Original Article

Is The Microlearning Approach A New Way to Influence Learners' Attitudes Towards Nursing Bioscience Education?

[1]Snezana Kusljic, [2]Aleksandra Kusljic

[1]Associate Professor, Department of Nursing, The University of Melbourne, Parkville, Victoria, Australia, [2] BSci & MPH, Department of Nursing , The University of Melbourne, Parkville, Victoria, Australia

How to cite this article: Snezana Kusljic, Aleksandra Kusljic. Is The Microlearning Approach A New Way to Influence Learners' Attitudes Towards Nursing Bioscience Education? International Journal of Nursing Education / Vol 18 No. 2, April - June 2026

Abstract

Objective: Historically, nursing students have found bioscience subjects challenging and anxiety provoking. To alleviate these factors, an online industry-based short course, *Biochemical Basis for Human Life (BBHL)* was developed. A survey with narrative analysis was used to explore learners' experience and satisfaction with the course and evaluate the effectiveness of microlearning approach in delivering nursing bioscience education.

Methods: Learners enrolled in the short course and following the course completion, they were invited to submit the End of Course Feedback survey. The survey included quantitative measures of course satisfaction, demographics pertaining to learners' country of origin and two open ended qualitative questions.

Results: A total of 444 learners were enrolled in the course, with 33.3% completion rate (148/444). Out of the learners who completed the course, 89.9% (133/148) completed the End of Course Feedback survey. Across all questions, agreement rates exceeded 90%, with negligible disagreement or nonresponse in relation to course satisfaction. Out of the learners who provided a qualitative response, majority expressed positive attitudes towards course delivery and course impact.

Conclusions: This study highlighted the beneficial nature of the course and its microlearning approach in relation to nursing bioscience education. Furthermore, this study provides a new strategy for educators where a bite-sized learning can be used as pre-classroom preparation for students to enhance student engagement and decrease burden associated with extensive material coverage in the classroom.

Keywords: Bioscience education; Microlearning; Nursing; Teaching models; Workforce development

Introduction

An understanding of bioscientific concepts is critical for nurses to deliver effective, evidence-based, safe, and patient-centered care[1,2]. Historically, nursing students have found bioscience subjects challenging and anxiety provoking[3-6] which in turn created the negative attitudes towards bioscience learning[3]. There are many factors that can influence the landscape of bioscience education including different program stages of student's learning , prior knowledge , and ability to apply biosciences to a clinically

Corresponding Author: Snezana Kusljic, Associate Professor The University of Melbourne Department of Nursing, Level 6, Alan Gilbert Building 161 Barry Street, Parkville, Victoria, 3010, Australia.

E-mail: skusljic@unimelb.edu.au;

Submission: Feb 5, 2026 **Revision:** March 20, 2025 **Published date: April 27 , 2026**

relevant situation. For example, a cross-sectional exploratory survey of final year entry-to-practice (undergraduate) nursing students revealed that students who did not complete science in secondary school found bioscience subjects (e.g., anatomy, physiology) difficult to learn whereas those with secondary school science had a better understanding of bioscience and its application to clinical situations[4].

Undergraduate nursing students are often challenged with bioscience subjects for various reasons including the large volumes of content, complexity behind science terminology, limited time to grasp the concepts and apply it to practice[6-9]. While acknowledging a significant challenge during their undergraduate studies, registered nurses wanted more bioscience with greater relevance to nursing practice which they considered crucial in their clinical roles[7]. Registered nurses also reported that limited exposure to bioscience education in their undergraduate program led to inadequate preparation for their clinical roles[10, 11] and a lack of confidence in their bioscience knowledge[12]. Interestingly, registered nurses undertaking bioscience subjects in their postgraduate studies indicated a confidence boost in their bioscience knowledge and application to nursing practice[13].

