ORIGINAL ARTICLE

An exploration of IPAC educational intervention research: What do we mean by education?

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ABSTRACT

Background: Education is considered an important component of Infection Prevention and Control (IPAC) practice. A shift has occurred from exploring how education plays a role in changing healthcare provider infection control practices to increased interest in the use of multimodal interventions. However, several comprehensive systematic literature reviews have identified theoretical, conceptual and methodological challenges in IPAC educational intervention research.

Methods: To gain deeper insight into the challenges, a qualitative review was conducted using a content analysis of 122 papers published between 1989 and 2017.

Results: IPAC educational practice and research is predominantly informed by the traditional educational paradigm of knowledge acquisition, with a commitment to quantitative research methodologies that treat education as a static tool. Limited attention is given to educational theories, teaching and learning concepts and instructional design processes.

Conclusions: IPAC educational practice is constrained by implicit philosophical assumptions about education as information delivery. This paper proposes a paradigm shift from transmission educational practices to those more attuned to the concepts of teaching and learning. By making this shift, IPAC can begin to address the challenges identified in the literature and explore educational theories, contemporary active and engaged teaching and learning processes, instructional design frameworks, and using innovative educational research methodologies.

KEYWORDS:
Infection prevention and control; education; teaching and learning

INTRODUCTION

Education is considered an important component of Infection Prevention and Control (IPAC) practice. Infection Control Professionals (ICPs) describe their role as educators to be central to their practice because it is embedded in every aspect of their consultative role in promoting IPAC practice and patient safety [1]. However, the limited conceptualization of education in IPAC research and practice has led to undervaluing education's role in and contribution to facilitating behaviour change. This paper is the first in a series of four that explore IPAC educational research and practice and the need to build ICP educational expertise by focusing on teaching and learning processes to explore the full value and potential of IPAC education.

Recommendations have been made to move toward the use of multimodal interventions, shifting focus away from reliance on education to incorporating the use of bundles, utilizing aspects of social science and health behaviour models [2, 3, 4]. However, in multimodal approaches, education is integrated primarily to promote knowledge acquisition, without paying critical attention to what IPAC means by education, how it is applied, and how and what healthcare providers learn as a result of education [4]. A shift away from using education to promote behaviour change may be premature. Six systematic literature reviews examining IPAC educational intervention studies identified three areas of concern linked to the lack of success: 1) minimal attention is given to a *priori* pedagogical assumptions informing IPAC educational intervention research; 2) limited consideration is given to education as a construct; and 3) significant methodological challenges exist with the application of experimental research designs, the quality of data collected and the resulting inconclusive findings [5, 6, 7, 8, 9, 10].

The central goal of education is to facilitate learning. Etienne Wenger, founder of "Communities of Practice," contends that "our perspectives on learning matter: what we think about learning influences where we recognize learning, as well as what we do when we decide we must do something about it – as individuals, as communities, and as organizations" [11, p. 4]. The concept and process of learning has been largely overlooked in IPAC educational intervention research. Limited attention is given to questions about where and how learning occurs, and the role learning plays in influencing beliefs, attitudes, motivations and behaviour change at individual, community and organizational levels. IPAC is hindered by a circumscribed conceptualization and practice of education in our research. This paper proposes a paradigm shift from IPAC's existing view of education to more contemporary conceptualizations of teaching and learning.

MATERIALS AND METHODS

To gain deeper insight into how education is conceptualized and applied in IPAC educational intervention research, a content analysis, involving a qualitative thematic exploration of text using a broad interpretive approach to summarize important facets of the materials being analysed, was used to review 122 research papers published between 1989 and 2017 [12]. Text from each paper was systematically reviewed and coded into the categories described in Table 1. The coding scheme was informed by the principles of grounded theory [13]. Categories, created in advance by the researcher, were based on the IPAC educational literature and pedagogical concepts from the Learning Sciences, a multidisciplinary field focused on the study of learning processes and the design and implementation of effective learning environments [14].

