science, information technology, and digital business fields. A sample of 30 lecturers at Southeast Bangkok University was selected through simple random sampling. Data were collected using two validated, structured questionnaires, achieving reliability coefficients of 0.93 (ITS) and 0.95 (CPSS) for expected conditions and 0.95 and 0.98 for actual conditions, respectively. Statistical analysis included calculating means, standard deviations (SD), and the Priority Needs Index (PNImodified), with paired t-tests applied to determine significant gaps. Findings revealed that while lecturers expected students' ITS to be high, the actual performance was moderate, prioritizing knowledge of innovative techniques for enhancement. CPSS was also observed as a development priority, particularly in creative problem-solving processes and complex problem-solving, suggesting targeted improvements to meet lecturer expectations.

Keywords: creative problem-solving, Innovative thinking skills, necessary needs, $PNI_{modified,}$ Thailand

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INTRODUCTION

In today's rapidly evolving and increasingly complex world, creative problem-solving skills have emerged as critical competencies for personal and professional success (De Jager et al., 2013). These skills empower individuals to tackle unfamiliar challenges effectively, think outside the box, and innovate solutions to complex problems (Kanter, 2020). However, the effective development of CPSSs requires a systematic needs assessment for the identification of gaps between the current state and the desired outcomes.

As we enter the 21st century, characterized by swift changes in technology, economy, and society, innovative thinking and creative problem-solving have become essential for undergraduate students preparing for the workforce and their roles as responsible citizens (Chanyawudhiwan et al., 2023). Over the past decade, research has highlighted these skills' significance in enhancing national competitiveness and fostering sustainable economic development.

Studies, such as those by Tan (2021), indicate that students with high levels of innovative thinking and creative problem-solving skills tend to succeed academically and professionally and adapt more effectively to new challenges. Furthermore, research by Lee (2020) reveals that leading global organizations prioritize recruiting individuals with these skills.

However, despite the importance of ITS and CPSS, many undergraduate students still lack the skills required by today’s labor market (Lee, 2020; Tan, 2021), which points to a significant gap between the skills students possess and those demanded by industries, particularly in terms of out-of-the-box thinking and complex problem-solving abilities. Consequently, educational institutions must prioritize the development of these skills through curriculum adjustments, teaching methods, and extracurricular activities to meet these demands (Avcı & Durak, 2023). Additionally, fostering collaborations between academic institutions and the business sector is crucial for skill development.

Identifying the need for CPSS is a critical process that helps stakeholders recognize, analyze, and prioritize the skill gaps that must be addressed (Pimdee et al., 2024). The outcomes of this assessment will offer suggestions for the design of training programs, curricula, and development activities focused on students' actual needs. Moreover, it facilitates the efficient allocation of resources for maximum benefit.

Therefore, this article aims to present concepts, processes, and methods for assessing the needs related to innovative thinking skills (ITS) and creative problem-solving skills (CPSS). It covers relevant theories, assessment tools, related studies and theories, and the analysis and application of assessment results in skill development (Khamcharoen et al., 2022). Additionally, challenges and considerations in implementation will be discussed, along with strategies for application in various contexts, including education, organizational human resource development, and self-improvement. From the analysis, it is hoped that readers will better understand the importance of needs assessment in developing CPSS. They can apply these concepts and methods effectively to enhance ITS and CPSS and foster innovation in this era of change (Zou et al., 2023).

LITERATURE REVIEW

Innovative Thinking Skills (ITS)

Innovation continues to be recognized as a driver of scientific and social progress (Ness, 2015), though educational systems still need to prioritize creative and innovative thinking skill development. Innovative thinking skills encompass generating and applying new concepts and ideas that hold intrinsic and practical value across various domains. Complex Problem-Solving Skills (CPSS) are closely associated with ITS, which involves recognizing challenges, diagnosing underlying issues, and crafting original, practical solutions. The synergy of ITS and CPSS forms a fundamental pillar for innovation and resilience in today's fast-paced, technology-driven world.

Research has consistently highlighted the complexity of nurturing ITS and CPSS among students. For instance, Najatbekovna (2021) points out that professional growth is more than just about knowledge acquisition; it requires integrating diverse competencies and skills, which remain challenging for undergraduate students to develop fully. Crawford (2019) echoes this, finding that many students need more core skills foundational to innovation, such as analytical and critical thinking, which are necessary precursors to creative problem-solving. In alignment, Cheng (2011) and Creely et al. (2021) noted that a fear of failure and risk aversion often prevent students from sharing novel ideas, a key obstacle in cultivating creativity.

