Original Article

A Model for Building Research Capacity and Infrastructure in Oncology: A Nursing Research Fellowship

Ann M. Mazzella Ebstein, Margaret Barton-Burke, Kristen L. Fessele

Office of Nursing Research, Memorial Sloan Kettering Cancer Center, New York, NY, USA

Corresponding author: Ann M. Mazzella Ebstein, PhD. Office of Nursing Research, Memorial Sloan Kettering Cancer Center, New York, NY, USA.
E-mail: mazzella@mskcc.org

Received: April 21, 2020; Accepted: June 05, 2020; Published: September 14, 2020

ABSTRACT

Objective: This article describes how one comprehensive cancer center in the Northeast United States reorganized their nursing research fellowship (NRF) with the goals of engaging nurses in research processes, developing a culture of inquiry, building nursing research capacity, and sustaining infrastructures for facilitating high-quality, nurse-led oncology research studies. **Methods:** The basis for the curriculum, course work, and research practicum is derived from academic courses taught at the undergraduate, graduate, and doctoral levels. Evidence from the current literature, expertise of nurse-scientists, and feedback from former fellows provided the background for a fellowship model that included: (1) amending curriculum timeframes; (2) incorporating protected time; (3) improving access to resources; (4) enhancing the protection, data sharing, and accessibility of data; and (5) involving nurse-scientists as mentors and facilitators of research processes. These factors were incorporated over 3 years. Metrics included individual class and overall course evaluations and ongoing assessments. **Results:** In three cohorts from 2016 to 2019, a total of 21 nurses were accepted, and 18 (86%) nurses completed the NRF. In cohort 1 through cohort 3, 17 fellows presented their research findings internally, and a total of nine projects were presented at external forums. There were seven fellows whose manuscript submissions resulted in 21 journal publications. Of the 18 fellows, 15 (83%) conducted institutional review board-approved studies and three (17%) fellows developed studies involving one concept analysis and two systematic reviews. **Conclusions:** Utilizing technology, the fellowship improved access beyond the classroom setting. Improved application processes, the inclusion of protected time for nurses, and mentoring from nurse-scientists demonstrate a commitment to fostering a culture supporting new knowledge and innovation for improving patient care.

Key words: Cancer, fellowship, mentoring, oncology, research capacity, research infrastructure

Introduction

The Memorial Sloan Kettering (MSK) Cancer Center has been a research-intensive institution since 1884, and the Department of Nursing garnered research activities long before nursing research (NR) was specified by the American Nurses Credentialing Center (ANCC) Magnet® Program.[1-3] With the support of nursing administration and guided by an ANCC Magnet®[1] accreditation criteria, the belief was that nurses are capable of developing insightful

Access this article online

Quick Response Code:

Website: www.apjon.org

DOI: 10.4103/apjon.apjon_35_20

Cite this article as: Mazzella Ebstein AM, Barton-Burke M, Fessele KL. A Model for Building Research Capacity and Infrastructure in Oncology: A Nursing Research Fellowship. Asia Pac J Oncol Nurs 2020;7:312-8.

research questions based on their clinical practice, but lack skills and support required to conduct oncology-relevant independent research studies.[4-6] In 2006, a year long NR fellowship (NRF) was initiated at MSK but concentrated on evidence-based content and projects. The emphasis of the NRF changed in 2015 to a nurse scientist-directed research course that focused on a clinical-based research studies.

Nurses caring for oncology patients are uniquely positioned to identify clinical practice areas requiring investigation.[5,7] Yet the lack of formal didactic instruction in research methods limited the staff nurses' ability to design and successfully conduct research studies. Although MSK staff nurses embraced the research fellowship, bona fide research requires additional education and research mentoring. At MSK, the NRF is sponsored by nursing administration and supports dedicated time for nurses to attend classes and finish a research study. Given that their role is patient care, work schedules are accommodated that meet the nurses' individual needs during the NRF.[3,4,7] The purpose of this article is to describe a NRF where the fellowship actively engages nurses in the research process, develops a culture of inquiry, builds nursing research capacity, and sustains an infrastructure that facilitates high-quality, nurse-led oncology research studies.

