

ORIGINAL RESEARCH

# Factors Associated with Creativity and Innovation among Undergraduate Nursing Students



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## Abstract

**Background:** Creativity and innovation are essential competencies in nursing education, as they support problem-solving, critical thinking, and adaptability in dynamic healthcare environments. However, limited evidence exists on factors associated with creativity and innovation among undergraduate nursing students.

**Purpose:** This study aimed to examine the association between selected sociodemographic and academic characteristics (age, gender, cumulative grade point average [CGPA], year of study, and exposure to creativity- and innovation-related courses) and creativity and innovation among undergraduate nursing students.

**Methods:** This cross-sectional study was conducted among undergraduate nursing students at a public university in Malaysia. Using total sampling, 167 students were included. Data were collected using a structured questionnaire. Descriptive statistics were used to summarise the variables. Pearson correlation, independent t-test, and one-way ANOVA were performed to examine associations, with significance set at  $p < 0.05$ .

**Results:** A total of 167 undergraduate nursing students were included. The mean total creativity and innovation score was 27.56 (SD = 0.79). Male students and those who had attended creativity- and innovation-related courses had significantly higher scores ( $p = 0.007$  and  $p < 0.001$ , respectively). Creativity and innovation scores were positively correlated with CGPA ( $r = 0.188$ ,  $p = 0.015$ ) and negatively correlated with age ( $r = -0.162$ ,  $p = 0.036$ ), with no significant difference by year of study ( $p = 0.872$ ).

**Conclusion:** Creativity and innovation among undergraduate nursing students were significantly associated with gender, attendance in creativity- and innovation-related courses, CGPA, and age, but not with year of study. These findings suggest that both academic performance and educational exposure may play a role in shaping creativity and innovation competency, underscoring the importance of supportive learning experiences in nursing education.

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## 1. Introduction

Creativity and innovation are essential components of nursing education, as they support the development of problem-solving abilities, critical thinking, and adaptability in complex healthcare settings (El-Sayed et al., 2024; Liu, 2022b). In nursing practice, these competencies are valuable for helping future nurses respond effectively to changing patient needs, improve care processes, and adapt to evolving clinical environments (Bahari et al., 2021; Cheraghi et al., 2021; Toscano et al., 2023). Therefore, nursing education should not only focus on clinical knowledge and technical competence but also encourage the development of creativity and innovation among student (Can Özdemir & Işık, 2022; Chen, 2024; Chooaha et al., 2022). Creativity and innovation among nursing students may vary by personal and educational characteristics (Bodla et al., 2018; Dackert, 2016; Liu et al., 2021a, 2024). Sociodemographic and academic factors such as gender and participation in learning-related activities have been reported to influence students' creativity and innovation-related capacities (Can Özdemir & Işık, 2022; Liu et al., 2021a, 2024; Moser et

al., 2019). Nevertheless, a previous study reported no significant association between age and gender toward student creativity (Dackert, 2016). Educational exposure, including structured innovation-related learning activities, may also contribute to the development of innovative thinking and related skills among nursing students (Chooaha et al., 2022).

Recent evidence suggests that creativity among nursing and midwifery students is influenced by educational and interpersonal factors (Liu, 2022a). In interprofessional learning settings, team creativity among nursing students has been associated with collaborative processes such as swift trust, spontaneous communication, helping behaviour, and lower task conflict, indicating that team interaction plays an important role in creative outcomes (Liu, 2022a). Similarly, another study in interprofessional education reported that nursing students who perceived higher team creativity reported better interaction behaviours and lower process conflict, with spontaneous communication and task conflict identified as significant predictors of perceived team creativity (Liu et al., 2021b). Beyond team-based learning, a study among midwifery students found differences in specific dimensions of trait creativity, particularly imagination, suggesting that creativity-related characteristics may vary across student groups (Li & He, 2023). In addition, a course-based study reported that participation in a decorative arts course contributed to the development of creativity and critical thinking among nursing students, highlighting the possible role of educational exposure in fostering these competencies (Taşdelen Baş et al., 2022).

