

Twenty-First Century Skills of Nursing Students at Mission Faculty of Nursing, Asia-Pacific International University

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Abstract

Aim/Purpose: The increasing complexity of global health-care systems, driven by rapid technological advancement, expanding cultural diversity, and continuous shifts in societal health demands, has intensified the need for nursing graduates equipped with strong 21st-century competencies. These include analytical literacy, communication proficiency, ICT capability, creativity, adaptability, collaboration, and cross-cultural understanding. Therefore, the present study aimed to examine and compare the perceived 21st-century skills of nursing students at the Mission Faculty of Nursing, Asia-Pacific International University, based on age, gender, cumulative grade point average (GPA), and year level.

Introduction/Background: This research is rooted in the growing emphasis on 21st-century learning frameworks within higher education, particularly in professional disciplines such as nursing. Thailand's education reforms highlight the importance of preparing learners for global competitiveness, guided by frameworks such as Panich's (2013) 3Rs, 8Cs, and 2Ls. However, empirical evidence regarding nursing students' perceived competency development in multicultural academic settings remains limited.

Methodology: A descriptive research design was employed. The population consisted of undergraduate nursing students enrolled in Thai and international programs during the second semester of the 2024 academic year. Convenience sampling yielded 275 participants. Data were collected using a 78-item questionnaire developed based on Panich's (2013) framework. The instrument demonstrated satisfactory content validity and excellent internal consistency (Cronbach's $\alpha = .99$). Descriptive statistics and one-way ANOVA were used for data analysis, with statistical significance set at $p < .05$.

Findings: The findings indicated that nursing students perceived their overall 21st-century skills at a good level (Mean = 4.06, $SD = .63$). When examined by framework components, Core Competencies for Modern Professional Practice (8Cs) demonstrated the highest overall mean score (Mean = 4.13, $SD = .71$), followed by Lifelong Learning and Leadership (2Ls) (Mean = 4.20, $SD = .74$), while Foundational Literacies (3Rs) showed the lowest mean score (Mean = 3.63, $SD = .74$), though still at a good level. At the domain level, Cross-cultural Understanding received the highest mean score, followed by Career & Learning Skills, Learning, and Computing & ICT Literacy, reflecting students' strengths in multicultural engagement, lifelong learning orientation, and digital readiness.

Contribution/Impact on Society: The study provides empirical evidence on the strengths and developmental needs of nursing students' 21st-century competencies. The findings emphasize the importance of cultural competence, lifelong learning orientation, and digital readiness, while also highlighting the need to strengthen foundational academic literacies to support evidence-based practice and global professional communication.

Recommendations: Nursing educators should integrate experiential learning, simulation, and technology-enhanced instructional strategies to further develop higher-order competencies. Targeted

interventions to strengthen reading and writing skills—particularly in English—should be embedded across the curriculum. Institutional support for faculty development in 21st-century skill-oriented pedagogy is also recommended.

Research Limitations: The use of convenience sampling and data from a single institution may limit generalizability. In addition, reliance on self-reported measures may introduce response bias.

Future Research: Future studies should employ longitudinal and multi-institutional designs to examine the developmental trajectories of 21st-century competencies and evaluate the effectiveness of specific pedagogical interventions in nursing education.

Keywords: *Twenty-first century skills, nursing students, ICT literacy*

Introduction

The 21st century has transformed the expectations of higher education and professional practice, particularly in fields that require rapid decision-making, human interaction, and technological engagement, such as nursing. Globalization, digitalization, demographic shifts, and the rising complexity of health-care systems have reshaped the competencies required for nurses to function effectively. Beyond clinical knowledge, contemporary nurses must possess cognitive flexibility, digital fluency, cross-cultural communication, and strong analytical reasoning—competencies widely recognized as 21st-century skills. Trilling and Fadel (2009) emphasize that these skills form the foundation for lifelong learning and professional adaptability, enabling individuals to interpret complex information, collaborate with diverse teams, and innovate across contexts. Similarly, the Partnership for 21st Century Learning (P21) framework emphasizes that learners must develop a combination of life and career skills, learning and innovation skills, and information, media, and technology skills to succeed in rapidly evolving environments (Stehle & Peters-Burton, 2019).

