Identification of positions in literature using Thematic Network Analysis: The case of early childhood inquiry-based science education

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Reviews and meta-analyses often summarise research within a given field to provide succinct and accessible information about state of the art as well as gaps for future research to address. In educational research such information may include different positions within a field; for example, theoretical positions underpinning empirical studies. Such theoretical positions may influence interpretations of research results, and they remain a challenge to map and present. In this paper, we show how to use thematic analysis combined with network analysis to construct maps, analyse, and synthesize theoretical positions within educational research. We use early childhood inquiry-based science education (ECIBSE) literature as a case, because of its historical roots in Dewey’s educational philosophy. This allows us to discuss our findings in light of a well-known theoretical framework. Using our methodology, we identify and analyse four theoretical positions for teaching and learning: (1) that science should be learned/understood through inquiry, (2) that teaching should model scientific practices, (3) that children should develop science-related competencies, and (4) that the child’s exploration and experience should take precedence. After discussing these positions in relation to Dewey, we turn to the methodological possibilities and challenges of using thematic network analysis for literature reviews.

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Subject classification codes: include these here if the journal requires them

# Introduction

Educational research shares with other research disciplines a reliance on literature reviews to “compile a great deal of information in an accessible and succinct manner.” (Rozas & Klein 2010, p. 387). Different fields of research have different standards for literature reviews. In the natural sciences, *systematic* reviews of a large body of literature comprise the highest form of evidence in a hierarchical “evidence ladder” (REF). In humanistic sciences, *narrative* reviews “serve the purpose of generally describing the extant research including methods, populations, and findings” (Rozas & Klein 2010, p. 389). This purpose will also often include a synthesis of the research. The social sciences make use of both types of reviews (REF), and this is also the case in educational sciences.

[DESCRIBE BRIEFLY THE PROBLEMS WITH SYSTEMATIC AND NARRATIVE REVIEWS]

One approach to narrative reviews relies on thematic analysis (Braun & Clarke, 2006). Thematic analysis is a rigorous approach, where the purpose is to develop patterns of meaning across a set of data. The process entails data familiarisation, coding of data, development of themes, revisions, and weaving an analytical narrative from themes and data extracts (Braun and Clarke 2020). This approach to reviewing has found some use in educational research (e.g. REFs), sometimes in parallel with systematic reviews (e.g. REFs).

Recently, two new kinds of reviews have emerged in the literature: citation/co-author analysis and keyword co-occurrence (REF). Both methods have been developed utilising network analytical methods. While citation/co-author analysis can help identify communities of researchers within a field, key-word co-occurrence has been used as a way of revealing what is researched.

While analysing article keywords does provide a level of analysis, keywords suffer from two problems. First, they are attributed to the article by the authors. Any relation to a particular keyword may be speculative. Second, a keyword does not reveal the structure of for example theoretical arguments or conceptualisations; one keyword can have multitude of different meanings as is the case with IBSE. We argue that while keywords do provide information about what is written, a synthesis of perspectives and positions requires more than keywords to provide a rich and diverse map of a complex field of research.

## Early childhood inquiry-based science education as an exemplar

In this paper we illustrate a novel method of literature review, which combines elements from systematic reviews and narrative reviews, while expanding keyword analysis to include what is actually written in the literature. Our purpose is not only to compile information, but to synthesize, analyse, and map different positions in a subfield of education. To do this, we have chosen recent literature in the field of early childhood inquiry-based science education (ECIBSE) as our illustrative example.

There are several reasons for using ECIBSE as an exemplar for our methodology. First, IBSE has a century long history where well-known positions have been proposed and discussed. Thus, we can compare and contrast themes and positions synthesized in our work with well-known educational philosophies and arguments. Often the work of John Dewey (1859–1952) is highlighted as the origin of inquiry with a focus on fostering curiosity and relating that to scientific practice (Johnson & Christensen, 2014).

Second, we expect that there are different theoretical positions to be identified. IBSE is conceptualised and implemented in different ways across different contexts and domains, as Rönnebeck et al. (2016) illustrate for the upper secondary level. Even within a single domain and context, IBSE may be conceptualised differently in terms of theoretical stance as is illustrated for middle and secondary school by Martin-Hansen (2002). Thus, we would expect our new method to find patterns that can be distinguished as different positions.

Third, IBSE is an important area of research in science education. Educational policies around the world emphasise inquiry-based science (IBSE) approaches to teaching as vital ingredients in building a scientifically literate community for all age groups and educational levels (Harlen & Allende, 2006), including early childhood levels. We argue particularly for the importance of focusing on early childhood IBSE (ECIBSE) as early encounters with science learning likely shape children’s future attitudes towards science and science learning (Eshach, H., & Fried, M. N. 2005).