However, several important gaps remain. First, much of the existing evidence focuses on team creativity in interprofessional or project-based settings rather than on individual creativity and innovation competency among undergraduate nursing students, as seen in the studies by Liu (2022a) and Liu et al. (2021b). Second, prior studies have examined different but related constructs, such as team creativity, trait creativity, and creative thinking dispositions, using different instruments and educational contexts, which limits comparability across findings, as illustrated by Li and He (2023) and Taşdelen Baş et al. (2022). Third, many studies have concentrated on contextual or intervention-related factors, such as trust, communication, conflict, and specific courses, while less is known about whether commonly measured student characteristics, such as age, gender, academic performance, year of study, and exposure to creativity and innovation-related courses, are associated with creativity and innovation competency among undergraduate nursing students (Bodla et al., 2018; Can Özdemir & Işık, 2022; Dackert, 2016; Liu et al., 2021a, 2024; Moser et al., 2019).

Although some studies have explored nursing students' attitudes or general perceptions of creativity and innovation (Can Özdemir & Işık, 2022), fewer have examined the association between selected sociodemographic and academic characteristics and creativity and innovation competency (Bodla et al., 2018; Dackert, 2016). This gap is important because understanding whether commonly measured student characteristics are associated with creativity and innovation may help inform nursing education strategies and identify areas requiring further exploration. Therefore, this study aimed to examine the association between age, gender, cumulative grade point average (CGPA), year of study, and attendance in creativity and innovation-related courses and creativity and innovation competency among undergraduate nursing students.

## **2. Methods**

### **2.1 Research design**

This study used a cross-sectional design to examine the association between selected sociodemographic and academic characteristics and creativity and innovation competency among undergraduate nursing students at a public university in Malaysia. The independent variables included age, gender, year of study, current CGPA, and attendance in a creativity and innovation-related course. The dependent variable was the Creativity and Innovation Effectiveness Profile (CIEP) score. This design was considered appropriate because it enables measurement of variables at a single point in time and supports the examination of associations between variables in a relatively efficient and practical manner. The selection of age, gender, year of study, CGPA, and attendance in creativity and innovation-related courses was informed by previous studies (Can Özdemir & Işık, 2022; Liu et al., 2021a, 2024; Moser et al., 2019), indicating that personal, academic, and educational exposure variables may be associated with creativity-related outcomes among nursing and health professions students.

## 2.2 *Setting and samples*

This study was conducted at a public university in Malaysia. The study population consisted of all undergraduate nursing students enrolled in years 1 to 3 of the nursing program during the study period. The total population frame comprised 167 students, and a total sampling approach was used by inviting all eligible students to participate (Canonizado, 2024). Inclusion criteria included undergraduate nursing students enrolled during the study period who provided informed consent. Students who declined participation during data collection or returned incomplete questionnaires were not included in the final analysis.

## 2.3 *Measurement and data collection*

Data were collected using a self-administered structured questionnaire consisting of two sections. Section A collected participants' sociodemographic and academic information, including age, gender, year of study, CGPA, and attendance in creativity- and innovation-related courses. Age and CGPA were collected as open-ended responses, while gender, year of study, and attendance of creativity and innovation-related courses were collected as categorical variables.

Section B consisted of the Creativity and Innovation Effectiveness Profile (CIEP), a self-administered questionnaire in its original English version, which has undergone international validation and has been used in various educational settings (Warner, 2004). No translation was required because English is the medium of instruction in the nursing programme, and students are required to meet the minimum English language proficiency requirement for programme entry.

The CIEP comprises seven domains: creative consciousness, levels of curiosity, pattern-breaking skills, idea-nurturing ability, willingness to experiment and take risks, levels of courage and resilience, and energetic persistence. Each domain contains 12 items rated on a five-point Likert scale, ranging from 1 (rarely) to 5 (almost always). For each domain, item scores were averaged to obtain a domain score ranging from 1 to 5. The total CIEP score was calculated by summing the seven domain scores, yielding a possible score range from 7 to 35. Higher scores indicate higher creativity and innovation competency.

The psychometric properties of the instrument were assessed before the main data collection. Test-retest reliability was conducted over a two-week interval and demonstrated good stability, with a correlation coefficient of  $r = 0.84$ ,  $p < 0.05$ . Content validity was assessed by five experts in innovation-related student assessment. All experts rated the CIEP items as representative, appropriate, and clear, yielding excellent content validity indices, with an item-level content validity index of 1.00 for all items and a scale-level content validity index based on the average method of 1.00.