Selection criteria

The 122 papers were selected from a review of 280 papers that were either referenced in the six systematic literature reviews of IPAC educational research, or identified in a literature search of papers published between 2012 and 2017. Combinations of the key words 'education', 'teaching', 'training', 'professional development', 'instruction', 'in-service', 'curriculum', 'infection prevention and control', 'healthcare personnel', 'healthcare providers', 'healthcare professionals', and 'healthcare workers' were searched for in PubMed, Medline and CINAHL databases to find relevant publications. Papers were excluded if education was not identified as an intervention in the study, the paper was not available in English, or it was an abstract. (See Appendix A at *https://ipac-canada.org/cjic-abstracts-online-journal-2.php.*)

RESULTS

Research design

The majority (106/122, 86%) of papers employed quantitative research methods; experimental or quasi-experimental research designs were the most common (82/106, 77%), such as before/after studies. As an intervention variable in these studies, education was generally treated as a static tool congruent with traditional reductionist research philosophy. Despite being a core variable in these designs, limited attention was given to the concept of education, its meaning, utility or boundaries as a construct. Most studies focused on the clinical problems they were trying to impact and on measurable outcomes, and gave limited consideration to how the educational intervention might address those problems and facilitate the achievement of outcomes. Only one study utilized an educational research methodology, Action Research, to study teaching and learning of IPAC principles.

Categorizing types of interventions

Categorization of educational interventions proved challenging due to the heterogeneity in terminology used in the papers. Without a clear conceptual framework, there was ambiguity around what was considered an educational strategy in a study. Consequently, various strategies were inconsistently applied. For example, it was often unclear if posters were designed and implemented as a social marketing intervention to create awareness and provide behavioural cues, or whether these were designed to deliver explicit declared knowledge. Similarly, it was often unclear if feedback was used as an approach to practice improvement, or as a motivational tool to create social awareness and pressure to facilitate cultural or behavioural change.

Over the two decades in which the 122 papers were published, two events impacted the types of educational interventions being researched. The first was an increased interest in using multimodal approaches [15, 16]. The second and more predominant was the proliferation of Internet and digital technologies impacting teaching and learning [17]. In response, the types of educational interventions and strategies were grouped into three periods based on the decade of publication: prior to 2000, between 2000–2009, and 2010–2017 (see Tables 2 and 3).

Overall, multimodal interventions were the dominant type reported in the studies (48/122, 39%). The exploration of single interventions has been increasing and constitutes 48% of educational interventions since 2010, perhaps due to increased focus on online and simulation strategies. Most papers exploring simulation were published after 2013 and focused on teaching in post-secondary institutions, or on organisation disaster planning and preparation for Ebola. Studies of online learning generally focused on its efficacy in delivering information compared to face-to-face education. Despite being described as interactive, most online education still followed a passive content delivery format.

Education theory, learning concepts, and instructional design

Education theories, learning concepts, and instructional design constitute underlying conceptual foundations of educational research and inform the choice of research questions, methodology, design of an intervention, as well as the intended outcomes. In reviewing the studies, each of these three categories was given a broad definition so that coding might be

TABLE 1: A summary of categories used for coding in the content analysis

Categories	Description
1**. Type of Intervention**	Based on purpose or use of the education, number, and type of educational interventions identified in the study
a. Single b. Multi-educational c. Multimodal with education d. Comparison of methods	a. One type of educational intervention being used/explored b. More than one type of educational intervention being used c. The use of multiple types of interventions, including education as at least one type of intervention d. Two or more types of educational approaches being compared to each other
2. Theory	Any generalized thinking providing an explanatory framework informing the educational intervention or research
a. Formal Theory b. Principles/ideas c. Assumptions	a. Any education, learning or instructional design theory b. Concepts providing a framework used to make predictions, explain education, or inform understanding of the education intervention c. Assumptions (explicit or implicit) regarding the education intervention and learning outcomes
3. Learning	Use of the term learning particularly in relation to acquiring, modifying or reinforcing knowledge, behaviours, skills and values
a. Description b. Aspects of Learning	a. Any description or discussion of learning regarding the intervention b. Any discussion of learning domains, assessment, transfer or process
4. Instructional Design	Any discussion of a systematic process or learning and design theory, in part or in whole, for educational strategies and materials used to support either instruction or learning
a. Assessment b. Design c. Development d. Implementation e. Evaluation	a. Assessment of instructor or learner needs b. Design/creation of elements that will be used c. Development of activities and resources that will be used d. Implementation/pilot testing and roll out of activities e. Evaluation of materials – did they achieve the learning or instructional intent
5. Learning Ecology	An ecology that explores the relationships between instructor, learner, content, activities and environment
a. Learners b. Teachers c. Content d. Strategies e. Environment	Any discussion related to: a. Learners (students, healthcare staff) b. Teachers (instructors, educators, Infection Control Professionals) c. Educational content and domain knowledge, skills, procedures d. Types of educational activities, tools, aids and resources used e. The context in which the educational intervention is offered and the type of learning environment in which it occurs (e.g., online, practice setting, classroom)