Building on these findings, recent studies emphasize the need for strategic teaching approaches and culturally sensitive methodologies to foster ITS in diverse educational settings. For example, Barak and Yuan (2021) underscored the importance of culturally aware instruction in promoting High Order Thinking Skills (HOTS) among students, while Mok et al. (2021) and Stretch and Roehrig (2021) observed that students frequently struggle with the uncertainty inherent in innovation and complex problem-solving processes. Additionally, Avcı and Durak (2023) found that some students lack intrinsic motivation or a clear understanding of ITS and CPSS's relevance, resulting in stagnation in these competencies.

Technological access further plays a role in the acquisition of ITS. Songkram et al. (2021) found that students' ITS development can be improved with access to tools like design software. The challenges in assessing ITS and CPSS remain, as De Jager et al. (2013) observed, indicating a gap in effective measurement instruments.

Recent studies expand the conversation around ITS by exploring innovative instructional tools and methodologies. Blegur et al. (2023) highlighted the importance of developing tailored assessment instruments to foster analytical thinking within elementary education, mainly through engaging in physical activities like throw-and-catch games. This Indonesia-based study found that while such activities support the growth of analytical thinking as part of HOTS, physical education instructors often need more resources to develop adequate measurement tools, suggesting a gap in early educational frameworks supporting ITS.

Zhou et al. (2023) made strides in assessing HOTS among pre-service teachers using a sample of 701 participants in China. Their study developed a validated 4-dimensional,

14-factor HOTS assessment scale, including critical thinking, problem-solving, teamwork, and practical innovation skills, showcasing the need for targeted assessments to prepare future educators for innovative teaching in the 21st century.

Further, Dilekçi and Karatay (2023) examined the impact of a 21st-century skills curriculum on creative thinking, finding significant improvements among students exposed to a 10-week program. This study, conducted in Turkey, employed the Torrance Creative Thinking Test alongside qualitative interviews, reporting gains in creativity, digital literacy, and a stronger learning desire indicative of comprehensive skill-building in innovative thinking.

Puger et al. (2024) researched the effect of a metacognitive-based learning model on agile innovation and critical thinking within elementary science education in Bali, Indonesia. The intervention involved 32 students and demonstrated a marked improvement in agile innovation and critical reasoning compared to a control group. This suggests that incorporating metacognitive strategies significantly enhances students' adaptability and critical thinking, even at an early educational stage.

In addition, Durnali et al. (2023) explored the interrelationship between emotional intelligence, creative thinking, and entrepreneurial skills among teacher candidates in Turkey, finding that emotional intelligence positively influences both creativity and entrepreneurship. Their findings from a sample of 412 teacher candidates emphasize that fostering creative thinking can be pivotal in linking emotional intelligence with entrepreneurial aspirations, highlighting its importance in teacher education.

The role of technology in fostering ITS is further examined by Songkram et al. (2024), who investigated the impact of ChatGPT on innovative thinking among Thai students. With a large sample of 3,860 students, this study highlights the potential of AI tools like ChatGPT in generating innovative ideas while also stressing the need for ethical guidelines to support responsible AI use in academic settings.

Lastly, Sukkeewan et al. (2024) developed an assessment tool for measuring ITS among vocational students involving 1,250 participants. Their research confirmed a five-factor structure for assessing innovative thinking, affirming the tool’s efficacy in accurately measuring this skill within vocational education contexts.

The literature shows significant advancements in understanding and fostering ITS across diverse educational environments. From metacognitive interventions to AI-assisted idea generation, recent research underscores the importance of developing contextually sensitive approaches to cultivating innovative thinking. These studies provide critical insights for educators, policymakers, and curriculum developers working to prepare students for an innovation-driven future.

Creative Problem-Solving Skills (CPSS)

Revised Literature Review on Creative Problem-Solving Skills (CPSS)

Creative Problem-Solving Skills (CPSS) are increasingly recognized as essential competencies for thriving in today’s fast-evolving educational and professional landscapes (Chen & Cheng, 2009; Pimdee & Pipitgool, 2023). These skills encompass

thinking divergently, generating innovative solutions, and managing complex challenges (Barrett et al., 2013; Kletke et al., 2001). As modern society demands individuals capable of adapting to rapid changes, CPSS has become a critical focus within educational curricula and professional development initiatives worldwide (Khalid et al., 2020; Kim et al., 2013).