Academics have employed various educational approaches and teaching methods to deliver bioscience content and enhance bioscience learning including online learning platforms[5], clinically-relevant real-life nursing scenarios[14], virtual reality[15], classroom lectures and group seminars[16]. However, no single educational model was singled out to be the most effective[8]. Therefore, to bridge the gap between postgraduate nursing students' desire to have more bioscience content and undergraduate nursing students' challenges to grasp bioscientific concepts and apply these to practice, wide-angle research is required. Implementation of educational approaches in the preparatory stage before students commence their nursing studies whether undergraduate or postgraduate could contribute to an attitude shift towards bioscience subjects.

A short online course entitled *Biochemical Basis for Human Life* was developed to equip future students with knowledge of the basic concepts of anatomy, physiology, and biochemistry. This industry-based course is not linked to any academic award degree or program and was designed for potential students who are planning to undertake a range of nursing academic programs including Master of Nursing Science (MNSci) entry-to-practice, specialty and advanced programs such as nurse practitioners. Additionally, some individuals undertaking this industry-based course might have already been registered clinicians, i.e. nurses, and they enrolled in the course to refresh their bioscience knowledge rather than pursue additional academic training. Therefore, in this manuscript we use term 'learners' rather than 'students.' The course consists of 5 interactive course units or tutorials, 10 case-based reflective exercises to practice application and 5 tutorial unit self-assessments, and it is delivered through an online learning platform. The learner accesses the materials through a web browser on any device including a mobile phone and works through the materials in a self-directed fashion. The aim of this research is to a) identify learner satisfaction with the course content and its relevance in their current or future role and b) evaluate the effectiveness of pedagogical approaches in delivering bioscience theory and applying it to clinical practice.

Methods

Features of the Short Course

Biochemical Basis for Human Life (BBHL) integrates relevant bioscientific theories with general clinical contexts and it requires approximately 15 hours of learning. A Certificate of Completion is provided upon satisfactory completion of self-assessments and case-based reflective exercises. Utilizing constructivist and humanistic teaching practices, the course design integrates both problem and inquiry-based learning and covers the fundamentals of human life from structural, functional, and chemical angles. Clinical contexts are embedded into the content to enable early exposure and reinforcement of the importance and relevance of understanding bioscientific concepts.

Study Design

A survey with narrative analysis was used to explore learners' experience and satisfaction with the course. The survey included a quantitative questionnaire design for six (6) questions and two (2) open ended qualitative questions to capture ideas from learners about the course.

Participants and Data Collection

Learners enrolled in the course through the Mobile Learning Unit and upon paying the course fee, they agreed with the Magento Store Policy T&Cs including collection of demographic data such as country of origin. Following the course completion,learners submitted the End of Course Feedback survey. The survey captured data relating to learners' satisfaction with the course in two domains: course delivery and course impact. Using two (2) open ended questions, learners were invited to share their perspectives on the relevance and appropriateness of the course content, as well as the overall accessibility of the course materials and resources available to them. All survey responses were anonymized. The survey included quantitative measures of course satisfaction which were measured on a 5-point Likert scale (strongly agree to strongly disagree) and demographics pertaining to learners' country of origin. The two (2) open ended qualitative questions asked learners the following: "*Do you have any additional comments regarding course delivery?*" and "*Do you have any additional comments regarding course impact?*".

Quantitative Data Analysis

Quantitative data from the survey was analyzed using *Microsoft Excel*. The survey measured student satisfaction across the course delivery and impact capturing the material accessibility and interactivity, application of learning to day-to-day practice, appropriateness for current or future role, and overall expectations. Responses were recorded on a five-point Likert scale (1= Strongly Disagree, 5 = Strongly Agree), with an additional "Not Applicable" option where relevant. Descriptive statistics, that is, frequency and percentages were calculated to summarize satisfaction levels for each item.