In Thailand, this global movement is reflected in the National Education Plan (2017–2036), which underscores the need to cultivate the 3Rs (Reading, wRiting, aRithmetic), 8Cs (Critical Thinking, Creativity, Collaboration, Communication, Cross-cultural Understanding, Career Skills, Compassion, and Computing), and 2Ls (Learning and Leadership) as core educational priorities (Office of the Education Council, Ministry of Education, 2017). Panich (2013) argues that these competencies underpin the development of responsible, flexible, and innovative citizens capable of responding effectively to societal and technological change. In health-care education, these expectations align with recommendations from the World Health Organization (WHO, 2021), which highlight the importance of strengthening digital literacy, communication, leadership, and decision-making skills to prepare future health professionals.

The Mission Faculty of Nursing at Asia-Pacific International University (AIU) serves a unique multicultural student population and has integrated these competencies into its curriculum. However, the degree to which students perceive themselves as competent in each domain remains insufficiently explored. Existing research suggests that 21st-century skill development varies across academic years due to differing levels of clinical exposure and experiential learning opportunities (Ortega-Galán et al., 2022; Yoder-Wise, 2019). Thus, evaluating nursing students' self-perceived competencies not only provides insight into individual preparedness but also reflects curriculum effectiveness, learning environmental quality, and institutional support mechanisms. The present study therefore situates itself at the intersection of educational development, behavioral competencies, and professional readiness—key areas of interest within human behavior and development scholarship.

Research Objectives

1. To study the perceived 21st-century skills of nursing students at the Mission Faculty of Nursing.
2. To compare the perceived 21st-century skills according to age, gender, GPA, and academic year.

Conceptual Framework

This study is guided by the 21st-century competencies framework proposed by Panich (2013), which integrates foundational literacies, core competencies, and lifelong learning dispositions. The framework comprises the 3Rs, 8Cs, and 2Ls, offering a structured lens for examining student preparedness for contemporary professional practice. This conceptualization is consistent with international frameworks, including the Partnership for 21st Century Learning (P21) framework, which emphasizes substantial alignment across models regarding the importance and scope of these competencies (Voogt & Roblin, 2012; Stehle & Peters-Burton, 2019).

The 3Rs: Foundational Literacies

The 3Rs—Reading, wRiting, and aRithmetic— represent essential literacies for acquiring and applying knowledge. Reading and writing support access to, interpretation of, and communication of disciplinary knowledge, while arithmetic underpins numeracy skills required for accurate clinical judgment and safe practice. Comparative analyses of international competency frameworks, including those articulated by P21, identify such foundational literacies as core elements across diverse educational systems, forming the basis for more complex competencies (Voogt & Roblin, 2012). Stehle and Peters-Burton (2019) further emphasize that foundational literacies remain critical for supporting higher-order thinking and problem-solving skills in professional education.

The 8Cs: Core Competencies for Professional Practice

The 8Cs extend beyond basic literacies to include higher-order competencies required in complex and dynamic environments. Critical thinking, creativity, communication, collaboration, intercultural understanding, digital competence, self-regulation, and adaptability closely correspond with the Core Competencies and Life and Career Skills domains of the P21 framework. Voogt and Roblin (2012) report strong horizontal consistency among global frameworks regarding what constitutes 21st-century competencies and why they are essential. Similarly, Stehle and Peters-Burton (2019) highlight that such competencies are central to preparing learners for real-world problem solving, interdisciplinary collaboration, and professional adaptability.

The 2Ls: Lifelong Learning and Leadership

The 2Ls highlight dispositions essential for sustained professional development. Learning emphasizes continuous development and reflective practice, while leadership focuses on influencing and guiding others toward shared goals. These dispositions align with the Lifelong Learning and Leadership dimensions emphasized within the P21 framework, which underscore continuous skill development as a foundation for professional resilience and adaptability. International curriculum analyses indicate that lifelong learning is a central rationale underlying 21st-century competency frameworks, even though gaps often remain between policy intentions and educational practice (Voogt & Roblin, 2012). Stehle and Peters-Burton (2019) further note that leadership and lifelong learning dispositions are critical for enabling professionals to respond effectively to complex societal and workplace challenges.