At the foundation of CPSS is a structured approach involving problem identification, idea generation, solution evaluation, and implementation. Each stage demands distinct cognitive abilities, including creativity, critical thinking, and decision-making. These skills are effectively cultivated through educational practices to enhance CPSS (Simanjuntak et al., 2021). Recent research underlines the importance of refining instructional strategies to support the development of CPSS, allowing students to engage confidently with complex, real-world issues (Chanyawudhiwan et al., 2023).

Recent Advances in CPSS Research

New studies highlight how various educational approaches can enhance CPSS in diverse settings. Karamustafaoğlu and Pektaş (2023) conducted an inquiry-based STEM study in Turkey with 32 high school students, focusing on out-of-school environments to develop CPSS through STEM activities. Their findings underscore the importance of hands-on experiences in fostering CPSS, showing that inquiry-based STEM activities increased STEM awareness and encouraged collaborative problem-solving and productivity, critical components of CPSS.

Similarly, Aytekin and Topçu (2024) explored the impact of computational thinking on CPSS among Turkish 6th graders, using both "plugged" (digital) and "unplugged" (non-digital) approaches in a study involving 16 hours of instruction over four weeks. Their quasi-experimental design revealed that both computational approaches enhanced CPSS more effectively than traditional science instruction, with unplugged methods proving particularly successful. This finding emphasizes the effectiveness of interactive, problem-solving-focused approaches in developing young students' CPSS.

In a different context, Zakiyah et al. (2024) developed an assessment tool in Indonesia to measure CPSS and critical thinking within lessons on sound waves. This tool, constructed using the Facione and Osborn-Parness frameworks, proved valid and reliable for assessing CPSS, supporting educators in accurately evaluating students' creative and critical thinking abilities. This assessment tool signifies a step forward in providing educators with reliable instruments for measuring CPSS, essential for further tailoring educational interventions to nurture these skills.

Innovative Methodologies in CPSS Development

Digital technology also plays a role in enhancing CPSS. Dhitasarifa and Wusqo (2024) examined the effect of STEAM (Science, Technology, Engineering, Arts, and Mathematics) digital teaching materials on CPSS in an Indonesian middle school setting. Utilizing a quasi-experimental design, the researchers found a significant improvement in CPSS among students in the experimental group, who achieved high gains compared to those in the control group. This study supports the idea that incorporating digital resources in the classroom can significantly enhance students'

problem-solving capabilities by making learning more engaging and contextually relevant.

CPSS in Collaborative and Real-World Contexts

Furthermore, Hether (2023) explored CPSS development in an American strategic communication course through a collaborative assignment. Surveying 42 students, this study utilized the Creative Problem-Solving (CPS) model. It revealed that students valued idea generation and solution development stages most in enhancing their learning and problem-solving abilities. However, the study noted variation in outcomes linked to gender, race, and team dynamics, suggesting that collaborative assignments could be optimized to support diverse student populations in CPSS development better.

Lastly, Wuttikamonchai et al. (2024) applied a needs analysis using the $PNI_{modified}$ method to identify priority areas for CPSS enhancement. Findings highlighted creative and complex problem-solving as top areas needing systematic improvement. This assessment suggests that while students may demonstrate baseline competencies in CPSS, there is still a pressing need for focused development strategies to prepare them for increasingly complex professional environments.

These studies demonstrate that diverse instructional approaches—from STEM-based inquiry and computational thinking to digital STEAM resources and collaborative assignments—can significantly enhance CPSS across different educational contexts and age groups. Through these innovative methodologies, educators are better positioned to equip students with the creative problem-solving skills essential for navigating and excelling in complex, dynamic environments. As CPSS remains crucial for modern workforce readiness, continued research, and adaptation of educational practices are necessary to align instructional strategies with evolving professional demands.

Needs Assessment

The concept of needs assessment has evolved into a fundamental methodology across various research and educational contexts. Initially introduced by the United Nations Development Programme (UNDP) in the 1990s, this approach has become pivotal in numerous fields, including education, where it plays a vital role in shaping curricula and enhancing student skills (Al-Ismail et al., 2023). The focus on continuous professional development is emphasized by Al-Ismail and colleagues, highlighting the importance of adapting the needs assessment methodology to meet evolving educational demands.