Background

Although NRFs may differ slightly between health-care organizations, there are consistent themes in all programs that are fundamental for building research capacity and infrastructure.[1-5] A NRF focuses on staff nurses who can identify topics to investigate, but lack the education organizational resources administrative backing, and skills to initiate nurse-led research.[2-11] In addition to providing research content, mentoring, and support of individual research studies,[12,13] the NRFs assist in engaging NR fellows in collaborative roles with other researchers, such as a co-investigator. As part of a research team, the NR fellows' nursing expertise adds value in the data collection and analysis of study findings and are acknowledged through authorship on manuscripts and publication in peer-reviewed journals.[14] The NRF mentors provide fellows with support and guidance when disseminating study results at professional forums. Taken together, NRFs contribute to developing future nursing scholars and research leaders, who will advocate for improving patient care through research.[15]

The NRF aims to engage nurses in the research process to facilitate new knowledge and innovations to improve patient care through symptom management. The literature supports similar organizational experiences when implementing a research fellowship for staff nurses.[3-5,8,10,11] Consistent ideas emerged as important factors for enhancing research capacity and building sustainable infrastructure. These factors include specific education, support, mentoring, and learning new skills.[2-5,8-10,12]

Nurses caring for oncology patients identify clinical practice situations requiring research rigor,[5,7] however the specific skills and resources necessary to pursue oncology-relevant independent research studies may be insufficient.[4,5] The need for mentorship by an experienced nurse scientist is underestimated and an individual fellow's needs, such as hands-on learning the application of research processes, protocol development, and grant funding[7] affect the ability to complete a research project in a given timeframe.[3,4,7] Research mentors are a necessary resource for building research capacity.[12] The mentor's role translates research into practice,[2,11] disseminates findings, supports research activities, and guides primary NR and systematic reviews.[8,12] At MSK, the mentoring of nursing fellows is provided by nurse-scientists who are PhD-prepared and are essential to research and scholarly productivity.[7,8,13]

Nurse's time for research is usually in competition with day-to-day clinical work, resulting in research initiatives conducted on their own time rather than as part of daily assignments. This becomes a barrier to engage in research activities.[2,6,7] Efforts to change the current practice necessitate protected time for research and is a critical building block for developing research capacity and infrastructure sustainability.[4,16]

Blended and e-learning classes provide innovative opportunities for learning.[17,18] These methodologies are used in academic institutions and workplaces to improve access and are cost-effective.[17] Organizations with robust information and data networks can connect staff across all facilities with one secure system to facilitate e-learning and video-conferencing. Finally, ensuring security for a data-sharing infrastructure and the ability for the NR fellows and mentors working in different geographic areas to remotely access the data is a challenge for protecting sensitive research information and maintaining strong privacy practices among investigators.[19,20]

Nursing research is essential for generating science that leads to changing clinical practice and patient care.[7] As an ANCC Magnet®[1] hospital and comprehensive cancer center, the NRF is important for supporting nurse-led research and building a model for research capacity and sustainable infrastructure.

Methods

The design of the nursing research fellowship model

The basis for the curriculum, course work, and research practicum is derived from academic courses taught at the undergraduate, graduate, and doctoral levels.[21,22] The

NRF is designed similar to three academic semesters: (1) September through November, (2) December through February, and (3) March through May. The NRF spans 18 months beginning with classes starting in September and finished by the end of the following year [Table 1].

There are 18 days of protected class time and research days that are spread over the initial nine months, which is outlined in the NRF syllabus [Table 1]. Class semesters are progressively organized based on content and research days needed to implement a study. In the first three months, there is one day of class each month (three days in total). In the second three months, there is a class day followed by a research day every month that allows time for the NR fellows to work on writing their study protocol application for submission to the Institutional Review Board (IRB) (six class days in total). The last three months include three class days and two research days in each month for the NR fellows to begin their study (nine days in total; three class plus six research days).