TABLE 2: Types of educational interventions grouped by year published

Type of Educational Intervention[a]	Year Article Published			Total
	< 2000 N=11	2000-2009 N=65	2010-2017 N=46	All Years N=122
Single Education	1 (9%)	17 (26%)	22 (48%)	40 (33%)
Multi-education	7 (64%)	11(17%)	11 (24%)	29 (24%)
Multimodal with education	3 (27%)	33(51%)	12 (26%)	48 (39%)
Comparison of methods	0	4 (6%)	1 (2%)	5 (4%)

[a] Definitions for the various types of interventions are provided in Table 1.

as inclusive as possible. Almost three quarters (88/122, 72%) of the papers made no reference to any of the three categories, and only 10 studies (8%) discussed all three. Appendix B summarizes those studies which dealt even minimally with these educational concepts. (See Appendix B at *https://ipac-canada.org/cjic-abstracts-online-journal-2.php*.) Studies that made reference to all three categories were often exploring educational approaches such as online learning, simulation, and novel interventions like the use of peers, role models or musical parodies. Discussion in each of the three categories varied, ranging from cursory to an in-depth exploration of either the theoretical framework, learning concepts or design of an intervention.

Theory
In only 20% of the studies (24/122), the chosen interventions were intentionally informed by a theoretical framework, philosophy or explicit assumptions grounded in a variety of educational, behavioural or organizational change theories and models. In only one study the described educational theory intentionally informed the choice of research methodology.

For those studies providing a cursory discussion of the theoretical or conceptual frameworks, the focus tended to be on a description of 'what', rather than on an exploration of 'how' or 'why' the theory informed the research. Minimal attention was paid to how the theoretical framework supported the choice of educational intervention or facilitated learning, or why that intervention might achieve the intended

research outcomes. Studies that provided more detailed theoretical discussions focused on the 'how' of the learning process, that is, by what means the educational strategies might impact learning. These studies moved beyond treating educational activities as static intervention tools and attended to aspects of teaching and learning strategies that were more likely to facilitate knowledge acquisition, learning, and the transfer of new knowledge and skills into practice.

Learning
Only 15% of studies discussed concepts related to teaching and learning (18/122). While some explored the affordances and hindrances of the strategies in facilitating learning, studies that attended to the 'how' of the learning process focused on concepts such as learning by doing, interactivity, problem-solving, critique, coaching and reflection. They discussed how these concepts facilitated learning and how they could be used to achieve learning outcomes. However, most of the discussion about learning provided a description of teaching and learning concepts rather than how these concepts might be applied to facilitate teaching and learning, and how that new learning might transfer into practice and influence behaviour change.

Simply describing teaching and learning concepts leaves as implicit the process by which those concepts might achieve the desired educational outcomes. The reason for their application and the implications of their use varied across the studies, and remained unclear. As an example, in the studies