The needs assessment methodology in Thailand has been significantly refined to address local educational challenges. Wongwanich and Wiratchai (2005) developed the $PNI_{modified}$ formula, a unique adaptation of the global framework, which has become widely used in Thai educational systems. Wongwanich (2019) underscores how this localized adaptation ensures that educational strategies and interventions are better tailored to the specific needs of students in Thailand. This modified approach demonstrates the flexibility and practical utility of needs assessments in diverse educational environments, underscoring the importance of tailoring the process to fit the local context.

One of the core strengths of needs assessment is its ability to analyze gaps between current and desired conditions, ensuring that solutions are well-aligned with stakeholder needs (Wongwanich, 2019). By systematically identifying areas for improvement, needs assessments can optimize operational efficiency and promote more effective learning outcomes. Numerous studies have demonstrated the value of this process in educational contexts, especially in preparing students for real-world challenges (Borriraklert & Kiattisin, 2021; Chanyawudhiwan et al., 2023; Chimnoy et al., 2023; Choomsri & Chansirisira, 2023; Khang et al., 2023; Pitiporntapin et al., 2023; Prasittichok & Klaykaew, 2022; Sittisak et al., 2022; Somintara et al., 2018; Ussarn et al., 2022).

For example, Wuttikamonchai et al. (2024) employed a needs assessment to evaluate mobile web development skills among students. Their study highlighted the critical skills prioritized by industry professionals and educators, aligning educational efforts with the demands of the workforce. This alignment addresses the immediate skills gap and fosters the development of innovative thinking and creative problem-solving skills—both crucial for students in the 21st century.

Similarly, Ussarn et al. (2022) used needs assessment methods to identify essential digital skills required for students, further underscoring the importance of adapting educational practices to meet current technological demands. These studies illustrate how needs assessment can serve as a strategic tool for shaping curricula that promote both ITS and CPSS among undergraduate students.

The development of ITS and CPSS has become increasingly critical in the 21st century, as students must navigate complex problems and adapt to rapidly changing environments. In this context, needs assessment is particularly valuable for uncovering gaps in current educational practices that hinder the development of these skills. By pinpointing the areas in which students are lacking, educational institutions can develop targeted interventions that foster these crucial skills, thereby better-preparing learners for future challenges in academic and professional settings (Ussarn et al., 2022; Wuttikamonchai et al., 2024).

Purpose of the Study

The study focused on faculty needs for innovative thinking skills (ITS) and creative problem-solving skills (CPSS). As such, the following research objectives (RO) are proposed:

RO1: To assess the current (actual) levels of innovative thinking skills (ITS) and creative problem-solving skills (CPSS) among undergraduate education faculty members at Southeast Bangkok University.

RO2: To identify the desired (expected) levels of ITS and CPSS skills among faculty members in their fields of expertise.

RO3: To analyze the gap between actual and expected ITS and CPSS levels using the Priority Needs Index (PNImodified) for targeted professional development.

RO4: To determine statistically significant differences between actual and expected ITS and CPSS levels and to prioritize areas for faculty development.

RO5: To provide actionable recommendations based on the needs assessment findings to inform professional development initiatives to enhance ITS and CPSS among faculty.

METHOD

Population and Sample

The study targeted undergraduate education faculty members from three departments and seven fields relevant to computer science, information technology, and digital business at Southeast Bangkok University during the 2024 academic year, totaling 35 individuals (Table 1). Using simple random sampling, a sample of 30 faculty members was selected based on departmental and field representation (Hargrove & Nietfeld, 2015). This selection ensured a diverse and representative sample reflecting the faculty's expertise and departmental composition.

Table 1
Population and sample of faculty members

Department/Field	Population	Sample
1. Digital Technology and Innovation Information Technology	10	7
2. Digital Business Technology	10	6
3. Computer Technology and Innovation	5	3
4. Information and Communication Tech	5	3
5. Business Computer Education	5	4
6. Computer Education	5	3
7. Digital Marketing	5	4
Totals	35	30

Research Instruments

ITS Needs Assessment Questionnaire

The ITS Needs Assessment Questionnaire was developed to evaluate faculty members' actual and expected proficiency levels across three core areas: innovative idea generation, innovative thinking connectivity, and technical knowledge of innovation. To ensure comprehensive coverage, a structured 5-point Likert scale was applied (Figure 1), with ratings from "Strongly Disagree" (1) to "Strongly Agree" (5). The instrument's content validity was established through expert judgment, with a Content Validity Index (CVI) ranging from 0.60 to 1.00, based on evaluations by five domain experts. This indicates a strong agreement on the relevance of items. Additionally, the instrument's reliability was confirmed through a pilot test involving 30 non-sample faculty members, yielding confidence values between 0.92 and 0.96, as shown in Table 2.