A preliminary pilot study was conducted among 30 diploma nursing students from another nursing institution who were not included in the main study. The overall CIEP demonstrated acceptable internal consistency, with a Cronbach's alpha of 0.75. At the domain level, Cronbach's alpha coefficients were 0.69 for creative consciousness, 0.85 for levels of curiosity, 0.80 for pattern-breaking skills, 0.80 for idea-nurturing ability, 0.92 for willingness to experiment and take risks, 0.62 for courage and resilience levels, and 0.89 for energetic persistence. These findings indicate that most domains demonstrated acceptable to excellent internal consistency, although lower reliability was observed for creative consciousness and courage and resilience levels.

Data collection was conducted between September and December 2020, following ethical approval from the institutional ethics committee and permission from the nursing department. The researcher coordinated with the nursing programme to schedule the data collection session. The questionnaires were administered in paper-and-pencil format in the faculty's main auditorium during a scheduled session. Before data collection, the researcher explained the purpose of the study, informed students that participation was voluntary, and obtained written informed consent from those who agreed to participate. The questionnaire required less than 20 minutes to complete. To protect confidentiality and minimise potential bias associated with data collection in an academic setting, students were informed that their participation or non-participation would not affect their academic standing. They were also assured that their responses would be kept confidential and used only for research purposes. Questionnaires were completed individually, and no identifying personal information was collected. Completed

questionnaires were returned in sealed envelopes to help maintain confidentiality and reduce the influence of peers or lecturers on students' responses.

#### 2.4 Data analysis

Data were analysed using IBM SPSS Statistics version 30.0. Data were first screened for completeness, accuracy, and missing values before analysis. Descriptive statistics were used to summarise participants' sociodemographic and academic characteristics. Continuous variables, including age, CGPA, domain scores, and total CIEP score, were summarised using mean and standard deviation. Categorical variables, including gender, year of study, and attendance in creativity- and innovation-related courses, were presented as frequency and percentage.

The total CIEP score was used as the main outcome variable in the inferential analysis. Pearson correlation analysis was used to examine the association between the total CIEP score and the continuous variables, namely age and CGPA. An independent samples t-test was used to compare the total CIEP score between two groups defined by categorical variables, including gender and attendance in creativity- and innovation-related courses. One-way analysis of variance (ANOVA) was used to compare the total CIEP score across years of study. Prior to inferential analysis, the assumptions for parametric tests were assessed. Normality was examined using appropriate descriptive and graphical methods, while homogeneity of variance was assessed for group comparisons. Statistical significance was set at  $p < 0.05$ .

#### 2.5 Ethical considerations

Ethical approval was granted by the Medical Research Ethics Committee on 25 September 2020 (Reference No. JKEtika 4/20 [7]). Permission to conduct the study was obtained from the nursing program coordinator. Data collection was conducted in the faculty's main auditorium to facilitate access to eligible students; however, several measures were taken to minimise any perceived pressure to participate. Students were clearly informed that participation was voluntary, that they could choose not to participate, and that they were free to leave the hall without penalty. They were also assured that non-participation would not affect their grades, academic standing, or access to faculty and university benefits. Informed consent was obtained before participation. No names or personal identifiers were recorded on the questionnaires, and completed forms were returned in sealed envelopes to maintain anonymity and confidentiality.

### 3. Results

#### 3.1 Characteristics of the participants

As shown in [Table 1](#), a total of 167 participants were included in the analysis. The participants had a mean age of 19.48 years (SD = 1.73) and a mean CGPA of 3.39 (SD = 0.35). The majority were female (72.5%), in Year 1 (50.9%), and reported not having attended any creativity- and innovation-related courses (64.1%).

