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The effect of Personal Digital Assistants in supporting the development of clinical reasoning in undergraduate nursing students: a systematic review

Abstract

The knowledge and skills mandate of nurses in the 21st Century have evolved in complexity and depth. Nurses are required to engage in higher cognitive thinking processes for safe and effective practice. The ability to integrate theoretical knowledge as it applies to the individual context of the patient to prevent or amend an adverse event has born testimony to nursings' professional development. A symbiotic relationship exists between nursing theoretical knowledge and nursing practice; however a gap exists in reality for integrating and contextualising nursing knowledge into the clinical environment following graduation from tertiary institutions.

Keywords

review, systematic, nursing, assistants, digital, personal, students, undergraduate, reasoning, clinical, development, supporting, effect

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**The effect of Personal Digital Assistants in supporting the development of
clinical reasoning in undergraduate nursing students**

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Background

The knowledge and skills mandate of nurses in the 21st Century have evolved in complexity and depth. Nurses are required to engage in higher cognitive thinking processes for safe and effective practice. The ability to integrate theoretical knowledge as it applies to the individual context of the patient to prevent or amend an adverse event has born testimony to nursings' professional development¹.

A symbiotic relationship exists between nursing theoretical knowledge and nursing practice; however a gap exists in reality for integrating and contextualising nursing knowledge into the clinical environment following graduation from tertiary institutions².

Clinical reasoning can be likened to the thread that binds the two pieces of nursing theory and practice together.

Numerous theories and models have been applied to describe clinical reasoning³⁻⁵ and no one standard definition exists at present. For the purpose of this systematic review clinical reasoning can be defined as a cognitive process that manifests into an action among the four categories of clinical skills, clinical knowledge, problem solving capabilities and reflection^{6,7}.

Other frequently used terms include: critical thinking, nursing judgement, critical reflection, decision making, information processing and the nursing process, however not all these terms will meet the criteria for clinical reasoning adopted in this paper.

Traditional teaching resources are resources currently used in nursing education to facilitate reflective learning which include textbooks and verbal guidance from educators or mentors^{8,9}.

New teaching methods which promote the early development of clinical reasoning, such as personal digital assistant devices (PDAs), requires further exploration in the nursing literature to

ensure changes are based on best practice. The potential significance of doing so means a bridging of the practice-theory gap and ensuring future practitioners are confident in decision making and reflective practice.

PDA's are hand held computing devices that have the functional capacity to access programs such as *Adobe Reader*, open and document in *Microsoft Word* files, or other applications that store and organize personal information. They are also capable of wireless connections to the internet, as well as storing and running add on software such as clinical references and clinical decision support systems¹⁰. These multifunctional devices are also frequently known as pocket PC, handheld computers and palm technology. The recently released *Apple iPad* will be considered in this review, as will the newer technology of smartphones if usage reflects that of a PDA device.

The use of the PDA in nursing education has gained attention with the expansion of the capabilities of the PDA beyond an organisational tool to include medical and nursing references and access to wireless internet services¹⁰.

However a paucity of literature in nursing, focusing on PDA usage and clinical reasoning currently exists. Kuiper¹¹ is one such researcher exploring this area through her descriptive comparative design on undergraduate nursing students in the United States of America. Her outcome measure for clinical reasoning in this study was described in terms of problem solving and decision making¹¹. The study revealed that the use of PDA's were no more effective in supporting clinical reasoning than the use of traditional textbooks as a resource tool¹¹.

Conversely, some studies showed that the use of PDA's is beneficial to clinical reasoning development. A non-randomised quasi-experimental project conducted on undergraduate nursing students in the United States of America, measured the effect of PDA's in reducing medication errors¹². Findings from this study revealed an improvement in accuracy and time efficiency in

comparison to textbook users¹². Another study using a comparative group design concluded that PDAs are beneficial in reducing student dependence on faculty staff as a dominant resource means¹³.

While findings appear to be inconclusive, it is hypothesised that PDAs can potentially prove to be a useful resource for clinical reasoning development through supporting elements of the process such as improving accuracy, time efficiency and by providing access to a wider variety of relevant and current clinical information readily. PDA devices may in fact help to construct a clearer picture of the patient context and by these means improve students' problem and decision making skills^{14,15}.

Determinants for PDA adoption in nursing education identified in the literature include, issues with interface and the level of skill required to use the device^{13,15,16}, limited recourses¹⁶ and the costs to institutions to implement this technology^{18,19}. These issues require further attention in the nursing literature due to the potential to impede the development of clinical reasoning among nursing students.