Figure 1
Rating scale and values

Table 2
IOC and reliability of the ITS and CPSS needs assessment

Skills	Items	IOC 0.60-1.00	Confidence Values	
			Actual Condition	Expected Condition
Innovative Thinking Skills (ITS)	24			
Innovative Idea Generation	6	1.00	0.95	0.92
Innovative Thinking Connectivity	6	0.60-1.00	0.96	0.93
Technical Knowledge of Innovation	6	1.00	0.96	0.92
Creative Problem-Solving Skills (CPSS)	20			
Complex Problem-Solving	10	0.60-1.00	0.99	0.99
Creative Problem-Solving Processes/Steps	10	0.60-1.00	0.96	0.93

CPSS Needs Assessment Questionnaire

A complementary instrument, the CPSS Needs Assessment Questionnaire, was developed to assess complex and creative problem-solving skills among faculty members. Like the ITS questionnaire, it employed a 5-point rating scale and achieved a CVI of 0.60 to 1.00 after expert review. The pilot test results for CPSS further validated the instrument's reliability, with values ranging from 0.93 to 0.99 (Kaoian et al., 2024), presented in Table 2.

Data Collection

Data was collected in March 2024 using online questionnaires distributed to 30 undergraduate faculty lecturers across computer science, information technology, and digital business fields at Southeast Bangkok University. Using digital survey tools (Google Forms) facilitated comprehensive and efficient data collection, achieving a 100% response rate.

Data Analysis

ITS and CPSS Faculty Opinion Analysis

The responses were analyzed to determine the means and standard deviations of lecturer opinions on ITS and CPSS among students. The rating scale allowed for quantitative comparisons between the current (actual) and target (expected) levels of ITS and CPSS.

ITS and CPSS Needs Assessment Analysis

For a deeper understanding of skill gaps, the Priority Needs Index (PNI) was calculated using a modified formula adapted to fit the research context (Wongwanich, 2019):

$PNI_{modified} = (I-D)/D$ (1)

$PNI_{modified}$ = Index of the difference between expected and actual conditions

I = mean of the desired outcome

D= Mean of the actual results

Comparison of Actual and Expected Conditions

The needs assessment analysis of ITS and CPSS involved comparing the expected conditions (I) with the actual conditions (D) using a paired t-test for dependent samples (Zafari et al., 2020).

Comparison of Actual and Expected Conditions

To assess the significance of the difference between actual and expected conditions, a paired t-test for dependent samples was conducted. This statistical approach enabled a reliable comparison and facilitated interpretation of whether the differences in ITS and CPSS needs were statistically significant, following the guidelines established by Zafari et al. (2020).

The Critical Nature of Needs Assessment in This Study

Conducting a needs assessment was integral to this study for a precise and evidence-based approach to understanding ITS and CPSS among lecturers. The methodological foundation of needs assessments, originating from the United Nations Development Programme (UNDP) in the 1990s, provides a framework that enables researchers to gather and analyze data on social, educational, and skill-based needs systematically (Chuenbooncu et al., 2024; Kaoian et al., 2024; Moonsan et al., 2024). This structured approach, particularly in the context of professional development for lecturers, has shown its value in identifying competency gaps and prioritizing areas for improvement (Dong & Mhunpiew, 2024; Kantathanawat & Tungkunanan, 2024; Luo & Chittranun, 2024).

In Thailand, the Priority Needs Index (PNImodified) offers a context-specific adaptation of this methodology, allowing for prioritizing faculty lecturer development needs based on empirical data (Wongwanich & Wiratchai, 2005). The PNImodified approach has been instrumental in areas ranging from digital competency assessment to

professional development in education, as demonstrated by numerous studies (Chanyawudhiwan et al., 2023; Sittisak et al., 2022). By applying the $PNI_{modified}$ formula, this study leverages a well-validated tool to ensure data-driven decision-making in curriculum design and lecturer training initiatives.