Once submitted to the IRB, the approval processes may take several months during which the NR fellow will prepare to conduct his/her study. The NR fellow understands that although support for 18 protected days is provided per the NRF, there remains a certain amount of research time that they need to work on their study that is over and above the research fellowship curriculum.

The NRF consists of online modules and in-person didactic instruction over a period of nine months, followed by additional mentored, protected time to complete the research project. All classes include assignments and benchmarks intended to guide the NR fellows and keep project development on time.[23] Prior to beginning formal research classes, all NR fellows review the online research modules that lay a foundation differentiating NR from evidence-based practice and performance implementation initiatives. The online modules present an overview of research and the development of a National Institutes of Health (NIH) biosketch. The NR fellows also complete courses for Protection of Human Subjects sponsored by the Collaborative Institutional Training Initiative including Good Clinical Practice. These courses are required for all investigators submitting protocols to the MSK IRB for approval.

The class content is presented monthly utilizing a variety of speakers from the Office of NR (ONR) and other areas of research within the institution. During and after the nine months of classes, the NR fellows work independently with an ONR nurse-scientist, with the goal of finishing their studies and developing a presentation to disseminate findings internally at a NR Forum. In addition, the nurse scientist works with NR fellows on conference abstracts and manuscript development. When possible, the NR fellows submit their research protocol for internal and/or external funding mechanisms.

The fellow presentations at the NR Forum serve as an organizational venue and formal graduation. Attended by our hospital administrators, the NR fellows are presented with award plaques in recognition of their research accomplishments and flowers to their nurse leaders in appreciation for supporting a research culture. All staff are invited to attend the NR Forum program.

Table 1: Fellowship Curriculum

Class	18-month timeline: Curriculum/protected days	Description: Preparation/project implementation
0	August: Human subjects protection modules	Online modules: CITI and GCP
	Development of Bio-sketch (online) Overview of research basics (online)	Online modules: Completed by first class. Prepare presentation for the first class
Class	September-November/3 days	1 day/month
1	Differentiate research, evidence-based practice and process improvement	Fellows present their intended study to the cohort group. Feedback provided
	Identify knowledge gaps and problem significance	Preliminary literature searches completed
	Theoretical/conceptual frameworks	Theoretical model selected
2	A comprehensive literature review	Information lists/librarians
3	Quantitative research/statistics	Designs and statistics overview
Class	December-February/6 days	1 class day/1 research day/month
4	Study designs	Using research designs
5	Qualitative research and study designs	Draft of proposal
6	The IRB process	IRB proposal feedback
Class	March-May/9 days	1 class day/2 research days/month
7	Research and technology office and grant funding	Internal/external funding sources; research budget
8	Research dissemination and manuscript prep	Workshop
9	Leadership and organizational change; NR Fellow presentations	Chief Nursing Officer; NR Fellows' projects to date
Class	July-August - independent study	Check-in with mentors
	September-December: Develop presentations	Nursing Research Forum; Nursing Grand Rounds

CITI: Collaborative Institutional Training Initiative; GCP: Good Clinical Practice; IRB: Institutional Review Board

The application process

All nurses working more than one year at MSK are encouraged to apply to the NRF. Selection is based on specific criteria including a current curriculum vitae, a personal statement from the applicant, their interest in the NRF, and short description of the research project. In addition, applicants submit a letter of support from their immediate nurse administrator. The main objective of this letter is to have the applicant discuss the research idea with the nurse administrator. The nurse administrator is a key stakeholder in the NRF because s/he ensures release for classes and that the study meets strategic, organizational, nursing, and unit goals.[5] The applications are reviewed by former NR fellows and interviewed by the nurse scientists. Approximately eight applicants are chosen annually, and acceptance letters are sent to the applicants and their nurse administrator.