Overall, research into PDAs in nursing education is only beginning to emerge in the nursing literature with the first study conducted in 2001 at the University of Virginia with a sample of graduate nurses^{11,18}. Since this time, momentum has gradually gained with the greatest aggregation of studies focusing on PDAs as a reference tool for nursing students^{11,13,14,16,19,20}.

The majority of nursing quantitative studies use comparative^{11,13} and quasi-experimental designs^{12,16}. Mixed method design and qualitative studies are also largely present in the nursing literature^{14,15,19}.

The current fascination with information communication technology is anticipated to make nursing education confront traditional methods of education delivery and its place in a technological age.

A search of the Cochrane Collaboration Library of Systematic reviews, Australasian Digital Thesis Program and The Joanna Briggs Institute Library of Systematic reviews have revealed that no current systematic review examining the use of PDAs to support the development of clinical reasoning in undergraduate nursing students currently exists. With interest already present in this focus of study, a thorough systematic review of the literature is necessary to ensure the large financial expenditure needed to incorporate the changes to university infrastructure is well founded in quality evidence and that these changes will indeed improve the development of clinical reasoning for future nurses.

Review Objective/ Question

Review Objective

The objective of this systematic review is to identify whether the use of Personal Digital Assistants (PDAs) in undergraduate nursing education facilitates the development of nursing clinical reasoning skills.

Review Question

Are Personal Digital Assistants (PDAs) more effective than traditional teaching resources in supporting the development of clinical reasoning in undergraduate nursing students?

Inclusion Criteria

Types of Studies

All randomised and quasi- randomised controlled trials will be included in the review to achieve findings of substantial quality to be used as a basis for evidence based practice. In the absence of

randomised and quasi-randomised controlled trials, other types of studies will be considered including, cohort studies, case- control studies and cross-sectional studies.

Types of Participants

Only studies where undergraduate nursing students studying within a tertiary institution are the participants will be considered eligible for this study. All stages or level of experience within the undergraduate nursing course, age in years and gender of undergraduate nursing student will be included.

Types of intervention

Intervention: Personal Digital Assistant use

Comparison: Traditional teaching resources

Methods of the delivery of the comparison will be inclusive of the classroom, hospital, or simulated environment (written, audiotaped, computer or human patient simulations).

Types of Outcome Measures

The primary outcome measure for this systematic review is clinical reasoning.

Traditional methods of studying clinical reasoning have centered on the outcome of reasoning as reflected in actions or outcomes⁷. This is evident in studies testing relevant knowledge or skills through paper based exam questions or clinical practicum examinations⁷. It is the degree of accuracy or ability to identify clinical cues that determine the success of the reasoning process^{5,6}.

These methods are favored in quantitative studies due to their objective and measurable outcome.

Reflection is defined as the activity of cognitively reflecting on concluded outcomes or actions⁶.

Whilst not always acknowledged in traditional paradigms of clinical reasoning, reflection is a

significant step in identifying cause and effect and may even serve as a lever board for further problem solving.

In this review, the basis for the outcome measure of clinical reasoning among nursing students will comprise of four categories being; clinical skills, clinical knowledge, problem solving capabilities and reflection^{6,7}.

Other outcome measures may include:

- 1) Students self perception of alteration in clinical reasoning; as clinical reasoning is a cognitive process, manifestations may not always be measurable but may be perceived by the student as an increase in confidence or knowledge.
- 2) Students satisfaction with the use of the PDA
- 3) Student usage of the PDA
- 4) Problems identified with its implementation and strategies used to overcome such difficulties.

Search strategy

This systematic review will seek to identify both published and unpublished literature which will be limited to the English language between the years 1993 to the present. It has been identified that the first palm device was developed in 1993²¹ thus it is not anticipated that trials relating to nursing education exists prior to this date.

An initial keyword search in MEDLINE and CINAHL will be undertaken. Attention will be made to the controlled vocabulary required of certain databases identified through equivalent MESH searches, and search key terms will be altered in accordance with the variances of terminology and spelling.

Initial keywords to be used to commence searching will include:

- 1) Nurs* Students

- 2) Undergrad* Nurs*
- 3) PDA* OR Personal Digital Assistants
- 4) Computer* handheld
- 5) Handheld computer*
- 6) Pocket PC
- 7) Smartphone*
- 8) Clinical information retrieval technology
- 9) Palm technology
- 10) Apple iPad
- 11) Clinical reasoning
- 12) Nursing judgment*
- 13) Diagnostic reasoning
- 14) Decision making
- 15) Critical thinking

Identified keywords will then be used in a number of combinations using Boolean terms such as “OR” and “AND” to search electronic databases in the search category ‘article, title, abstract and key terms’ to refine available data to the specified topic under investigation.