Qualitative Data Analysis

Open-ended survey responses were analyzed using a qualitative data analysis approach which was informed by the framework proposed by O'Cathain and Thomas (2004). Responses were imported into NVivo 15 (QSR International) for systematic coding. An inductive coding strategy was employed, allowing themes to emerge directly from the data. Initial coding was conducted line-by-line, with codes grouped into categories and refined into overarching themes through iterative comparison. Following the mentioned framework guidance, the analysis treated open-ended responses as a legitimate qualitative dataset[17].

Results

Learner country of origin

A total of 444 learners were enrolled in the course. The majority were from Australia (n = 315; 70.9%), followed by smaller numbers from China (n=16; 3.6%), South Korea (n=5; 1.1%), the United States (n=4; 0.9%), and New Zealand (n=4; 0.9%). Single learners were recorded from Hong King, the United Kingdom, the United Arab Emirates, Kenya, Nigeria, Vietnam, Indonesia, Ireland, Macao SAR China, Singapore, and Taiwan (each n = 1; 0.23%). Two students/learners (0.45%) were from India, and three (0.68%) from Taiwan. A large proportion of students (n = 85; 19.1%) preferred not to disclose their country of origin.

Table 1. Learner country of origin.

Country	n (%) learners
Australia	315 (71)
Hong Kong	1 (0.2)

Continue....

United Kingdom	1 (0.2)
United States	4 (0.9)
United Arab Emirates	1 (0.2)
Taiwan	3 (0.7)
Kenya	1 (0.2)
China	16 (3.6)
India	2 (0.5)
New Zealand	4 (0.9)
Nigeria	1 (0.2)
South Korea	5 (1.1)
Vietnam	1 (0.2)
Indonesia	1 (0.2)
Ireland	1 (0.2)
Macao SAR China	1 (0.2)
Singapore	1 (0.2)
Rather not say	85 (19.1)
Total	444

Learner Satisfaction with The Course – Quantitative

Out of 444 enrolled, 148 participants or 33.3% completed the course with a total number of 133 completing the End of Course Feedback survey. Overall, responses indicated high levels of satisfaction with the accessibility, interactivity, and relevance of the course content (Table 2). Almost all respondents agreed that the course materials were easy to access online, with 98 participants (73.7%) *strongly agreeing* and 35 (26.3%) *agreeing* (Q1). Similarly, most respondents found the course content to be interactive with 77 (57.9%) *strongly agreeing* and 44 (33.1% *agreeing*), while only 11 (8.3% *disagreed*).

Table 2. Learner responses to End of Course Feedback survey.

Please note that learners were not required to answer all questions hence variability in number of responses.

Question	**Strongly Agree n (%)**	**Agree n (%)**	**Disagree n (%)**	**Strongly Disagree n (%)**	**Not Applicable n (%)**	**Total (n)**
Q1. It was easy to access course materials online	98 (73.7%)	35 (26.3%)	0 (0%)	0 (0%)	0 (0%)	133
Q2. The course content was interactive	77 (57.9%)	44 (33.1%)	11 (8.3%)	0 (0%)	1 (0.8%)	133
Q3. I can apply what I have learned to my day-to-day practice	67 (50.4%)	52 (39.1%)	3 (2.3%)	0 (0%)	11 (8.3%)	133

Continue....

Q4. I would recommend the course to my peers	79 (59.4%)	51 (38.3%)	1 (0.8%)	0 (0%)	2 (1.5%)	133
Q5. The course was appropriate/ relevant for me in my current or future role	76 (57.1%)	50 (37.6%)	6 (4.5%)	0 (0%)	1 (0.8%)	133
Q6. The course delivered was what I expected	52 (54.7%)	39 (41.1%)	3 (3.2%)	1 (1.1%)	0 (0%)	95

Regarding the application of learning to practice, 67 participants (50.4%) *strongly agreed* and 52 (39.1%) *agreed* that they had applied what they learned to their day-to-day work (Q3). A comparable pattern was observed for participants' willingness to recommend the course to peers (Q4), with 79 (59.4%) *strongly agreeing* and 51 (38.3%) *agreeing*, and only 1 (0.8%) *disagreeing*.Perceptions of course relevance were similarly positive (Q5), with most respondents indicating that the course content was appropriate to their current roles; however, data for this item was incomplete in the dataset. Finally, more than 95% of respondents agreed that the course met their expectations (Q6), with 52 (54.7%) *strongly agreeing*, 39 (41.1%) *agreeing*, and only 4.3% reporting any level of disagreement. Thus, across all items i.e., all six questions, agreement rates exceeded 90%, with negligible disagreement or nonresponse.