Metrics

The evaluation is formative and summative including the impact of the program, class evaluations, cumulative course evaluations, and ongoing narrative assessments from the fellows. All evaluation components are used in NRF program revisions. The NR fellows anonymously complete individual class evaluations, a final evaluation for the course, and suggestions and constructive feedback from these evaluations are key to program revision.

The ONR partnered with the MSK's Nursing Professional Development Department to provide continuing education units (CEUs). There are 28.8 CEUs provided by the NRF. CEUs are an additional incentive for fellows and may be applied to licensure and specialty certification.

The ongoing assessment tool was designed internally[24,25] to collect information about the fellows' progress toward project completion; subsequent research work on the same or different topics; and dissemination of the project result through forums that include posters, podiums, or manuscripts and other nurse-led research initiatives. This research-rich information from the ongoing assessment tool is included in the MSK Magnet®[1] re-designation documents.

The ongoing assessment is disseminated and completed by the current cohort of fellows at the end of their program, and annually to all the past fellows. The assessment is administered through REDCap,[26,27] allowing fellows to respond to a survey link sent by e-mail. The responses captured in the assessment tool are stored in a secure departmental database that serves as a longitudinal repository, highlighting the growth of ONR and MSK nursing's research capacity.

Results

An overview of each cohort is described in Tables 2 and 3. In the past three cohorts, 21 nurses were admitted and 18 (86%) completed the fellowship. More females than males applied, and more females were accepted into the NRF. The NR fellows were evenly distributed across all the three cohorts according to status on the MSK career development ladder (i.e., clinical nurse II-IV). The largest group of NR fellows across all cohorts constituted the clinical nurse III's, $n = 6$ (33%).

The program's return on investment (ROI) is measured in several ways. An NR fellow is considered successful if he/she completes the program and their study with internal dissemination at MSK. The fellows are encouraged and supported to submit findings for presentation at a professional conference and to also submit a manuscript [Table 3]. Several NR fellows leave the fellowship for various reasons. For example, personal issues, moving to another state, the fellowship is not what they expected, and maternity leave. Table 3 shows the number of podium and poster presentations from cohorts 1 and 2, respectively.

There were 15 (83%) NR fellows who conducted IRB-approved studies, two NR fellows who successfully conducted systematic reviews, and one who completed a concept analysis. One NR fellow successfully received external funding for her study. Most NR fellows presented their research studies internally at the MSK, but more than half of the fellows presented podium, poster, and pre-conference workshops at conferences externally. The most impressive finding was the number of journal submissions ($n = 21$) from the NR fellows. A part of measuring ROI includes data about policy and practice changes and that will be collected as the NR fellows' studies mature within the organization.

The cost of the nursing research fellowship

In the climate of doing-more-with-less, decreased third-party reimbursements, and cost containment, an understanding of a ROI is central when budgeting for and maintaining broad leadership support for a research training program. An overview of what was included in developing the NRF budget is shown in Table 4. Rather than salaries, the approximate number of hours to complete the task is provided. Costs according to the hospital or the organization's geographic location may be applied for the estimated dollar cost to implement and maintain a fellowship program. Creative alternatives to offset costs of implementing the fellowship could include seeking funding sources to support educational materials and food and identifying speakers to volunteer to teach lectures.