The databases to be searched for primary literature include:

- a) MEDLINE
- b) CINAHL
- c) Meditext
- d) Cochrane Library
- e) Scopus

The search for unpublished literature will include:

- 1) Digital Dissertation

- 2) conference Proceedings
- 3) Reference lists and bibliographies of all relevant trials and reviews will be searched
- 4) *Apple, Hewlett-Packard* and *Palm* company representatives will be contacted to identify findings or contemporary research in the field.

Methods of the review:

Assessment of methodological quality

Papers selected for retrieval will be assessed by two reviewers for methodological validity prior to inclusion in the review using appropriate standardised critical appraisal instruments from JBI-MASStARI (Joanna Briggs Institute Meta Analysis of Statistics Assessment and Review Instrument) (Appendix I). A third reviewer will be consulted when an agreement cannot be reached. In the instance of replicated studies, these articles will only be included once.

Data Extraction

Quantitative data will be extracted from papers included in the review using the standardised data extraction tool from JBI- MASStARI (Appendix II). The data extracted will include specific details about the interventions, populations, study methods and outcomes of significance to the review question and specific objectives.

Data Synthesis

The JBI-MASStARI software will be used to perform meta-analysis of quantitative data using appropriate data synthesis approaches as recommended for different types of data by the JBI Reviewers manual 2008 edition.

Where meta-analysis cannot be performed, data will be presented in a narrative summary form.

Potential conflicts of interest

None

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Appendix I

JBI Critical Appraisal Checklist for Experimental Studies

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

Yes No Unclear

1. Was the assignment to treatment groups truly random?
2. Were participants blinded to treatment allocation?
3. Was allocation to treatment groups concealed from the allocator?
4. Were the outcomes of people who withdrew described and included in the analysis?
5. Were those assessing outcomes blind to the treatment allocation?
6. Were the control and treatment groups comparable at entry?
7. Were groups treated identically other than for the named interventions?
8. Were outcomes measured in the same way for all groups?
9. Were outcomes measured in a reliable way?
10. Was appropriate statistical analysis used?

Overall appraisal: Include Exclude Seek further info.

Comments (Including reasons for exclusion)

JBI Critical Appraisal Checklist for Comparable Cohort/ Case Control

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

Yes No Unclear

1. Is sample representative of patients in the population as a whole?
2. Are the patients at a similar point in the course of their condition/illness?
3. Has bias been minimised in relation to selection of cases and of controls?
4. Are confounding factors identified and strategies to deal with them stated?
5. Are outcomes assessed using objective criteria?
6. Was follow up carried out over a sufficient time period?
7. Were the outcomes of people who withdrew described and included in the analysis?
8. Were outcomes measured in a reliable way?
9. Was appropriate statistical analysis used?

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

JBI Critical Appraisal Checklist for Descriptive/ Case Series

Reviewer _____ Date _____

Author _____ Year _____ Record Number _____

Yes No Unclear

1. Was study based on a random or pseudo-random sample?
2. Were the criteria for inclusion in the sample clearly defined?
3. Were confounding factors identified and strategies to deal with them stated?
4. Were outcomes assessed using objective criteria?
5. If comparisons are being made, was there sufficient descriptions of the groups?
6. Was follow up carried out over a sufficient time period?
7. Were the outcomes of people who withdrew described and included in the analysis?
8. Were outcomes measured in a reliable way?
9. Was appropriate statistical analysis used?

Overall appraisal: Include Exclude Seek further info

Comments (Including reason for exclusion)

Appendix II

JBI Data Extraction Form for Experimental/Observational Studies

Reviewer Date

Author Year

Journal Record Number

Study Method RCT Quasi-RCT Longitudinal

Retrospective Observational Other

Participants

Setting

Population

Sample size

Intervention 1 Intervention 2 Intervention 3

Interventions

Intervention 1

Intervention 2

Intervention 3

Clinical outcome measures

Outcome Description	Scale/ Measure

Study results

Outcome	Intervention () Number/ Total Number	Intervention () Number/ Total Number

Continuous data

Outcome	Intervention () Mean & SD (number)	Intervention () Mean & SD (number)

Authors Conclusions

Comments