Learner Perceptions of the Course and Ideas for Improvement – Qualitative

Learners' responses to two (2) open-ended questions on course impact and course delivery ranged from a singular word to a few sentences. Many learners chose not to provide further comments pertaining to these two questions. Out of the learners that provided a response, majority expressed positive attitudes towards course delivery and course impact. Three key themes were identified across both open-ended questions and these included: (1) content and relevance, (2) accessibility and delivery and (3) learning modalities. Illustrative quotes were provided, and these were followed by the respondent's identification number (ID) numbers.

Content and relevance

Most learners felt that the course content was too easy with a lack of detail, however they still found the course to be useful as a part of bioscience learning.

"Could have been made a bit trickier." [9]

"It was a bit more basic than I expected, but I still learned a lot." [27]

"The course is great, and I think it may be more useful for me if the course will be more details in anatomy." [86]

"This course is not detailed enough." [92]

In contrast, one learner found the content difficult to follow, suggesting a need for more background information to aid understanding.

"Some parts, specially the first few tutorials, were a bit hard to follow, as I personally felt lost. It has been a long time since most of us have read these subjects. If more background information was provided, it would have been more effective." [86]

Learners have also noted that the course was appropriate and relevant to their roles whether they are students and/or qualified nurses.

"The course has successfully equipped me with the basic knowledge i need before pursing MNSc course." [84]

"I undertook this course, as a refresher. I am a registered nurse of some 20+ years and this course really was supportive in my learning and refreshing of my knowledge." [19]

"Now that I am a practicing nurse, I have more clarity about human physiology and it gives great impact on my practice." [79]

Furthermore, many learners found that the course was informative and beneficial in relation to expanding their knowledge of bioscience and at the same time serving as a good refresher course.

'It provides me with basic knowledge of human biology.' [25]

'Thank you for all the content and i have understand much more through this course. this is really helped me a lot.'[82]

"Overall, I enjoy studying the course, which is a good refresher course for me to revise my science knowledge. Through learning from the course, I managed to recall back the science knowledge that I learned from bachelor degree about 20 years ago! "[19]

Accessibility and delivery

With respect to course delivery a multitude of learners stated that the course was easily accessible and straightforward to use. Additionally, learners expressed positive sentiments towards course delivery in that it was well delivered and uniform throughout.

"Easily accessible and to follow." [13]

"The overall layout was easy to navigate and understand which is excellent." [95]

"The course was well delivered." [88]

"it is consistent." [33]

Learning modalities

This theme revealed conflicting opinions from respondents regarding the course's learning modalities. Many learners expressed a desire for more visual materials to support their understanding of complex concepts. While many respondents suggested a need for a greater number of visual materials to aid in their learning, some felt that the existing visual materials were already effective in enhancing comprehension.

"Can include more visual information like videos." [7]

"It would be great to include more videos in the future to aid our understanding of certain chemical processes." [35]

"more videos required to understand content."[39]

"Probably could add more diagrams." [81]

"There should be more picture of cells, tissue types." [89]

"The additional images provided helped students understanding."[87]

In addition to an expressed need for additional visual aids, many learners called for more interactivity within the course. Most respondents suggested that more engaging features could improve motivation and learning outcomes.

"Could have been more interactive than just reading and answering questions." [10]

"If the student's interaction with the course, would be increased in a way, it would be much more effective." [22]

"The content, which is science heavy, involves a lot of self-reading resource. It would be good to make the content more interactive learning, to engage student learning."[88]

"The course content was not interactive." [90]

Conversely, a few respondents indicated that the current level of interactivity was sufficient for their learning needs.