This framework informed the development of the research instrument, data interpretation, and analytical approach. It reflects contemporary perspectives—shared by P21 and other international frameworks—that view professional competence as an integration of knowledge, skills, and dispositions rather than isolated abilities (Voogt & Roblin, 2012; Stehle & Peters-Burton, 2019)

Table 1 *Conceptual Framework Summary*

Component	Description
3Rs	Reading, Writing, Arithmetic
8Cs	Critical Thinking, Creativity, Cross-cultural Understanding, Collaboration, Communication, Computing, Career Skills, Change
2Ls	Learning and Leadership

Methodology:

Population

The population consisted of nursing students enrolled in both the Thai and International Nursing Programs at the Mission Faculty of Nursing, Asia-Pacific International University, from Year 1 to Year 4, who were in the second semester of the 2024 academic year, totaling 302 students.

Sample size

The sample size was determined using the G*Power 3.1 program (Faul et al., 2007) for both Two-sample independent *t*-test and One-way ANOVA. The parameters were set at power = .95 and α = .05. For the *t*-test, the effect size (Cohen's *d*) was set at .50, and for the ANOVA, the effect size (Cohen's *f*) was set at .20 with α = .10.

The calculation indicated that approximately 208 participants were required for the *t*-test and 210 participants for the ANOVA. To ensure greater accuracy, this study used a sample size of 275 students.

Instrument

The research instrument was a questionnaire assessing the 21st-century skills of nursing students from both Thai and International Programs at the Mission Faculty of Nursing, Asia-Pacific International University, developed by the researcher.

Part 1: General information, including age, gender, study program, cumulative GPA, and academic year.

Part 2: Students' self-perception of their 21st-century skills, developed according to operational definitions for each domain. The content validity of the questionnaire was examined by three experts in nursing education and educational measurement. The Index of Item-Objective Congruence (IOC) was calculated for each item. Items with an IOC value below .60 were revised or removed based on expert recommendations. After revision, all retained items demonstrated IOC values ranging from .67 to 1.00, indicating acceptable to excellent content validity. The final questionnaire consisted of 11 domains with a total of 78 items.

Testing the reliability and validity of the instrument

After revision, the questionnaire was pilot tested with 20 nursing students from the same faculty who were not part of the study sample. This pilot testing was conducted to further evaluate the clarity and internal consistency of the revised items. The Cronbach's alpha coefficient for the overall questionnaire was .99, indicating excellent internal consistency.

Protection of Participants' Rights

According to the resolution of the meeting, No. RRDC 2025-66, this study was reviewed and approved by the **Human Research Ethics Committee of Asia-Pacific International University** on April 3, 2025. The researcher explained the research objectives, data collection procedures, and confidentiality measures to the participants. All data were treated confidentially and reported in aggregate form. Participation was voluntary, and students could withdraw or decline without affecting their academic performance. Participants were given the opportunity to ask questions before providing written informed consent to participate.

Data Collection Procedures

The researcher carried out the following steps:

1. Submitted a formal request for approval to collect data from the university's Research Ethics Committee.
2. Met with students from each academic year to explain the purpose and details of the questionnaire, requested their cooperation, and distributed the questionnaires.

Data Analysis

1. General information (e.g., year level) was analyzed using frequency and percentage.
2. 21st century skills were analyzed using mean and standard deviation.
3. Differences in mean scores of 21st century skills among students categorized by age, gender, GPA, and year level were analyzed using One-way ANOVA. The homogeneity of variance test showed that the variances of 21st century skills across year levels were not significantly different. Scheffé's method was used for post hoc pairwise comparisons.

Research Results

Research results are as follows:

Table 2 shows that most participants were students in the Thai program, totaling 245 (89.10%), while 30 (10.90%) were from the international program. Most participants were female, totaling 231 persons (84.00%), and 44 participants (16.00%) were male. The majority were second-year nursing students, totaling 110 people (40.00%). Most participants were 20 years old, totaling 79 persons (28.70%). Additionally, the majority had a cumulative GPA between 3.00–3.49, totaling 112 persons (40.70%).