Table 2: Characteristic of nursing research fellowship cohorts

Demographics by cohort (C) Year	C-1: 2016-2017	C-2: 2017-2018	C-3: 2018-2019*	Total
Demographics of NR Fellows that were admitted to the research fellowship: *n* (%)				
N=Fellows admitted	7	6	8	21
Female	6 (86)	6 (100)	7 (88)	19 (90)
Male	1 (14)	-	1 (12)	2 (10)
Clinical nurse II	-	2 (33)	2 (25)	4 (19)
Clinical nurse III	2 (29)	2 (33)	2 (25)	6 (29)
Clinical nurse IV	1 (14)	-	2 (25)	3 (14)
Clinical nurse specialist	1 (14)	1 (17)	-	2 (10)
Nurse practitioner	2 (29)	-	1 (12.5)	3 (14)
Certified registered nurse-Anesthetist	-	1 (17)	1 (12.5)	2 (10)
Manager	1 (14)	-	-	1 (5)
Demographics of NR Fellows that completed the NRF: *n* (%)				
N=Fellows completed	7 (100)	5 (83)	6 (75)	18 (86)
Female	6 (86)	5 (100)	5 (83)	16 (89)
Male	1 (14)	-	1 (17)	2 (11)
Clinical nurse II	-	1 (20)	1 (17)	2 (11)
Clinical nurse III	2 (29)	2 (40)	2 (33)	6 (33)
Clinical nurse IV	1 (14)	-	2 (33)	3 (17)
Clinical nurse specialist	1 (14)	1 (20)	-	2 (11)
Nurse practitioner	2 (29)	-	1 (17)	3 (17)
Certified Registered Nurse Anesthetist	-	1 (20)	-	1 (5)
Manager	1 (14)	-	-	1 (5)

*Cohort 3: Recent group of fellows, some of whom are still in the data collection and/or analysis of their study. NRF: Nursing Research Fellowship. NR Fellows: Nursing Research Fellows

Table 3: Institutional review board approved studies and research dissemination

Institutional Review Board (IRB) and Funding: Cohort (C) year	C-1: 2016-2017, *n* (%)	C-2: 2017-2018, *n* (%)	C-3: 2018-2019*, *n* (%)	Total, *n* (%)
IRB studies	5 (71)	4 (75)	6 (100)	15 (83)
Non-IRB studies	2 (29)	1 (25)	-	3 (17)
Funded projects	-	1 (20)	-	1 (5)
Dissemination of research: Internal and External				
Dissemination: Internal	7 (100)	4 (80)	6 (100)	17 (94)
N=NR Fellow - Podiums	1 (14)	-	1 (17)	2 (11)
N=NR Fellow - Posters	2 (29)	2 (40)	1 (17)	5 (28)
Total number of external Podiums	1 (14)	-	1 (17)	2 (11)
Total number of external Posters	2 (29)	2 (40)	2 (33)	6 (33)
Preconference workshop	-	1 (17)	-	1 (5)
N=NR Fellow submitted manuscripts	4 (57)	3 (60)	-	7
Number of total manuscripts	8	11	2	21

*Cohort 3: Recent group of NR fellows, some of whom are still in the data collection and/or analysis of their study

Discussion

Challenges and unexpected obstacles

There were organizational obstacles encountered during the NRF cohorts. At MSK, several changes happened that impacted submission of a protocol to the IRB. The IRB instituted new costs based on the type of protocol to be submitted and these costs may delay the actual study time frame. To address this need, we looked for nurse scientist mentors, statistical support to facilitate study design, and funding for the study.

Lessons learned

Announcements for fellowship applications are sent to nurses to give enough time for necessary conversations with leadership, determine a topic for study, and complete the human subjects protection modules and application forms. The application process was revised and begins early in the calendar year. This change allows for a longer application period and encourages NR fellows to propose studies on topics that align with the nurse scientist's program of research. This alignment is intended to promote greater synergy from the collective efforts of NR fellows and faculty

Table 4: Budgets and costs for building a Nursing Research Fellowship

Costs in developing the NRF*	Hours* (h)
Speakers (honorarium)	4 h/class
Meeting space/classes and research days	10 h/16 days
A/V equipment	$50/class
Videoconferencing charges	$265/video class
Graduation - auditorium and reception	2 h
Class: Lunch/break food costs	Breakfast $9/lunch $14 per person
Books/1 class book/1 reference	$ 82 per person
Costs in hours for staff/nurse-scientists	
Mentoring - class time	4 h number of NR Fellows
Individual fellow meetings/guidance	1-2 h/meeting
Continuing Ed credit - content development	3-4 weeks/content development
Continuing Ed credit - regulatory forms/submission	1-2 weeks/submitted >45 days before the 1st class
Annual review of content	1 week
Costs for individual nurse's participation	
18 protected days/independent study days	RN hourly rate/8-10 h
Cost to the unit for coverage for NR Fellow/backfill	Per diem rate/shift type
Incidental/optional costs	
Graduation flowers/number of fellows and unit leadership	$22/number of NR Fellows and unit leadership
Plaques/award/number of NR Fellows	$140/number of NR Fellows