**Table 1.** Sociodemographic of the participants (n=167)

Variables	Categories	Frequency (f)	Percentage (%)
Age	Mean = 19.47; SD = 1.76		
CGPA	Mean = 3.37; SD = .32		
Gender	Male	46	27.5
	Female	121	72.5
Year of study	Year 1	85	50.9
	Year 2	43	25.7
	Year 3	39	23.4
Attendance in creativity- and innovation-related courses	Yes	60	35.9
	No	107	64.1

#### 3.2 Total Creativity and Innovation Effectiveness Profile (CIEP) score

[Table 2](#) below shows that the mean total CIEP score was 27.56 (SD = 0.79), with a minimum of 25.43 and a maximum of 30.00. At the domain level, the highest mean score was observed for creative consciousness (mean = 4.16, SD = 0.44), followed by willingness to experiment and take risks (mean = 4.01, SD = 0.21), pattern breaking skills (mean = 4.00, SD = 0.34), energetic

persistence (mean = 3.97, SD = 0.19), courage and resilience levels (mean = 3.97, SD = 0.32), idea nurturing ability (mean = 3.76, SD = 0.21), and levels of curiosity (mean = 3.71, SD = 0.23).

**Table 2.** Mean scores for each domain of the Creativity and Innovation Effectiveness Profile (CIEP)

Domains	Mean	SD
Creative consciousness	4.16	.44
Levels of curiosity	3.71	.23
Pattern breaking skills	4.00	.34
Idea nurturing ability	3.76	.21
Willingness to experiment and take risks	4.01	.21
Courage and resilience levels	3.95	.19
Energetic persistence	3.97	.19
Total CIEP Score	27.56	.79

*Notes.* The CIEP consists of seven domains: Creative Consciousness, Levels of Curiosity, Pattern-Breaking Skills, Idea-Nurturing Ability, Willingness to Experiment and Take Risks, Courage and Resilience Levels, and Energetic Persistence. Each domain score shown in this table is the average of 12 items rated on a 5-point Likert scale (1 = rarely to 5 = almost always). Higher scores indicate higher creativity and innovation competency in that domain. The total CIEP score is the sum of all seven domain scores (Minimum score = 7; Maximum Score = 35).

### 3.3 Association between age, cumulative grade point average (CGPA), and total Creativity and Innovation Effectiveness Profile (CIEP) score

Table 3 presents the Pearson correlation analysis, which indicates that the total CIEP score was significantly and positively correlated with CGPA ( $r = 0.188$ ,  $p = 0.015$ ), suggesting that students with higher CGPA tended to report slightly higher creativity and innovation scores. In contrast, the total CIEP score was significantly and negatively correlated with age ( $r = -0.162$ ,  $p = 0.036$ ), suggesting that older students tended to report slightly lower creativity and innovation scores. Both relationships were weak in strength.

**Table 3.** Pearson correlations between age, CGPA, and total CIEP score (n = 167)

Variables	Pearson Correlation		Interpretation of Cohen's correlation
	<i>p</i>	<i>r</i>	
Age	.036*	-.162	Negative correlation, small effect
Cumulative Grade Point Average (CGPA)	.015*	.188	Positive correlation, small effect

*Notes.* The Cohen's Correlation: Small effect,  $r = 0.10$  to  $0.29$ ; Medium effect,  $r = 0.30$  to  $0.49$ ; Large effect,  $r = 0.50$  and above

### 3.4 Comparison of total CIEP score by gender, attendance in creativity- and innovation-related courses, and year of study

#### 3.4.1 Gender

Table 4 shows that an independent-samples t-test indicated a significant difference in total CIEP scores between male and female students. Male students had a significantly higher mean score ( $M = 27.83$ ,  $SD = 0.81$ ) than female students ( $M = 27.46$ ,  $SD = 0.76$ ),  $t(165) = 2.73$ ,  $p = 0.007$ . The effect size was moderate (Cohen's  $d = 0.47$ ).

#### 3.4.2 Attendance in creativity and innovation-related courses

Table 4 also shows that an independent-samples t-test indicated a significant difference in total CIEP score according to attendance in a creativity- and innovation-related course. Students who had attended such a course reported significantly higher mean scores ( $M = 27.87$ ,  $SD = 0.84$ ) than those who had not attended ( $M = 27.39$ ,  $SD = 0.71$ ),  $t(164) = -3.89$ ,  $p < 0.001$ . The effect size was moderate (Cohen's  $d = 0.64$ ).