Table 2 Demographic Characteristics (N = 275)

Characteristic	<i>n</i>	%
Program of study		
Thai Program	245	89.10
International Program	30	10.90
Gender		
Male	44	16.00
Female	231	84.00
Academic year		
Year 1	59	21.50
Year 2	110	40.00
Year 3	68	24.70
Year 4	38	13.80
Age		
19 years	33	12.00
20 years	79	28.70
21 years	78	28.40
22 years	36	13.10
23 years and above	49	17.80
CGPA		
1.00–1.99	19	3.30
2.00–2.49	31	11.30
2.50–2.99	71	25.80
3.00–3.49	112	40.70
3.50–4.00	52	18.90

Objective 1. To study the perceived 21st-century skills of nursing students at the Mission Faculty of Nursing.

The 21st-century skills of nursing students at the Mission Faculty of Nursing, Asia-Pacific International University, were examined at both the domain and overall levels. As presented in Table 3, all domains demonstrated mean scores at a “good” level, with mean values ranging from 3.63 to 4.32 and standard deviations ranging from .70 to .77. The overall 21st-century skills score was also rated at a “good” level ($\bar{x} = 4.06$, $SD = .63$).

According to Table 3, Cross-cultural Understanding demonstrated the highest mean score ($\bar{x} = 4.32$, $SD = .77$), followed by Career & Learning Skills ($\bar{x} = 4.27$, $SD = .70$) and Learning ($\bar{x} = 4.25$, $SD = .74$). The lowest mean score was observed in Foundational Literacies (3Rs) ($\bar{x} = 3.63$, $SD = .74$), although it remained at a good level.

Table 3 Mean Scores of 21st-Century Skills by Domain and Framework Component

Framework Component (Domain)	Mean	SD	Interpretation
Foundational Literacies (3Rs)			
3Rs	3.63	.74	Good
Core Competencies for Modern Professional Practice (8Cs)			
Critical Thinking & Problem Solving	3.84	.76	Good
Creativity & Innovation	3.85	.74	Good
Cross-cultural Understanding	4.32	.77	Good
Collaboration & Leadership	4.24	.71	Good
Communication & Media Literacy	4.10	.72	Good
Computing & ICT Literacy	4.24	.72	Good
Career & Learning Skills	4.27	.70	Good
Change Adaptability	4.14	.75	Good
Total Core Competencies for Modern Professional Practice (8Cs)	4.13	.71	Good
Lifelong Learning and Leadership (2Ls)			
Learning	4.25	.74	Good
Leadership	4.14	.74	Good
Total Lifelong Learning & Leadership (2Ls)	4.20	.74	Good
Overall 21st-Century Skills	4.06	.63	Good

Objective 2. To compare the 21st-century skills as perceived by nursing students of the Faculty of Nursing, Mission College, Asia-Pacific International University, according to differences in age, gender, cumulative grade point average, and academic year level.

From Table 4, the one-way ANOVA results comparing the 21st-century skills of nursing students at the Mission Faculty of Nursing, Asia-Pacific International University, by age group, revealed that most of the 21st-century skills—both overall and by sub-domains—did not differ significantly. The exception was Domain 7, Computer, Information Technology, and Communication Skills, which showed a statistically significant difference in mean scores among age groups at the .05 level ($F = 2.75$, $p = .028$).

Table 4 One-Way ANOVA of 21st-Century Skills by Age

Domain	F	p-value
3Rs	1.15	.329
Critical Thinking & Problem Solving	1.17	.321
Creativity & Innovation	.975	.421
Cross-cultural Understanding	1.44	.221
Collaboration & Leadership	1.97	.099
Communication & Media Literacy	1.11	.351
Computing & ICT Literacy	2.75	.028*

Domain	<i>F</i>	<i>p</i> -value
Career & Learning Skills	1.41	.230
Change Adaptability	1.79	.131
Learning	1.41	.229
Leadership	.98	.410
Overall	1.54	.189

Note. * $p < .05$

In Table 5, when pairwise comparisons were conducted using Scheffé's method, it was found that nursing students at Asia-Pacific International University across different age groups did not show statistically significant differences in Computer, Information Technology, and Communication Skills.