FINDINGS

The research design was structured to capture a comprehensive understanding of innovative and problem-solving skills needs among teachers. We employed the $PNI_{modified}$ analysis and t-test for detailed statistical insights. We selected exemplary cases to illustrate specific findings based on the criteria of representativeness and relevance to the educational setting.

Our methodology, which incorporates the $PNI_{modified}$ analysis and t-test, was selected to provide statistically rigorous insights aligned with educational best practices. These methods have been successfully applied in prior studies assessing similar skill gaps (Chuenbooncu et al., 2024; Kaoian et al., 2024; Moonsan et al., 2024 Chuenbooncu et al., 2024; Kaoian et al., 2024; Moonsan et al., 2024; Wuttikamonchai et al., 2024) and competency gaps (Dong & Mhunpiew, 2024; Kantathanawat & Tungkunanan, 2024; Luo & Chittranun, 2024), reinforcing their relevance to educational practice.

The ITS and CPSS assessments revealed significant gaps between expected and actual skill levels across areas such as Innovative Technical Knowledge and Creative Problem-Solving. Tables 4 and 5 present these needs in a comparable format for consistency, and the following sections summarize vital insights.

General Information of the Respondents

Table 3 shows the general characteristics of the study's teacher participants. Most teachers were male (56.33%), with 30.00% having a doctoral degree, while the remaining 70.00% had a master's degree. Regarding academic positions, 83.33% were lecturers, and 16.66% were assistant professors.

Table 3
Teachers' general information

Item	Frequency	%
Gender		
Men	17	56.33
Women	13	43.33
Educational Level		
Master's Degree	23	70.00
Doctoral Degree	7	30.00
Academic Position		
Lecturer	25	83.33
Assistant Professor	5	16.66

ITS Needs Assessment Results

Table 4 shows the ITS needs assessment by comparing the expected and actual conditions using the $PNI_{modified}$ and t-test (Wuttikamonchai et al., 2024). The analysis

revealed that while innovative thinking skills were rated high in expected levels (mean = 4.18), actual skills were rated moderate (mean = 3.27). The highest need identified was for Innovative Technical Knowledge, indicating a critical area for development. Innovative Thinking Connectivity and Innovative Idea Generation followed this.

Table 4
ITS needs assessment results

Innovative Thinking Skills	Condition	Mean	SD	Level	$PNI_{modified}$		t-test		
					(I-D)/D	Rank	t	Sig.	Rank
Innovative Idea Generation	Expected (I)	4.16	0.01	High	0.16	3	19.01	<.00	2
	Actual (D)	3.37	0.02	Moderate					
Innovative Thinking Connectivity	Expected (I)	4.33	0.01	High	0.23	2	11.41	<.00	3
	Actual (D)	3.12	0.04	Moderate					
Innovative Technical Knowledge	Expected (I)	4.18	0.01	High	0.24	1	31.88	<.00	1
	Actual (D)	3.39	0.02	Moderate					
Total	Expected (I)	4.18	0.01	High	-	-	25.97	<.00	-
	Actual (D)	3.27	0.04	Moderate					

Sig.<.01, higher = 4.50-5.00, high=3.50-4.49, moderate=2.50-3.49

CPSS Needs Assessment Results

Table 5 presents the CPSS needs assessment by comparing the expected and actual conditions using $PNI_{modified}$ and t-test. The analysis shows that the expected level of creative problem-solving skills (I) was high, with a mean of 4.14, while the actual level (D) was high, with a mean of 3.09. The highest-ranked need identified by $PNI_{modified}$ was the *Creative Problem-Solving Processes/Steps*, followed by *Complex Problem-Solving*.

Table 5
CPSS needs assessment results

SPSS Essential Needs	Condition	Mean	SD	Level	Essential Needs Index		Hypothesis Tests Results		
					(I-D)/D	Rank.	t	Sig.	Rank.
Complex Problem Solving	Expected (I)	4.17	0.00	High	0.34	2	25.22	<.00	2
	Actual (D)	3.10	0.01	Moderate					
Creative Problem-Solving Processes/Steps	Expected (I)	4.19	0.00	High	0.35	1	78.61	<.00	1
	Actual (D)	3.10	0.00	Moderate					
Total	Expected (I)	4.14	0.00	High	-	-	48.38	<.00	-
	Actual (D)	3.09	0.01	Moderate					

Sig.<.01

DISCUSSION

Instructors' Perspectives on Students'

Instructors observed that students possess a high expected level of innovation thinking skills (I), while their actual skills (D) remain moderate, indicating a noticeable gap. The $PNI_{modified}$ analysis and the t-test results consistently identified the highest-priority need as innovative technical knowledge. This suggests that although students need innovative

thinking, their technical knowledge in this area requires significant enhancement to bridge the gap between expectations and reality.