**Table 4.** Comparison of total CIEP score by gender and by attendance of creativity and innovation-related course (n = 167)

Variables	t-test of Equality		t	df	p	Cohen's d
	Means					
	Mean Difference	SE difference				
Gender	.36	.13	2.73	165	.007*	0.47
Attendance in creativity- and innovation-related courses	-.48	.12	-3.89	164	<.001**	0.64

Notes. \* $p < .05$ ; \*\* $p < .001$  – significant ; Cohen's d : 0.2 = small effect; 0.5 = medium effect and 0.8 = large effect.

### 3.4.3 Year of study

The one-way ANOVA result in [Table 5](#) indicated no significant difference in total CIEP scores across year of study,  $F(2,164) = 0.14$ ,  $p = 0.87$ . The mean scores were 27.57 (SD = 0.83) for Year 1, 27.51 (SD = 0.76) for Year 2, and 27.60 (SD = 0.75) for Year 3.

**Table 5.** Comparison of total CIEP score by year of study (n = 167)

Source of Variation	SS	df	MS	F	p
Between group	171	2	.086	.14	.87
Within group	102.97	164	.63		
Total	103.14	166			

Notes. \* $p < .05$ ; \*\* $p < .001$  – significant

## 4. Discussion

This study examined the creativity and innovation competency profile of undergraduate nursing students and its association with selected sociodemographic and academic characteristics. Overall, the respondents demonstrated a relatively high mean total CIEP score, suggesting that the students possessed a generally favourable level of creativity and innovation competency. Among the seven domains, creative consciousness had the highest mean score, whereas levels of curiosity had the lowest. This pattern may indicate that although students perceived themselves as aware of creative thinking and open to innovation, their curiosity and exploratory tendencies may require further strengthening through educational strategies that promote questioning, inquiry, and active engagement in learning.

The findings showed that CGPA was positively correlated with total CIEP score, although the relationship was weak. This finding is consistent with previous studies ([Bodla et al., 2018](#); [Dackert, 2016](#); [Liu et al., 2021a, 2024](#)), which suggest that educational characteristics may be associated with student creativity and innovative thinking. This suggests that students with better academic performance may also demonstrate slightly higher creativity and innovation competency. One possible explanation is that students with stronger academic achievement may be better able to integrate knowledge, engage in reflective thinking, and apply what they learn in flexible ways. These abilities may support both academic success and creativity-related competency. This finding is consistent with our view that creativity in nursing education should not be seen as separate from academic development, but rather as part of a broader capacity for critical thinking, problem-solving, and adaptive learning. However, given the small effect size, CGPA should not be interpreted as a strong predictor of creativity and innovation. Instead, it may represent only one of several contributing factors.

Age was negatively correlated with the total CIEP score, although the relationship was weak. This finding suggests that older students in this sample tended to report slightly lower creativity and innovation scores than younger students. One possible explanation is that younger students may be more open to curiosity, exploration, and new learning experiences ([Sobel & Letourneau, 2018](#); [Taheri & Nasiri, 2024](#)), which could support innovative thinking and problem-solving skills. However, this interpretation should be made cautiously. Although direct evidence comparing junior and senior nursing students remains limited, the present finding suggests that

openness to exploration warrants further investigation regarding creativity and innovation among nursing students. Another possible explanation is that the age variation in this sample was relatively narrow; therefore, the observed relationship should be interpreted with caution. Given the small effect size, this result does not indicate a major age-related difference, but it may point to the value of further exploring how learning experiences, openness to new ideas, and academic adaptation differ across student groups.

A significant difference in total CIEP scores by gender was observed, with male students reporting higher scores than female students. Although this difference was statistically significant, the effect size was small to moderate and should therefore be interpreted with caution. The finding may reflect differences in self-perception, confidence in expressing creative ability, or learning experiences rather than a true difference in creativity potential. Since the proportion of female students was much larger than that of male students in this study, the imbalance in group size should also be considered when interpreting the results. Previous studies have also reported that gender may be associated with creativity- and innovation-related outcomes among nursing students, although the direction and strength of this relationship have not been consistent across studies (Can Özdemir & Işık, 2022; Liu et al., 2021a, 2024; Moser et al., 2019).