Table 5 *One-Way ANOVA of 21st-Century Skills by Gender*

Domain	<i>t</i>	<i>df</i>	<i>p</i> -value
3Rs	.05	273	.953
Critical Thinking & Problem Solving	.86	273	.389
Creativity & Innovation	1.09	273	.274
Cross-cultural Understanding	.38	273	.700
Collaboration & Leadership	-.20	273	.836
Communication & Media Literacy	-.26	273	.789
Computing & ICT Literacy	-.75	273	.452
Career & Learning Skills	-.84	273	.400
Change Adaptability	-.30	273	.760
Learning	.49	273	.621
Leadership	.83	273	.889
Overall	.00	273	.994

Note. * $p < .05$

From Table 6, the one-way ANOVA results comparing the 21st-century skills of nursing students at the Mission Faculty of Nursing, Asia-Pacific International University, classified by cumulative grade point average (GPA), revealed that the mean scores of most of the 11 skill domains and the overall average did not differ significantly. The exception was Domain 1, the 3R Skills (Reading, Writing, and Arithmetic), in which the mean scores differed significantly among GPA groups at the .01 level ($F = 4.19, p = .003$).

The pairwise comparison using Scheffé's method to identify GPA groups that differed in 3R skills showed that students with lower cumulative GPA (e.g., Group 1: $\bar{x} = 3.15$) had significantly lower mean scores in 3R skills than those with higher cumulative GPA (e.g., Group 4: $\bar{x} = 3.81$) at the .05 level. In contrast, most of the comparisons between other groups showed no statistically significant differences.

Table 6 *One-Way ANOVA of 21st-Century Skills by GPA*

Domain	<i>F</i>	<i>p</i> -value
3Rs	4.19	.003**
Critical Thinking & Problem Solving	2.10	.081
Creativity & Innovation	.70	.591
Cross-cultural Understanding	.44	.779
Collaboration & Leadership	.51	.726
Communication & Media Literacy	1.27	.308
Computing & ICT Literacy	2.23	.066

Domain	<i>F</i>	<i>p</i> -value
Career & Learning Skills	1.49	.204
Change Adaptability	.36	.833
Learning	.99	.412
Leadership	.89	.467
Overall	1.60	.174

Note. * $p < .05$, ** $p < .01$

From Table 7, the one-way ANOVA results comparing the 21st-century skills of nursing students at the Mission Faculty of Nursing, Asia-Pacific International University, classified by year of study, showed that overall 21st-century skills differed significantly by year of study ($F = 4.09$, $p = .007$).

At the domain level, the following skills demonstrated statistically significant differences:

- 3R Skills (Reading, Writing, and Arithmetic) at the .05 level ($F = 4.79$, $p = .003$)
- Collaboration, Teamwork, and Leadership ($F = 2.96$, $p = .033$)
- Communication, Information Literacy, and Media Literacy ($F = 3.19$, $p = .024$)
- Computer, Information Technology, and Communication Skills with a highly significant difference ($F = 6.41$, $p = .000$)
- Career and Learning Skills ($F = 3.93$, $p = .009$)
- Acceptance and Understanding of Change Skills ($F = 3.48$, $p = .016$)
- Learning Skills ($F = 2.71$, $p = .045$)
- Leadership ($F = 3.76$, $p = .011$)

Meanwhile, Critical Thinking and Problem-Solving, Creativity and Innovation, and Cross-Cultural Understanding Skills did not differ significantly by year of study ($p > .05$).

Table 7 One-Way ANOVA of 21st-Century Skills by Year of Study

Domain	<i>F</i>	<i>p</i> -value
3Rs	4.79	.003*
Critical Thinking & Problem Solving	1.77	.152
Creativity & Innovation	.88	.451
Cross-cultural Understanding	2.11	.099
Collaboration & Leadership	2.96	.033*
Communication & Media Literacy	3.19	.024*
Computing & ICT Literacy	6.41	.000*
Career & Learning Skills	3.93	.009*
Change Adaptability	3.48	.016*
Learning	2.71	.045*
Leadership	3.76	.011*
Overall	4.09	.007**

Note. * $p < .05$; ** $p < .01$

In summary, the findings indicate that nursing students across years of study differ in several 21st-century skill domains, particularly in Computer, Information Technology and Communication Skills, and basic 3R skills, while some skills, such as critical thinking and creativity, do not differ significantly.

From Table 8, Post-hoc pairwise comparison using Scheffé's method revealed that students in Year 1 and Year 4, as well as Year 2 and Year 4, had statistically significant mean differences in their 3R skills.