*NRF costs associated with our program and depending on choices/options may have different costs in other locations. NRF: Nursing Research Fellowship

and to offer the fellows greater access to mature research datasets or the opportunity to develop complementary projects.

Implications

In this article, barriers reported in the literature were evaluated along with feedback from nurses who were in the earlier evidence-based practice (EBP) program to revise and build research capacity with sustainable infrastructure for research studies. The NRF is part of a comprehensive cancer center that supports staff nurses to explore funding opportunities and successfully complete research studies. Although MSK implemented an NRF that appears costly when compared to other organizations, the costs of the program are outlined so that another organization can choose components of the NRF that are appropriate for their setting and budget.

Conclusion

Nursing research is essential for generating science supporting evidence-based policies and nursing practice that is pivotal for providing patient care.[7] As an ANCC Magnet® designated hospital and distinguished comprehensive cancer center, the NRF at MSK is a key success factor for supporting nurse-led research.

Creatively utilizing the available eLearning, video, and teleconferencing resources potentially can expand the program beyond the face-to-face classroom setting. The transparency of the application process, the availability for nurses to attend individual NRF classes as nonfellows, and the inclusion of nurse-scientists demonstrate the critical need for the Office of Nursing Research and a NRF in supporting nursing research and the commitment to fostering capacity and infrastructure within the organization.

Acknowledgments

We wish to thank Cynthia Paradiso, MA, RN, PhD Student, PACE University, Pleasantville, NY, for technical support and proofreading.

Financial support and sponsorship

This study was financially supported by the Memorial Sloan Kettering Cancer Center NIH/NCI Cancer Center Support Grant (Grant No. P30CAoo8748).

Conflicts of interest

There are no conflicts of interest.

References

1. American Nurses Association, American Nurses Credentialing Center Magnet Recognition Program. Available from: https://www.nursingworld.org/organizational-programs/magnet/. [Last accessed 2020 Apr 09].
2. Johantgen M, Weiss M, Lundmark V, Newhouse R, Haller K, Unruh L, *et al*. Building research infrastructure in Magnet® hospitals: Current status and future directions. J Nurs Admin 2017;47:198–204.
3. Clements-Hickman AL, Wilson J, Wright L, Davies C. Developing a research friendly hospital-based environment: A fellowship model focused on graduate students. Nurs Admin 2019;49:624-7.
4. Mason B, Lambton J, Fernandes R. Supporting clinical nurses through a research fellowship. J Nurse Admin 2017;44:529-31.