Students who had taken creativity and innovation-related courses reported significantly higher total CIEP scores than those who had not. This finding is consistent with evidence that structured educational exposure and experiential learning enhance students' problem-solving ability, innovation readiness, and adaptive thinking in clinical practice (Brewster et al., 2022; Rylee & Cvanagh, 2023). This finding is particularly important because it suggests that educational exposure may play a meaningful role in supporting creativity and innovation competency among nursing students. Compared with other significant findings in this study, course attendance showed a more pronounced group difference. This supports the view that creativity and innovation can be nurtured through structured educational experiences rather than being treated solely as personal traits. Learning activities that expose students to idea generation, experimentation, problem-solving, and innovation-related tasks may help strengthen their confidence and readiness to think beyond routine practice. Integrative reviews in nursing education also highlight that targeted training and access to innovation-related resources are associated with stronger creative performance and professional preparedness (Ma et al., 2018).

In contrast, no significant difference in total CIEP score was found across years of study. This may suggest that progression through the nursing programme alone does not necessarily lead to higher creativity and innovation competency. One possible explanation is that creativity and innovation are not automatically strengthened by advancing academic years unless they are intentionally embedded in teaching methods, learning activities, and assessment design. If the curriculum remains heavily content-based and examination-oriented, students may have limited opportunities to develop curiosity, engage in experimentation, and foster innovative thinking over time. Previous literature emphasizes that supportive educational climates, adequate resources, and mentorship are critical to nurturing creativity and sustaining innovative behaviours (Richardson & Mishra, 2018; Wang & Shibayama, 2022). Without such environments, traditional examination-oriented and risk-averse educational systems may inadvertently discourage experimentation and creative risk-taking. This finding highlights the importance of explicitly integrating creativity and innovation into the curriculum, rather than assuming that these competencies will develop naturally through general academic progression.

In summary, this study suggests that creativity and innovation competency among undergraduate nursing students is associated with age, CGPA, gender, and attendance in creativity- and innovation-related courses, with no differences across years of study. Among these findings, exposure to creativity- and innovation-related courses offers the clearest educational implication, as it supports the potential value of structured learning opportunities in fostering these competencies. Nursing educators should therefore consider strengthening the curriculum content and learning experiences to actively promote creativity, innovation, and inquiry in undergraduate nursing education.

## **5. Implications and limitations**

This study highlights the potential importance of exposure to creativity and innovation-related learning experiences among undergraduate nursing students. Students who had attended creativity- and innovation-related courses reported significantly higher total CIEP scores than

those who had not, suggesting that this exposure may support creativity and innovation competencies. This finding indicates that nursing programmes may consider providing opportunities for students to participate in creativity and innovation-related learning experiences, whether through elective courses, co-curricular activities, workshops, or other forms of educational exposure.

However, several limitations should be considered when interpreting the findings. First, the analyses focused on the overall CIEP score rather than on inferential testing of individual domains. Therefore, the findings should be interpreted as relating to overall creativity and innovation competency rather than to domain-specific relationships. Second, although several associations were statistically significant, the effect sizes for age and CGPA were weak, indicating that these variables explain only a small portion of the variation in total CIEP score. Third, the cross-sectional design does not allow causal conclusions to be drawn. The identified associations reflect relationships at a single point in time and should not be interpreted as evidence of causal influence. Fourth, the study was conducted at a single institution with relatively homogeneous participants, which may limit the generalisability of the findings to other educational or cultural contexts. Fifth, the data were collected in 2020, and this time gap should be acknowledged as a limitation because curriculum structure, teaching approaches, and learning environments may have changed since then. Nevertheless, the topic remains relevant because creativity and innovation continue to be recognised as important competencies in nursing education, and the findings related to exposure to creativity and innovation-related courses remain meaningful for current educational planning. Future studies should include more diverse settings and explore other educational and contextual factors that may influence creativity and innovation competency among nursing students.

## **6. Conclusion**

In conclusion, this study highlights the multifaceted nature of creativity and innovation in nursing education. The findings indicate that academic performance and exposure to creativity- and innovation-related courses were significantly associated with total CIEP scores, while other factors may also contribute to these competencies. These results suggest that providing nursing students with opportunities to engage in creativity- and innovation-related learning experiences, whether through electives, co-curricular activities, or other structured educational exposures, may help strengthen these important competencies. Such efforts may help prepare nursing graduates to respond more effectively to the evolving demands of healthcare practice.