Table 8 *Post-hoc Pairwise Comparison of 3R Skills (Reading, Writing, Arithmetic) by Academic Year Using Scheffé's Method*

Academic Year	Mean	Year 1	Year 2	Year 3	Year 4
1	3.49	–	-.035	-.250	-.478*
2	3.52		–	-.215	-.443*
3	3.74			–	-.228
4	3.96				–

Note. * $p < .05$

The findings indicate that nursing students possessed overall good levels of 21st-century competencies, consistent with studies conducted in similar multicultural nursing programs (Ortega-Galán et al., 2022). The highest scores in digital competencies among students in this study align with the World Health Organization's Global Strategy on Digital Health 2020–2025, which underscores the importance of strengthening digital health competencies among health professionals to support effective use of technology in healthcare delivery (WHO, 2021).

The significantly higher competencies among fourth-year students further underscore the value of experiential learning and clinical immersion. Previous researchers (Trilling & Fadel, 2009; Yoder-Wise, 2019) have noted that hands-on practice strengthens higher-order thinking, communication, and collaboration skills. The developmental progression observed in this study highlights that competency building is cumulative and influenced by authentic practice environments.

However, the lowest scores in Reading and Writing—especially English literacy—signal persistent challenges. Limited academic English ability may restrict students' access to international research, reduce the quality of nursing documentation, and hinder effective communication in multicultural clinical settings. This finding mirrors national concerns about English proficiency among Thai nursing students and reinforces the need for targeted interventions in language development. In addition, although ICT literacy was high, students may still lack integrated digital research skills, such as synthesizing scientific evidence or engaging with international research databases.

Summary of Research Findings

This study examined the perceived 21st-century skills of nursing students at the Mission Faculty of Nursing, Asia-Pacific International University, and compared these skills according to selected demographic variables, in accordance with the stated research objectives.

Objective 1. To study the perceived 21st-century skills of nursing students at the Mission Faculty of Nursing.

The findings revealed that nursing students perceived their overall 21st-century skills at a good level. As shown in Table 3, the mean scores across all 11 skill domains ranged from 3.63 to 4.32, with standard deviations between .70 and .77, indicating moderate variability. The overall mean score for 21st-century skills was 4.06 ($SD = .63$), which was also interpreted as being at a good level.

Among the domains, Cross-cultural Understanding demonstrated the highest mean score ($\bar{x} = 4.32$, $SD = .77$), followed by Career and Learning Skills ($\bar{x} = 4.27$, $SD = .70$) and Learning Skills ($\bar{x} = 4.25$, $SD = .74$). These findings suggest that students perceived themselves as particularly competent in working within multicultural contexts and in adapting to career-related learning demands.

In contrast, Foundational Literacies (3Rs: Reading, Writing, and Arithmetic) showed the lowest mean score ($\bar{x} = 3.63$, $SD = .74$). Although this domain remained within the good level, it represented a relative weakness compared with other skill areas, indicating a potential need for further academic skill enhancement.

Objective 2. To compare the 21st-century skills according to age, gender, cumulative grade point average, and academic year level.

The comparative analysis revealed that most demographic variables were not associated with significant differences in overall 21st-century skills.

Regarding age, the one-way ANOVA results in Table 4 indicated no statistically significant differences in overall 21st-century skills or most sub-domains. However, a significant difference was found in Computing, Information Technology, and Communication Skills ($F = 2.75, p = .028$). Subsequent post-hoc analysis using Scheffé's method (Table 5) did not identify statistically significant pairwise differences among age groups, suggesting that the observed variation was limited.

In terms of gender, the independent t-test results showed no statistically significant differences between male and female students across all skill domains and the overall score (Table 5), indicating comparable perceptions of 21st-century skills regardless of gender.

When classified by cumulative grade point average (GPA), the findings in Table 6 demonstrated that, overall, 21st-century skills did not differ significantly among GPA groups. Nonetheless, a significant difference was observed in Foundational Literacies (3Rs) ($F = 4.19, p = .003$). Post-hoc comparisons revealed that students with higher GPAs reported significantly stronger 3R skills than those with lower GPAs, highlighting the relationship between academic performance and basic literacy competencies.

In contrast, academic year level showed the most pronounced differences. As presented in Table 7, the overall 21st-century skills score differed significantly across year levels ($F = 4.09, p = .007$). Significant differences were also observed in multiple domains, including 3R Skills, Collaboration and Leadership, Communication and Media Literacy, Computing and ICT Literacy, Career and Learning Skills, Change Adaptability, Learning Skills, and Leadership. Post-hoc analysis using Scheffé's method (Table 8) indicated that fourth-year students consistently demonstrated higher mean scores than first- and second-year students, particularly in 3R skills.