## Research questions

The research question we seek to answer using our thematic network analysis methodology are

1. Which maps of theoretical expositions in early childhood inquiry-based science education (ECIBSE) literature can be constructed by combining word-adjacency networks with thematic analysis?
2. Which themes and meanings arise in analysing such maps, and how can these themes and meanings be interpreted in light of a narrative literature review?
3. Which theoretical positions in ECIBSE can be synthesized from maps and meanings, and how do these relate to historical developments in the literature.

To frame our later interpretations, analyses, and synthesis, the next section provides an overview of the origins of IBSE with a focus on Dewey’s perspective. We then present and provide methodological arguments for our methodology, thematic network analysis, which combines thematic analysis with network analysis to identify theoretical and empirical conceptualisations. The thematic network analysis leads to a network map of interconnected themes, where themes represent different aspects of theoretical conceptualisations. We analyse the map in detail and proceed to use our methodology to synthesize different theoretical positions, which can be found in recent ECIBSE literature. In our subsequent discussion, we begin by relating the synthesized theoretical positions to ECIBSE and implications. Then, we discuss the methodology in terms how it integrates qualitative and quantitative ways of analysing and synthesizing and what kind of knowledge it may produce.

# The origins of inquiry-based education

IBSE has deep roots in pragmatism, and John Dewey developed pragmatism from the perspective of education (Biesta & William, 2003). He saw thinking as an instrument for action. From this perspective, thinking and knowledge were tools to solve scientific and everyday problems. Dewey advocated “experiential teaching”, in which the learner is viewed as active, instead of passive receptors (Dewey, 2011). Dewey stressed that learning must be rooted as experience and awaken a curiosity about information and new ideas. Learning experiences are viewed as situations where children create and recreate knowledge as part of the educative process. For Dewey, this is the underlying idea of inquiry (Dewey, 1938/2015).

Dewey’s idea of inquiry is related to both contemporary IBSE conceptualisations and the practice of scientific inquiry. For example, for Harlen & Allende (2006), IBSE encompasses experiences that enable children to develop understanding about scientific aspects of the world through the development and use of scientific inquiry skills. For them, a key element of inquiry is the active participation of children in the thinking processes and investigations of scientific phenomena. *Scientific inquiry* refers to the varied ways in which scientists work, the process of investigating how, why, and what, making sense and evidence of data, and interpreting results (Biesta et al. 2003). Dewey (2005) outlines fundamental conceptual phases, such as defining a problem, formulating a hypothesis, and conducting tests, and most inquiry cycles can be seen as elaborations of these phases (Johnson & Christensen, 2014; Biesta et al., 2003).  Importantly, neither scientific inquiry nor IBSE are linear processes - aspects of inquiry interact in complex ways (Alake-Tuenter et al., 2012).

One major difference between scientific inquiry and IBSE is that teachers often know what children may learn, whereas the attained knowledge in scientific inquiry by nature is unknown. Dewey defined inquiry for both children and scientists as “*the controlled or directed transformation of an indeterminate situation into one that is so determinate in its constituent distinctions and relations as to convert the elements of the original situation into a uniﬁed whole”* (Dewey, 2013, p. 108). Combining these perspectives, IBSEmay be said to foster situations in which learners develop coherent scientific understanding through building relations between elements and experiences, which they perceived as unconnected beforehand.

Experiential education relies on the theory of experience, which is central to Dewey’s work. With a ‘philosophy of experience’, he mediates between traditional education and progressive education. Dewey regards both as mis-educative, because neither apply a carefully developed philosophy of experience (Dewey, 1938/2015). For Dewey, experience consists of three mutually dependent categories; situation, interaction, and continuity (Dewey, 1938/2015). ‘Situation’ refers to the fact we interact with other individuals and with objects in a concrete world and our lives here consist of a series of situations. Within a series of situations, continuity needs to emerge before it can contribute to the fulfilment of an educative experience. ‘Interaction’ refers equally to interactions between individuals and objects and interactions between individuals (Dewey, 2005).

Contemporary literature consistently provides evidence that hands-on experience with science phenomena is a necessary (but not sufficient) component for conceptual learning, especially when coupled with guidance from a teacher (Minner et al., 2010). Dewey advocated the facilitation of creative learning environments in which children may undergo development through educative experiences.  In this child-centred approach, adults must pay attention to what children are curious about and interested in to gauge and use the possibilities for children’s development. Activities should not only be based on children’s interest, but attention to children’s interests should guide the adults in choosing instructional strategies and materials to use. For that reason, questions or problems arising from the child’s everyday experiences are meaningful because they are driven by genuine curiosity. From this child-centred perspective then, it is essential to inquiry-based approaches that educative experiences and learning always include values, emotions, the act of doing, and cognition.

# Literature review with thematic network analysis

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