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## **Author contribution**

DCT conceptualized and designed the study, supervised data collection, and led the manuscript writing. RN contributed to the study design, data analysis, and manuscript drafting. NA assisted with proofreading, data collection, data interpretation, and literature review. RK supported data analysis and contributed to manuscript editing. RMJ was involved in data collection and literature review. RF contributed to data interpretation and critical revisions to the manuscript. PDR provided methodological guidance and critically reviewed the manuscript for important intellectual content. All authors read and approved the final manuscript.

## **Conflict of interest**

The authors declare that they have no competing interests

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## **Declaration of Use of AI in Scientific Writing**

The authors used an AI-assisted language tool solely to support language refinement and improve clarity during manuscript preparation. All scientific content, interpretation of findings,

and final decisions regarding the manuscript were made by the authors, who take full responsibility for the accuracy and integrity of the work.

## References

- Bahari, K., Talosig, A. T., & Pizarro, J. B. (2021). Nursing technologies creativity as an expression of caring: A grounded theory study. *Global Qualitative Nursing Research*, 8, 1–10. <https://doi.org/10.1177/2333393621997397>
- Bodla, A. A., Tang, N., Jiang, W., & Tian, L. (2018). Diversity and creativity in cross-national teams: The role of team knowledge sharing and inclusive climate. *Journal of Management & Organization*, 24(5), 711–729. <https://doi.org/10.1017/jmo.2016.34>
- Brewster, A. L., Lee, Y. S. H., Linnander, E. L., & Curry, L. A. (2022). Creativity in problem solving to improve complex health outcomes: Insights from hospitals seeking to improve cardiovascular care. *Learning Health Systems*, 6(2). <https://doi.org/10.1002/lrh2.10283>
- Can Özdemir, R., & Işık, M. T. (2022). Nursing students' innovation and creativity approaches: A descriptive study. *Health Sciences Quarterly*, 2(3), 117–126. <https://doi.org/10.26900/hsq.2.3.01>
- Canonizado, I. C. (2024, October 13). *When to use total population sampling in a research study*. HubPages. <https://discover.hubpages.com/education/When-to-use-total-population-sampling-in-a-research-study>
- Chen, K. L. (2024). Nursing innovation and patents: A pathway to advancing healthcare and nursing. *Jurnal Ners*, 19(2), 123–124. <https://doi.org/10.20473/jn.v19i2.58022>
- Cheraghi, M. A., Pashaeypoor, S., Dehkordi, L. M., & Khoshkesht, S. (2021). Creativity in nursing care: A concept analysis. *Florence Nightingale Journal of Nursing*, 29(3), 389–396. <https://doi.org/10.5152/FNJJN.2021.21027>
- Chooha, U., Pummarak, S., Phopa, Y., & Pianpijarn, A. (2022). Enhancement of nursing innovators among nursing students in public higher education institutions. *Journal of Educational Issues*, 8(1), 738. <https://doi.org/10.5296/jei.v8i1.19904>
- Dackert, I. (2016). Creativity in teams: The impact of team members' affective well-being and diversity. *Open Journal of Social Sciences*, 04(09), 19–28. <https://doi.org/10.4236/jss.2016.49003>
- El-Sayed, M. M., Abdelhay, E. S., Hawash, M. M., & Taha, S. M. (2024). The power of laughter: A study on humor and creativity in undergraduate nursing education in Egypt. *BMC Nursing*, 23(1), 259. <https://doi.org/10.1186/s12912-024-01913-0>
- Li, C.-P., & He, L.-P. (2023). Trait creativity among midwifery students: A cross-sectional study. *Revista Da Associação Médica Brasileira*, 69(4). <https://doi.org/10.1590/1806-9282.20221355>
- Liu, H.-Y. (2022a). Investigating the pathways between swift trust and team creativity among nursing student teams in Taiwan: A moderated mediation model. *BMC Nursing*, 21(1), 344. <https://doi.org/10.1186/s12912-022-01118-3>
- Liu, H.-Y. (2022b). Promoting creativity of nursing students in different teaching and learning settings: A quasi-experimental study. *Nurse Education Today*, 108, 105216. <https://doi.org/10.1016/j.nedt.2021.105216>
- Liu, H.-Y., Chen, N.-H., Wang, I.-T., Wu, S.-M., Han, C.-Y., Hsu, D.-Y., Han, H.-M., & Huang, D.-H. (2021a). Predictors of individually perceived levels of team creativity for teams of nursing students in Taiwan: A cross-sectional study. *Journal of Professional Nursing*, 37(2), 272–280. <https://doi.org/10.1016/j.profnurs.2021.01.010>
- Liu, H.-Y., Chen, N.-H., Wang, I.-T., Wu, S.-M., Han, C.-Y., Hsu, D.-Y., Han, H.-M., & Huang, D.-H. (2021b). Predictors of individually perceived levels of team creativity for teams of nursing students in Taiwan: A cross-sectional study. *Journal of Professional Nursing*, 37(2), 272–280. <https://doi.org/10.1016/j.profnurs.2021.01.010>
- Liu, H.-Y., Han, H.-M., Chen, H.-F., Han, C.-Y., Huang, D.-H., Hsu, D.-Y., & Chiang, C.-H. (2024). Team interaction behaviors correlates with team creativity among nursing students: Canonical correlation and moderation analyses. *BMC Nursing*, 23(1), 484. <https://doi.org/10.1186/s12912-024-02158-7>
- Ma, X., Yang, Y., Wang, X., & Zang, Y. (2018). An integrative review: Developing and measuring creativity in nursing. *Nurse Education Today*, 62, 1–8. <https://doi.org/10.1016/j.nedt.2017.12.011>