These findings suggest that 21st-century skill development progresses with academic advancement and clinical exposure, while certain competencies—such as critical thinking, creativity, and cross-cultural understanding—remain relatively stable across year levels.

Discussion

This study examined nursing students' perceived 21st-century skills using a conceptual framework consisting of Foundational Literacies (3Rs), Core Competencies for Modern Professional Practice, and Lifelong Learning and Leadership. As summarized in Table 3, students demonstrated good overall competency across all three components, with clear variation among specific domains.

Foundational Literacies (3Rs)

As shown in Table 3, Foundational Literacies (3Rs) yielded the lowest mean score among the three framework components, although the level remained "good." This finding is consistent with previous research indicating that reading and writing—particularly in English—remain challenging for nursing students in non-English-speaking contexts (Eden et al., 2021). Limited exposure to English academic materials and reliance on Thai-language resources may contribute to this pattern. Limited literacy, particularly limited health literacy, can constrain individuals' ability to access, understand, and use health information for evidence-based decision-making and effective communication, especially in multicultural healthcare contexts (Baumeister et al., 2021).

Core Competencies for Modern Professional Practice

Table 3 indicates that Core Competencies for Modern Professional Practice recorded the highest overall mean score, highlighting this component as a key strength of the students. Of all domains within this component, Cross-cultural Understanding achieved the highest mean score, followed by Career & Learning Skills and Computing & ICT Literacy. These findings are particularly relevant in the current era, as nurses are increasingly required to operate in culturally diverse and technologically advanced healthcare systems.

The high score in Cross-cultural Understanding may reflect the multicultural learning environment of the institution, which promotes frequent intercultural interaction and awareness. This aligns with findings from multicultural nursing education contexts, where exposure to diverse peers enhances

cultural competence (Ortega-Galán et al., 2022). Similarly, strong performance in Computing & ICT Literacy suggests that students are well prepared for digital health practices, including electronic health records, telehealth, and technology-assisted clinical decision-making (Panich, 2013; Yoder-Wise, 2019). High Career & Learning Skills further indicate students' adaptability and readiness for continuous professional development in rapidly evolving healthcare settings.

Lifelong Learning and Leadership

According to Table 3, the Lifelong Learning and Leadership component also demonstrated high mean scores, particularly in the Learning domain. These results suggest that students have a strong orientation toward self-directed learning and professional growth, both of which are essential for sustaining competence throughout their nursing careers (Trilling & Fadel, 2009).

Differences Across Academic Year Levels

When examining differences by academic year (Table 7), fourth-year students demonstrated significantly higher overall 21st-century skills and higher scores in multiple domains. This finding supports experiential learning theory, which posits that competencies develop progressively through real-world practice (Kolb, 1984). Senior nursing students typically engage more intensively in clinical placements, leadership roles, and interprofessional collaboration, which enhance applied skills such as communication, adaptability, and digital competence (Benner et al., 2010; Salamonson et al., 2011). However, Critical Thinking & Problem Solving, Creativity & Innovation, and Cross-cultural Understanding did not differ significantly across academic years (Table 7). This suggests that these competencies may be embedded early in the curriculum and reinforced consistently rather than developing progressively by year level. Prior studies indicate that without targeted pedagogical interventions, critical thinking may remain stable over years of study, while creativity and cultural competence are shaped by ongoing learning experiences and institutional context (Azizi-Fini et al., 2015; Chan, 2013).

Summary of Implications

Overall, the findings highlight that nursing students demonstrated strong competencies in areas essential for contemporary professional practice, particularly cross-cultural understanding, digital literacy, and lifelong learning. At the same time, the relatively lower performance in foundational literacies underscores the need for targeted strategies to strengthen reading and writing skills, especially in English. These results provide important insights for curriculum planners and nursing educators seeking to balance foundational skills with advanced professional competencies to prepare graduates for complex, globalized healthcare environments.