TABLE 3: Educational strategies used in interventions grouped year published				
Tool or Teaching Strategy	**Year Articles Published**			**Total**
	< 2000 **N=11**	**2000-2009** **N=65**	**2010-2017** **N=46**	**All Years** **N=122**
Lecture/training	7 (63%)	31 (48%)	21 (45%)	59 (48%)
Demonstration	5 (45%)	9 (14%)	8 (17%)	22 (18%)
Video	3 (27%)	7 (11%)	4 (8%)	14 (11%)
Poster	4 (36%)	19 (29%)	7 (15%)	30 (25%)
Feedback	5 (45%)	10 (15%)	7 (15%)	22 (18%)
Documents (brochure, policy, articles)	4 (36%)	13 (20%)	6 (13%)	23 (19%)
Online learning	0	10 (15%)	13 (28%)	23 (19%)
Simulation	0	1 (2%)	10 (22%)	11 (9%)
Other (e.g., games, role models, screensavers, musical parody)	4 (36%)	12 (18%)	4 (8%)	20 (16%)
Not described	0	9 (14%)	2 (4%)	11 (9%)

'interactivity' could mean interactions between learners and technology, groups interacting collaboratively through activity and discussion, or individuals interacting with game content. As the purpose for interactivity was not explicit, the intended impact on the learning process and outcomes was unclear. Sometimes, interactivity engaged the learner in passive or lower order learning processes, rather than higher order thinking such as critical evaluation and reflection, which can result in deeper learning.

Instructional design

Instructional design is the systematic development of educational strategies to facilitate high-quality teaching and effective learning experiences. Given limited attention to learning processes, it was not surprising that discussion focused on the research design. Discussion about the design of the educational interventions was identified in only 18% of the studies (22/122).

As with theory and learning, these discussions mostly provided a description of the educational strategies in the materials and methods sections, consistent with treating education as a tool. In a few studies, the educational theory informed the design of teaching and learning strategies. Three studies provided an in-depth discussion of the design of the educational intervention, two of which used the ADDIE instructional design model, (Assessment, Design, Development, Implementation and Evaluation).

The ecology of learning (learners, teachers, content, strategies and environment)

An ecological perspective of the learning environment considers the context in which the learning occurs. From this perspective, learning is a complex, dynamic process that occurs across interactions between learners, teachers, content, strategies and environment in which the teaching and learning occurs. Given limited emphasis on the learning process, limited attention was also given to learning ecology. In almost all the studies reviewed, components of the learning ecology were simply listed or briefly described in the studies' materials and methods section.

Educational strategies were provided as a list in almost all of the studies (120/122, 98%), the most frequent being formal or informal lectures, in-services, rounds and workshops (59/122, 48%). The next most frequently listed component was the domain content topic addressed in the education (116/122, 95%), and a general listing of the type of learners who received the intervention (115/122, 94%). Little information was provided regarding learner needs, experience, engagement, motivation or roles. Only one third of the studies identified the teacher or instructor. Even then, there was limited discussion regarding teachers' pedagogical expertise, involvement in the design of the educational strategies, or their teaching approach.

The least addressed aspect of the learning ecology was the environment in which the learning occurred. Only 7% of the studies explored the impact of context on learning (9/122), by discussing the social and cultural perspectives in clinical or other learning environments, the interactions and relationships between learners, the activities, technology or the teachers involved. Discussion of the learning environment was most likely to occur in studies that explored less traditional approaches such as online learning, simulation or the use of peer groups.

DISCUSSION

A central goal of education is to provide learning experiences that can be transferred or modified from the context in which learning occurs to another context where it can be applied [18]. The process of learning is complex and dynamic, and involves the development of knowledge and abilities, and also of emotions, attitudes and sociality [19]. Because of this complexity, clarity is needed about what is meant by education; assumptions need to be explicit and research grounded in theoretical frameworks. *A priori* epistemological assumptions influence both the theoretical framework informing the research, and the choice of educational and research designs [20].

Theoretical and design frameworks provide a foundation from which the research questions, methodology, interventions and outcomes can be systematically and intentionally threaded together.

The findings from this content analysis demonstrate that limited attention is given in IPAC education research to the complex and dynamic nature of the teaching and learning processes involved. This often results in implicit and unexamined educational assumptions informing the educational approaches used in that research. The approaches tend to follow a teaching as telling paradigm, focused on information delivery by knowledgeable experts to individual learners. The problem is that the educational strategies employed in information giving processes tend to engage lower order cognitive activities such as remembering and understanding, and facilitate passive learning that is less than ideal for producing behaviour change [17]. These approaches tend to result in what is considered de-contextualized knowledge that does not necessarily prepare the learner for their workplace practice, nor assist them in knowing how to apply or modify acquired knowledge in each new situation they face [17, 21].