- Moser, K. S., Dawson, J. F., & West, M. A. (2019). Antecedents of team innovation in health care teams. *Creativity and Innovation Management*, 28(1), 72–81. <https://doi.org/10.1111/caim.12285>
- Richardson, C., & Mishra, P. (2018). Learning environments that support student creativity: Developing the SCALE. *Thinking Skills and Creativity*, 27, 45–54. <https://doi.org/https://doi.org/10.1016/j.tsc.2017.11.004>
- Rylee, T. L., & Cvanagh, S. J. (2023). Innovation in nursing practice. *Advances in Nursing Science*, 46(4), E115–E131. <https://doi.org/10.1097/ANS.0000000000000464>
- Sobel, D. M., & Letourneau, S. M. (2018). Curiosity, exploration, and children’s understanding of learning. In *Active learning from infancy to childhood* (pp. 57–74). Springer International Publishing. [https://doi.org/10.1007/978-3-319-77182-3\\_4](https://doi.org/10.1007/978-3-319-77182-3_4)
- Taheri, F., & Nasiri, A. (2024). Clarifying the concept of professional curiosity in nursing: A concept analysis with Walker and Avant approach. *Nursing Forum*, 2024, 1084372. <https://doi.org/10.1155/2024/1084372>
- Taşdelen Baş, M., Özpulat, F., Molu, B., & Dönmez, H. (2022). The effect of decorative arts course on nursing students’ creativity and critical thinking dispositions. *Nurse Education Today*, 119, 105584. <https://doi.org/10.1016/j.nedt.2022.105584>
- Toscano, F., Giusino, D., Diana, R., & Rahimi Pordanjani, T. (2023). The role of emotional regulation in the relationship between nurses’ creative style and innovation behaviors: A cross-sectional study. *Nursing Reports*, 13(2), 811–822. <https://doi.org/10.3390/nursrep13020071>
- Wang, J., & Shibayama, S. (2022). Mentorship and creativity: Effects of mentor creativity and mentoring style. *Research Policy*, 51(3), 104451. <https://doi.org/https://doi.org/10.1016/j.respol.2021.104451>
- Warner, J. (2004). *Creativity and innovation effectiveness profile*. HRD Press Inc. [https://www3.hrdpress.com/files/product\\_pdfs/Competency\\_Profiles/ciep.pdf](https://www3.hrdpress.com/files/product_pdfs/Competency_Profiles/ciep.pdf)