Conclusion

This study demonstrated that nursing students at the Mission Faculty of Nursing possess overall good levels of 21st-century competencies across all three components of the conceptual framework: Foundational Literacies (3Rs), Core Competencies for Modern Professional Practice, and Lifelong Learning and Leadership. Among these, Core Competencies for Modern Professional Practice exhibited the highest overall performance, with particularly strong scores in Cross-cultural Understanding, Computing and ICT Literacy, and Career & Learning Skills, underscoring students' readiness for multicultural and technology-driven healthcare environments.

Differences by academic year indicate that experiential learning and clinical immersion contribute significantly to competency development, as reflected in higher overall scores among fourth-year students. However, the absence of year-level differences in Critical Thinking & Problem Solving, Creativity & Innovation, and Cross-cultural Understanding suggests that these competencies may be cultivated consistently throughout the curriculum rather than developing incrementally by year level.

Despite generally positive findings, Foundational Literacies—particularly reading and writing skills—remained comparatively weaker, highlighting an ongoing need for targeted academic literacy

support. Overall, the findings emphasize the importance of intentional curricular integration of digital competence, cultural awareness, lifelong learning, and leadership development to ensure nursing graduates are well prepared to meet the complex demands of contemporary and global healthcare systems.

Recommendations

Based on the study's findings, several recommendations are proposed for nursing educators, curriculum developers, and institutional leaders:

1. Curriculum Enhancement for 21st-Century Competencies

Integrate explicit instruction and assessment of 21st-century skills—particularly critical thinking, communication, digital literacy, and leadership—across all courses and clinical modules. Embedding these competencies into course learning outcomes and clinical evaluation tools will ensure consistent skill development throughout the program.

2. Strengthening English Literacy and Academic Communication

Develop targeted English-language interventions, such as academic writing workshops, English-medium case discussions, and access to online writing laboratories. Faculty may incorporate more English-based readings, reflective summaries, and evidence-based practice assignments to improve both literacy and professional communication.

3. Expanding Digital and ICT Learning Opportunities

Increase the use of simulation technologies, electronic health records, virtual case studies, and digital collaboration platforms. Providing hands-on ICT activities early in the curriculum will enhance technological confidence and readiness for digital healthcare environments.

4. Faculty Development on Innovative Pedagogies

Offer professional development programs for instructors focusing on active learning, inquiry-based learning, simulation pedagogy, and digital teaching strategies. Faculty confidence and competence in innovative teaching strongly influence student skill development.

5. Foster Inter-professional and Cross-Cultural Learning

Collaborate with other health science programs and international partners to provide inter-professional education (IPE), exchange learning, and multicultural experiences. Such opportunities strengthen teamwork, cultural intelligence, and global readiness.

6. Longitudinal Competency Monitoring

Implement a system for tracking students' 21st-century skill progression across all four year levels using standardized assessments. Longitudinal data will support curriculum refinement and targeted interventions for specific skill gaps.

Limitations

Several limitations should be considered when interpreting the findings. First, the study employed a self-report questionnaire, which may be subject to response bias and may not fully capture students' actual performance or behavioral competencies. Second, the study was conducted at a single private university, limiting the generalizability of results to other institutions with different contexts, curricula, or student demographics. Third, the cross-sectional design does not allow for conclusions regarding changes in competencies over time or causal relationships. Finally, although the instrument demonstrated excellent internal consistency, it relied on students' perceptions rather than objective assessments of skill proficiency.

Future Research Directions

Future studies should consider employing mixed-methods or performance-based assessments to validate students' actual competencies in real or simulated environments. Longitudinal research is recommended to track the development of 21st-century skills across different year levels and identify factors influencing growth. Comparative studies across multiple nursing institutions, both domestic and international, would enhance external validity and allow benchmarking of nursing students'

competencies. Additionally, intervention-based research—such as implementing digital learning modules, English literacy programs, or simulation-based leadership training—could evaluate the effectiveness of targeted strategies for improving specific skill domains. Exploring faculty perspectives and institutional factors would also deepen understanding of how learning environments shape the development of 21st-century competencies.

Author Contributions

Pornpan Saminpanya: Conceptualization, data curation, formal analysis, funding acquisition, investigation, methodology, project administration, resources, software, supervision, validation, writing – original draft, writing – review & editing; **Nirassiri Rojanadhamakul:** Data curation, investigation, methodology, project administration, resources, software, supervision, validation, writing – original draft.

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