How knowledge is acquired and transferred or fails to transfer into practice has long been regarded as one of the most important problems in learning. Translating knowledge of best practice based on research findings into healthcare clinical practice has been described as a slow and inconsistent process that requires focused effort [22, 23]. Interventional frameworks from the fields of Knowledge Translation and Implementation Science have been developed to address this know-do gap in healthcare [24, 25]. The empirical approach to knowledge creation and transfer into practice limits how the links between knowledge and action are studied as there are many ways of conceptualizing how knowledge is acquired. These include

knowledge being created, constructed, embodied, performed and collectively negotiated, all of which impact how knowledge manifests in practice [26]. The concepts of transfer, knowledge and learning are complex and multidimensional [19, 27]. Narrow perspectives of both education and knowledge result in undervaluing the role of educational processes in change interventions and of educators in facilitating behaviour change.

Longstanding educational approaches of knowledge acquisition, such as knowledge is a collection of facts and procedures that are transmitted to learners by content experts and that learners are vessels waiting to be filled, are grounded in traditional assumptions of teaching and learning from the 19th and 20th centuries [14, 28]. These assumptions treat knowledge as stable and education as a tool. From this perspective, knowledge and educational interventions are commensurate with classical experimental research methods treating education and knowledge as intervention variables to identify 'cause and effect' relationships in controlled environments. While such classical research designs do offer powerful methods, the research approach is not a scientifically sensitive method for understanding the dynamic relationships amongst teachers and learners in the contextual complexity of healthcare settings. There is a need for newer and broader methodological approaches to support research on education and change in complex healthcare settings [29, 30, 31].

Research from the Learning Sciences performed in response to the emergence of digital technologies, the Internet and the knowledge era is expanding and shifting our understanding of knowledge, teaching, and learning [32, 33]. In her article *Teaching in a Digital World*, Jacobsen clearly articulates these shifts [34]. She points out that knowledge is built and socially constructed through collaborative discussion and interactions with others around activities and through problem-solving within those activities. Contemporary teaching requires active and engaged designs that facilitate rich learning experiences. Finally, formal learning is an actively structured and engaged process that involves the development of deep understanding through meaning-making and interpretation.

Study limitations

A possible limitation of this content analysis is that the research team's professional experiences in the IPAC profession are likely to influence interpretation of the data and findings. While this affords both sensitivity and insight into the subject, it could also introduce bias. Therefore, the research team followed systematic coding processes, and obtained external feedback regarding findings by individuals outside the project. Another limitation of this analysis was the focus on educational intervention research studies. Other interesting and innovative research is emerging that explores IPAC educational practice and different forms of knowing. Nichols and Badger explored the role that tacit knowledge plays in nursing IPAC practice and behaviour [35]. More recently, Slyne et al. explored the manner in which experience enhanced the implementation of nursing infection

control knowledge in practice [36]. Such studies suggest that a paradigm shift regarding the teaching and learning of IPAC concepts and practice is beginning to occur.

CONCLUSIONS

This first paper in a series of four is a call to action for a paradigm shift in how IPAC as a profession thinks about education, teaching and learning. A critical appraisal is needed regarding the role and value of education in IPAC intervention research. Effective education calls for more active, engaged, and collaborative, interest-based teaching and learning relationships. Making a shift of this magnitude will take time and support. The subsequent papers in this series will provide tangible steps toward making this shift. In response to the need for innovative research methodologies that attend to the design and study of effective teaching and learning environments, the second paper will explore the application of a Design-Based Research (DBR) methodology that focuses on changing ICP educational practices and building their educational expertise. Papers three and four will discuss findings from the DBR study. Paper three will look at the complexities, value and challenges of ICP educational practice beyond educational intervention research settings. Paper four will describe a professional development framework that uses contemporary teaching and learning strategies to build ICP educational expertise. By building such expertise the relevance of education can be revaluated and IPAC educational research can be opened to new discoveries and advances in teaching and learning practices to improve our ability to effect behaviour change.

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