"easy and interactive." [14]

"The course content was interactive enough." [89]

Finally, some learners expressed a desire for more assessment opportunities to reinforce their understanding and provide a sense of progress.

"I think you could have longer assessments at the end of each section. Maybe 20 questions?" [18]

"I love the quizzes throughout the course and I wish for more quizzes." [26]

"I really liked the integrated test questions. I would, however, have liked to see many more, as it's my preferred learning style." [26]

Discussion

Evaluation of the course enabled an assessment of learners' satisfaction with the course and effectiveness of pedagogical approaches used in delivery of the content and its application to clinically relevant contexts.While the completion rate of 33% may be perceived as low, data from industry shows that only 5-15% of students who start free online courses obtain a certificate of completion[18]. The BBHL is a fee-associated online course and hence

compared to the higher end of industry free online course figures, its completion rate is several folds higher. Furthermore, Celic and Cagiltay (2024) compared Massive Open Online Courses completion rates and suggested that the most effective measure of completion rates is consideration of learners' intent and calculation of completion rates accordingly instead of traditional completion calculation based on all enrolled learners[19]. When this notion is applied to our study,a completion rate of 33% could be translated into almost 100% if only active learners, i.e. those with clear intent, were included.

The demographic data revealed that a composition of the learner cohort was diverse in terms of their country of origin and their professional background as to why they chose to undertake the course. Learners were at varying stages of their careers including registered nurses (RNs) with a long history of clinical practice wanting to refresh their bioscience knowledge and learners planning to enroll into entry-to-practice nursing programs. Despite majority of learners originating from Australia, overall, the responses represented a diverse international learner cohort. A quantitative component of the study identified that the learner satisfaction with the course was extremely high and indicated a consistently favorable evaluation of the course's accessibility, interactivity, relevance, and practical applicability.

The course design utilized pedagogy of bite-sized learning content, engaging activities, and promotion of active learning that facilitates the busy learner to move in and out of the course according to their time schedules, but still complete small learning cycles. Additionally, 10 case-based reflective exercises were embedded within the course to aid in applying bioscience concepts to nursing practice. Learners must complete all tasks within each tutorial and must achieve pass – minimum 80% to successfully complete the course and obtain a Certificate of Completion. While several learners perceived the course content as somewhat basic, the majority still acknowledged its educational appropriateness, value, and relevance to their professional or academic development. These findings highlight the beneficial nature of the course in relation to nursing bioscience education whether it is undertaken as a refresher or as a starter to embark on nursing career journey. Most learners regardless of their career stage found the course content to be relevant to their current or future role. The agreement on the item response relating to appropriateness/relevance of the course was 57.1% for *strongly agree* and 37.6 % for *agree,* which could potentially indicate learners' positive attitude towards bioscience and appreciation of the relationship between bioscience and their role.

Furthermore, this study highlighted the importance of this course in the development of future nursing workforce. For example, due to increased patient acuity and increased life expectancy, there is an exponential need for the uptake of bioscience knowledge by RNs to deliver evidence-based, safe, and patient-centered care[1, 2]. Additionally, in Australia, all RNs who are seeking endorsement as a nurse practitioner (NP) must complete the Nursing and Midwifery Board of Australia (NMBA) approved program of study at master's level in addition to having a significant clinical experience at an advanced practice level i.e., equivalent of three years' or 5,000 hours full-time experience[20]. One of the core subjects in the NMBA-approved program of study includes a standalone pharmacology subject and this short course was also suggested as a good refresher and/or preparatory material for learners planning to embark on their NP journey. Hence, the learners identified as RNs with years of clinical practice could have been those pursuing advanced nursing degrees as NP program of study.

