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Defining the Science of Learning: A Scoping Review Protocol

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Abstract

Interest in research on the Science of Learning continues to grow. However, ambiguity makes it unclear what is meant when governments, universities, or researchers talk about research on the Science of Learning. This ambiguity can negatively impact communication and collaboration and may inadequately inform educational training programs or funding initiatives that are not sufficiently inclusive in focus. The proposed review aims to synthesize a working definition of the Science of Learning based on previous work. Searches will be performed using Web of Science and ProQuest databases. Findings will be reported using tabular and qualitative synthesis. The findings of this review will support a shared understanding of what constitutes Science of Learning research in support of understanding and effective communication.

Keywords: science of learning; learning sciences; educational neuroscience; education; scoping review

1. Introduction

1.1. Background

Interest in the Science of Learning has continued to grow as researchers and educators seek to better understand and improve teaching and learning. Despite this increased popularity, there is considerable confusion surrounding the exact scope and focus of the field. This confusion is most clearly evidenced in the various definitions and conceptual frameworks that have been offered, ranging from an almost exclusive emphasis on cognitive science (Deans for Impact, 2015) or neuroscience (Singapore National Research Foundation, 2021) to more inclusive views that incorporate contributions from fields such as sociology, anthropology, or machine learning (e.g., Meltzoff et al., 2009). What do we mean when we say that we are investigating the Science of Learning? To date, there have been no attempts to synthesize a working definition of the Science of Learning based on these many disparate ways the field has been described.

The conceptual ambiguity of the Science of Learning has the potential to muddle communication and collaboration between researchers and between researchers and educators. Additionally, perceived overlap with similar fields such as Educational Neuroscience (Patten & Campbell, 2011), Mind, Brain, and Education (Ferrari & McBride, 2011), and the Learning Sciences, the latter of which being used almost interchangeably with Science of Learning (e.g., Sawyer, 2006), may obscure the uniqueness of this area of inquiry. Most troublingly, the absence of a clear understanding of what the Science of Learning is may result in the development of educational training programs or funding initiatives that are not sufficiently broad to support the multidisciplinary nature of research needed to advance our understanding of learning. There is much to be gained by identifying the common threads that link current definitions of the Science of Learning and distilling the true essence of this emerging field.

1.2. Aims

The proposed scoping review's primary objective is to identify and synthesize existing definitions of the Science of Learning in the interest of conceptual clarity. By identifying shared components across definitions and clarifying ambiguities, the proposed review aims to generate a clearer understanding of what the Science of Learning is and what it is not. Findings from this review can inform future research as well as guide the structuring of educational programs and funding initiatives aimed at attracting inclusive groups of investigators interested in the Science of Learning.

1.3. Research Questions

The proposed scoping review's primary research question is "how has the Science of Learning been defined?" The research sub-questions are:

1. What fields make up the Science of Learning?
2. What is/are the stated goal(s) of Science of Learning research?
3. Which institutions are contributing to definitions of the Science of Learning?
4. How have definitions of Science of Learning changed over time?

2. Methods

Given the objectives of the proposed review, the methodology of a scoping review was selected (Munn et al., 2018). The conduct of this review will be guided by Arksey and O'Malley's five-stage framework (2005) with further refinement based on the most recent updates in scoping review methodology (Peters et al., 2022). Risk of bias assessment or critical appraisal will not be carried out with identified studies as the proposed review is concerned with identifying and mapping the extant literature and not evaluating quality. This protocol was developed based on published guidance from Peters and colleagues (2022).

2.1. Search Strategy

To address our research questions, we will synthesize evidence from all available published and unpublished grey literature (i.e., theses, conference papers). The decision to include unpublished literature is based on the goal of providing the most comprehensive summary of existing Science of Learning definitions. Evidence will be identified through searches conducted using Web of Science and ProQuest. These databases were selected due to their extensive indexing of relevant published work as well as conference papers, theses, and dissertations. Databases will be searched for articles using the term "science of learning" in either the title or abstract. Studies identified across both databases will be pooled and filtered for duplicate results before screening and selection.

2.2. Selection and Screening

Selection of studies will follow guidance provided in the Preferred Reporting Items for Systematic Reviews and Meta-Analyses Extension for Scoping Reviews (PRISMA-ScR) checklist (Tricco et al., 2018). Full details of the screening process will be summarized in PRISMA flow diagram format (Page et al., 2021). Screening will initially occur at the title and abstract level for articles that include the term "science of learning" in either of these fields. Full-text screening will be limited to only studies that are candidates for inclusion. During screening, the following criteria will be applied:

2.2.1. Inclusion Criteria

- Journal articles, theses, dissertations, conference papers, book chapters, and working papers
- The term "Science of Learning" appears in either the title or abstract
    - Can include highly related terms at the beginning (e.g., Cognitive Science of Learning) or end (e.g., Science of Learning and Development)
- Provides either an explicit or implicit definition of the Science of Learning in the abstract or full-text

- Focused on human learning
- Written in English
- Full text available

2.2.2. Exclusion Criteria

- Magazine articles, blog posts, editorials, commentaries, corrigenda, books, and book reviews
- The term "Science of Learning" only appears in:
    - journal name (e.g., NPJ Science of Learning)
    - research center name (e.g., Science of Learning Research Center)
    - training program name (e.g., Science of Learning Workshop)
    - part of a statement that is not about science of learning as a research field (e.g., science of learning about data; science of learning to read)
    - in reference to another resource (e.g., "in their book. "The Science of Learning")

Inter-reviewer reliability will be calculated across 20% of studies to ensure inclusion and exclusion criteria were reliably applied. In the event a full text article is unavailable or additional information is needed to determine if inclusion criteria are met, corresponding authors will be contacted. If no response is received within two weeks after contacting, articles will be excluded. Search and selection of relevant articles is expected to be completed by March 31st, 2023.