This finding is consistent with Tan (2021), who emphasized that students with a solid foundation in innovative thinking are more likely to excel academically. Martinez-Sanchez and Vicente-Oliva (2023) highlighted how leading organizations globally prioritize hiring individuals proficient in innovative thinking and flexibility. This further underscores the critical importance of enhancing these skills among students. However, the results also align with Lauder and Mayhew (2020), who pointed out that many higher education students struggle to meet today's labor market innovation demands.

The gap between expected and actual innovation skills can be attributed to limited hands-on opportunities and practical training in technical innovation. These results indicate that innovative thinking skills, particularly technical knowledge, must be integrated more effectively into academic curricula to better prepare students for future career demands. Additionally, Barak and Yuan (2021) emphasize that exposure to real-world problems significantly enhances innovative technical knowledge, suggesting that a more practice-oriented educational model might help close this skills gap. Therefore, as Sumarno et al. (2023) have pointed out, emphasis needs to be placed on fostering a culture of innovation and sustainability.

Instructors' Perspectives on Students' CPSS

The results indicate that instructors perceive students' expected level of creative problem-solving skills (I) and performance (D) as high. The $PNI_{modified}$ analysis and the t-test revealed that the creative and complex problem-solving processes were the top needs for improvement. Although students perform relatively well in creative problem-solving, the significant gap between their expected and actual performance suggests that further enhancement is needed, particularly in structuring and optimizing the creative process.

This is because many students need help with the practical application of complex problem-solving steps. Hartmann et al. (2021) noted that even students with high theoretical knowledge often need help to apply creative problem-solving processes to real-world scenarios. This issue aligns with Lavi and Marti (2023), who suggested that creative problem-solving should be taught using case-based learning, allowing students to apply theoretical knowledge to realistic problems.

Furthermore, employers across various industries rank complex problem-solving among the most valuable skills (Carnevale et al., 2020; Danaher & Schoepp, 2020). This finding highlights the importance of teaching students the steps of problem-solving and ensuring that they can apply these steps in dynamic and complex environments.

The findings indicate a gap in technical innovation skills, a conclusion supported by the PNImodified analysis. This gap suggests a need for enhanced technical training within academic programs, aligning with similar observations by Martinez-Sanchez and Vicente-Oliva (2023).

Based on the identified gaps in Innovative Technical Knowledge, we recommend integrating real-world problem-solving exercises, as suggested by Barak and Yuan (2021). This approach could bridge the gap between expected and actual performance in technical innovation among students.

IMPLICATIONS

The gaps identified between expected and actual skill levels in innovative thinking and creative problem-solving underline the need for curriculum reform. Universities must focus on integrating more hands-on activities and real-world problem-solving opportunities into their programs. Lake et al. (2021) recommended incorporating cross-disciplinary projects to foster innovative thinking and creative problem-solving, as this approach encourages students to think more broadly and apply their skills across various contexts.

LIMITATIONS

The current study focuses on teachers within a specific geographic and academic context. Future studies could expand the geographic scope of their sample. Also, Tsang and Nguyen (2023) have suggested that cultural and institutional differences may influence the development of these skills. Therefore, cross-cultural studies could provide a more holistic view of innovation and problem-solving in higher education.

CONCLUSION

This study assessed the gap between the expected and actual levels of students' ITS and CPSS from the instructors' perspective. The findings revealed a significant discrepancy between expected and actual skill levels, particularly in *innovative technical knowledge* and *creative problem-solving processes*. This gap underscores the need for curriculum improvements emphasizing practical, real-world application of these skills. The study's results highlight the critical importance of developing both ITS and CPSS to meet the demands of today's labor market, as innovation and problem-solving abilities are increasingly sought after by employers across various industries. Incorporating experiential learning opportunities, case-based exercises, and cross-disciplinary projects into academic programs can help bridge the gap between practice and theory, ensuring students are better prepared for future careers.

Future research should expand the scope of this study by exploring a more diverse sample of educators and students across different academic disciplines and cultural contexts. In conclusion, addressing the skills gap in innovative thinking and creative problem-solving is vital for enhancing students' academic success and career readiness.

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