The accessibility and delivery of the course was identified as a strong aspect of learning experience and a diverse range of learner preferences regarding course design were captured. While many advocated for more visual and interactive elements, others were satisfied with the current structure, suggesting that learners engage with materials in varied ways. These differing views identified a need for some course revisions and inclusion of different media elements and formats such as podcasts, custom-made videos that highlight specific aspect of the complex bioscientific principles, text-based interactive materials such as flashcards[21-23]. Based on our

experience with online learning design (unpublished data) we also propose other interactive strategies such as 'respond and reveal' where learners respond to questions and then compare their answer to expert responses.

The pedagogical approach utilized in designing this course is well aligned with recent evidence highlighting the effectiveness of microlearning or bite-sized learning on improving cognitive i.e. knowledge, behavioral i.e., engagement, and affective i.e., motivation learning outcomes[24, 25].Considering that there is a lack of evidence on effectiveness of strategies to best support nursing students' bioscience learning in the classroom[8, 26, 27], this study could help educators to implement microlearning approach as an additional strategy to influence learner attitudes towards bioscience learning. While various learning strategies have been utilized in nursing bioscience education, many students are challenged with extensive content delivery in the classroom[8, 27]. Hence, using bite-sized learning as pre-classroom preparation may improve student engagement and decrease burden associated with extensive material coverage.

Conclusion

The importance of nursing bioscience education cannot be underestimated despite exposed challenges relating to extensive material delivery and concept complexity. The findings of this study have implications for enhancing bioscience-nursing practice nexus, as well as informing the development of future bioscience curricula and delivery. A limitation of this study was the inability to follow learners' career trajectory and assess the course's impact on the application of bioscience knowledge and motivation for any future bioscience-related challenges. Further research should extend to macro-level learning outcomes via structured interviews to examine how microlearning impacts on knowledge retention and application to nursing practice.

Funding Sources: This research did not receive any specific grant from funding agencies in the public, commercial, or not-for-profit sectors.

Ethical Clearance: The study was approved by the University of Melbourne Human Research Ethics Committee (Reference Number: 2025-31098-61841-3; approval date 01/11/2024). The Mobile Learning Unit holds custodianship of the data and digital data pertaining to the course delivery and impact is presented to the course director (corresponding author).

Acknowledgements

The authors gratefully thank the Mobile Learning Unit at the University of Melbourne for their involvement in the enrolment process, data collection and storage, and provision of the annual reports. Specifically, the authors thank Jay McLean for their involvement in creating annual reports and promptly responding to any queries in relation to data sets.

Declaration of Conflicts of Interest Statement: No conflict of interest.

References

1. Barton MJ, Bentley S, Craft J, Dupen O, Gordon C, Cayanan EA, et al. Nursing students' perceptions of clinical relevance and engagement with bioscience education: A cross-sectional study of undergraduate and postgraduate nursing students. Nurse Educ Today. 2021;99:104767.
2. Perkins C. Enhanced bioscience content is urgently needed in UK pre-registration nursing curricula. Nurse Educ Pract. 2019;34:7-11.
3. Craft J, Hudson P, Plenderleith M, Wirihana L, Gordon C. Commencing nursing students' perceptions and anxiety of bioscience. Nurse Educ Today. 2013;33(11):1399-405.
4. Gordon CJ, Hudson PB, Plenderleith MB, Fisher M, Craft JA. Final year Australian nursing students' experiences with bioscience: A cross-sectional survey. Nurs Health Sci. 2017;19(1):22-8.
5. Gresty KA, Cotton DR. Supporting biosciences in the nursing curriculum: development and evaluation of an online resource. J Adv Nurs. 2003;44(4):339-49.
6. McVicar A, Andrew S, Kemble R. The 'bioscience problem' for nursing students: an integrative review of published evaluations of Year 1 bioscience, and proposed directions for curriculum development. Nurse Educ Today. 2015;35(3):500-9.