2.3. Data Extraction

Extraction will be guided by a common, digital, fillable spreadsheet. Extracted data will include: (1) authors; (2) publication year; (3) source name; (4) title; (5) source format; (6) primary affiliation of first author (department and university); (7) country of first author's primary affiliation; (8) definition of Science of Learning; and (9) stated goals of Science of

Learning research. Inter-reviewer reliability will be calculated across 20% of included studies to ensure accuracy in extraction. In the event necessary data were not reported in the original articles, corresponding authors will be contacted. Authors not responding to a request for data within two weeks will not be contacted again and the study in question will be included with incomplete details. Extraction table finalization is expected to be completed by April 15th, 2023.

2.4. Reporting Results

Extracted data from all included studies will be summarized in tabular format following the organization of the extraction template. Extracted data will also be summarized through narrative synthesis and reporting of word frequencies across definitions and stated research goals. The primary research question and sub-questions will guide the structure of the narrative synthesis. Finally, a working definition of Science of Learning will be proposed based on the findings of the review. Complete results of the proposed review will be written up into a full-length manuscript that will be submitted for review and publication in an academic journal.

3. Discussion

Findings from the proposed scoping review will contribute to our developing understanding of the complex, multi-disciplinary nature of research on the Science of Learning. Synthesizing a working definition of the Science of Learning based on existing definitions and stated goals can clarify what this field is and support distinguishing it from related fields such as the Learning Sciences. Importantly, a shared understanding of what constitutes Science of Learning research can support clear and effective communication between researchers, policy makers, funding organizations, educators, and members of the public. This is especially helpful in the drafting of funding initiatives to ensure that criteria are inclusive enough to capture the diverse range of research topics likely under the Science of Learning umbrella.

4. Limitations

The proposed scoping review's contributions are limited, in part, based on its exclusive focus on defining the Science of Learning. Consequently, findings reported will likely not be helpful in summarizing key findings from this research nor for identifying future research trends. Additionally, as only research published in English will be considered, developments in the Science of Learning from parts of the world where publishing in English is uncommon will likely be missed. Finally, drafting a working definition of the Science of Learning does not immediately solve the problem of ambiguity. The proposed working definition should be considered a first step in an iterative process towards clarifying specifically what the Science of Learning is. It is also the case that this definition will need to be updated considering methodological and technological advances that impact on this field.

References

Arksey, H., & O'Malley, L. (2005). Scoping studies: towards a methodological framework. *International Journal of Social Research Methodology*, *8*(1), 19-32.

Deans for Impact. (2015). *The Science of Learning*.

Ferrari, M., & McBride, H. (2011). Mind, Brain, and Education: The birth of a new science. *Learning Landscapes*, *5*(1), 85-100.

Meltzoff, A. N., Kuhl, P. K., Movellan, J., & Sejnowski, T. J. (2009). Foundations for a new science of learning. *Science*, *325*(5938), 284-288.

Munn, Z., Peters, M. D. J., Stern, C., Tufanaru, C., McArthur, A., & Aromataris, E. (2018). Systematic review or scoping review? Guidance for authors when choosing between a systematic or scoping review approach. *BMC Medical Research Methodology*, *18*(1), 1-7.

Page, M. J., Moher, D., Bossuyt, P. M., Boutron, I., Hoffmann, T. C., Mulrow, C. D., Shamseer, L., Tetzlaff, J. M., Akl, E. A., & Brennan, S. E. (2021). PRISMA 2020 explanation and elaboration: updated guidance and exemplars for reporting systematic reviews. *BMJ*, *372*.

Patten, K. E., & Campbell, S. R. (2011). Introduction: Educational Neuroscience. *Educational Philosophy and Theory*, *43*(1), 1-6.

Peters, M. D., Godfrey, C., McInerney, P., Khalil, H., Larsen, P., Marnie, C., ... & Munn, Z. (2022). Best practice guidance and reporting items for the development of scoping review protocols. *JBI Evidence Synthesis*, *20*(4), 953-968.

Sawyer, R. K. (2006). The new science of learning. *The Cambridge Handbook of the Learning Sciences*, *1*, 18.

Singapore National Research Foundation. (2021). *Science of Learning*. Retrieved March 7th from https://www.nrf.gov.sg/funding-grants/scienceoflearning

Tricco, A. C., Lillie, E., Zarin, W., O'Brien, K. K., Colquhoun, H., Levac, D., Moher, D., Peters, M. D. J., Horsley, T., & Weeks, L. (2018). PRISMA extension for scoping reviews (PRISMA-ScR): checklist and explanation. *Annals of Internal Medicine*, *169*(7), 467-473.

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