5. Stutzman S, Olson DW, Supnet C, Harper C, Brown-Cleere S, McCulley B, Goldberg M. Promoting bedside nurse-led research through a dedicated neuroscience nursing research fellowship. J Nurs Admin 2016;46:648-53.
6. Latimer R, Kimbell J. Nursing research fellowship: Building nursing infrastructure in a hospital. J Nurs Admin 2010;40:92-8.
7. Scala E, Price P, Day J. An integrative review of engaging clinical nurses in nursing research. Nurse Scholarship 2016;48:4, 423-30.
8. Reid Ponte P, Hayman L, Berry DL, Cooley ME. A new model for postdoctoral training: The postdoctoral nursing research fellowship in cancer and health disparities. Nurs Outlook 2015;63:189-203.
9. Weaver S, Hessels AJ, Paliwal M, Wurmser TA. Administrative supervisors and nursing unit-based managers: Collaboration and job satisfaction. Nurs Econ 2019;37:67-75.
10. Hinds PS, Gattuso J, Morrell A. Creating a hospital-based nursing research fellowship program for staff nurses. Nurs Admin 2000;30:317-24.
11. Kelly KP, Turner A, Speroni KG, McLaughlin MK, Guzzetta CE. A national survey of hospital nursing research, part 2: Facilitators and hindrances. J Nurs Admin 2013;43:18-23.
12. Chan R, Gardner GE, Webster J, & Geary A. Building research capacity in the nursing workforce: The design and evaluation of the nurse research role. Aust J Adv Nurs 2010;27:62-9.
13. Gruber J, Prinsteinm MJ, Davila J, Klein DN, Borelli JL, Clark LA, *et al*. Best practices in Research Mentoring in Clinical Science. J Abnorm Psychol 2020;129:70-81.
14. Edwards N, Webber J, Mill J, Kahwa E, Roelfs S. Building capacity for nurse-led research. Int Nurs Rev 2009;56:88-94.
15. Hetland B, Lindroth H, Kamp K, Edmiston E, Wierenga KL, Hardin HK, *et al*. The emerging scholars' network within Midwest Nursing Research Society (MNRS): From acorns to oaks. West J Nurs Res 2020;42:143-52.
16. Pintz C, Zhou QP, McLaughlin MK, Kelly KP, Guzzetta CE. A national study of nursing research characteristics at Magnet®-designated hospitals. J Nurs Admin 2018;48:247-58.
17. Gilbert J, Morton S, Rowley J. e-Learning: The student experience. Brit J Educ Technol 2007;38:560-73.
18. McGowan BS, Balmer JT, Chappel K. Flipping the classroom: A data-driven model for nursing education. Contin Educ Nurs 2014;45:477-8.
19. Koltay T. Quality of open research data: Values, convergences and governance Inform. 2020;11:175. Available from https://www.mdpi.com/2078-2489/11/4/175. [Last accessed 2020 Jul 01].
20. Tenopir C, Rice NM, Allard S, Baird L, Borycz J, Christian L, *et al*. Data sharing, management, use, and reuse: Practices and perceptions of scientists worldwide. PLoS ONE 2020;15: e0229003. https://doi.org/10.1371/journal.pone.0229003. [Last accessed 2020 Jul 01].
21. Alsubaie MA. Curriculum development: Teacher involvement in curriculum development. J Educ Practice 2016;7:106-7.
22. Birks M, Ralph N, Cant R, Tie YC, Hillman E. Science knowledge needed or nursing practice: A cross-sectional survey of Australian Registered Nurses. Collegian J Royal College Nurs Aus 2018;25:209-15.
23. McLaughlin MK, Speroni KG, Kelly KP, Guzzetta C, Desale S. National survey of hospital nursing research, part 1: Research requirements and outcomes. Nurs Admin 2013;43:10-7.
24. Zhao Y, Ho AD. Evaluating the Flipped Classroom in an Undergraduate History Course. Harvard-X Research Memo; 2014. Available from: https://harvardx.harvard.edu/files/harvardx/files/evaluating_the_flipped_classroom_-_zhao_and_ho.pdf. [Last accessed on 2020 Jun 02].
25. Szparagowski R. The Effectiveness of the Flipped Classroom. Bowling Green State University, Honors Projects; 2014. p. 127. Available from: https://scholarworks.bgsu.edu/honorsprojects/127. [Last accessed on 2019 Sep 17].
26. Harris PA, Taylor R, Thielke R, Payne J, Gonzalez N, Conde JG. Research electronic data capture (REDCap)-a metadata-driven methodology and workflow process for providing translational research informatics support. J Biomed Inform 2009;42:377-81.
27. Harris PA, Taylor R, Minor BL, Elliott V, Fernandez M, O'Neal L, *et al*. on behalf of The REDCap Consortium: Building an international community of software partners. J Biomed Inform 2019;95:10328. Available from https://doi.org/10.1016/j.jbi.2019.103208. [Last accessed on 2019 Oct 12].