7. Craft JA, Hudson PB, Plenderleith MB, Gordon CJ. Registered nurses' reflections on bioscience courses during the undergraduate nursing programme: an exploratory study. J Clin Nurs. 2017;26(11-12):1669-80.
8. Manchester KR, Roberts D. Bioscience teaching and learning in undergraduate nursing education: A systematic review with narrative synthesis. Nurse Educ Pract. 2025;82:104226.
9. Satoh M, Fujimura A, Miyagawa S. Difficulties and innovations in teaching anatomy and physiology in nursing. Nurse Educ Pract. 2023;67:103551.
10. Branney J, Priego-Hernandez J. A mixed methods evaluation of team-based learning for applied pathophysiology in undergraduate nursing education. Nurse Educ Today. 2018;61:127-33.
11. Davis GM. What is provided and what the registered nurse needs--bioscience learning through the pre-registration curriculum. Nurse Educ Today. 2010;30(8):707-12.
12. Clancy J, McVicar A, Bird D. Getting it right? An exploration of issues relating to the biological sciences in nurse education and nursing practice. J Adv Nurs. 2000;32(6):1522-32.
13. Van Wissen K, McBride-Henry K. Building confidence: an exploration of nurses undertaking a postgraduate biological science course. Contemp Nurse. 2010;35(1):26-34.
14. Mortimer-Jones S, Fetherston C. The nursification of a bioscience unit and its impact on student satisfaction and learning in an undergraduate nursing degree. Nurse Educ Today. 2018;64:1-4.
15. Saab MM, Hegarty J, Murphy D, Landers M. Incorporating virtual reality in nurse education: A qualitative study of nursing students' perspectives. Nurse Educ Today. 2021;105:105045.
16. Evensen AE, Brataas HV, Cui G. Bioscience learning in nursing: a cross-sectional survey of beginning nursing students in Norway. BMC Nurs. 2020;19:2.
17. O'Cathain A, Thomas KJ. "Any other comments?" Open questions on questionnaires - a bane or a bonus to research? BMC Med Res Methodol. 2004;4:25.
18. Ahearn A. Moving From 5% to 85% Completion Rates for Online Courses: International Society for Technology in Education (ISTE) and Association for Supervision and Curriculum Development (ASCD).2019 [updated 2019 June 6]. Available from: https://www.edsurge.com/news
19. Celik B, Cagiltay K. Uncovering MOOC Completion: A Comparative Study of Completion Rates from Different Perspectives. Open Prax. 2024;16(3):445-56.
20. NMBA NaMBoA. Guidelines: For nurses applying for endorsement as a nurse practitioner. 2025.
21. Choo CY, Rahim ASA. Pharmacy students' perceptions and performance from a microlearning-based virtual practical on the elucidation of absolute configuration of drugs. Asian Journal of University Education. 2021;17(4):1-10.
22. Fidan M. The effects of microlearning-supported flipped classroom on pre-service teachers' learning performance, motivation and engagement. Education and Information Technologies 2023;28(10):12687-714.
23. Shabadurai Y, Chua FF, Lim TY. Investigating the employees' perspectives and experiences of microlearning content design for online training. International Journal of Information and Education Technology. 2022;12(8):786-93.
24. Mazlan CAN, Abdullah MH, Sulong MA, Abas A, Ramdan MR, Safian AR, Fuad DRSM. Exploring the integration of bite-sized learning: A scoping review of research in education and related disciplines. Contemp Educ Technol. 2023;15(4).
25. Monib WK, Qazi A, Apong RA. Microlearning beyond boundaries: A systematic review and a novel framework for improving learning outcomes. Heliyon. 2025;11(2):e41413.
26. Jensen KT, Knutstad U, Fawcett TN. The challenge of the biosciences in nurse education: A literature review. J Clin Nurs. 2018;27(9-10):1793-802.
27. Manchester KR, Roberts D. From classroom to clinic: Bridging the gap in nursing anatomy and physiology education. Nurse Educ Pract. 2024;75:103870.