# Transforming knowledge, crossing boundaries: exploring educational knowledge brokering

**Lucy Jayne Rycroft-Smith**

Homerton College

**67261 words**

January 2025

**This thesis is submitted for the degree of Doctor of Philosophy**

This thesis is the result of my own work and includes nothing which is the outcome of work done in collaboration except as declared in the preface and specified in the text. It is not substantially the same as any work that has already been submitted, or, is being concurrently submitted, for any degree, diploma or other qualification at the University of Cambridge or any other University or similar institution except as declared in the preface and specified in the text. It does not exceed the prescribed word limit for the relevant Degree Committee.

# Abstract

**Aim**: To investigate the concept of educational knowledge brokering (activities aimed at better connecting research to practice and policy in the educational ecosystem) in terms of its processes and implications for practice, with a focus on mathematics education but with broader implications for educational contexts and beyond.

**Method**: A collection of four research papers was developed using varied methods - including narrative synthesis, art-based approaches, and mixed methods research - to explore theoretical, methodological, and practical dimensions of knowledge brokering. The thesis integrates these papers with reflective commentary.

**Results**:

1. To answer the questions: "What kinds of knowledge brokering work, processes and products are there in the international education research-practice space and how have they been characterised?"; "What has been found to be effective, and less effective, in knowledge brokering in education?" and "How might we evaluate, critically examine and otherwise hold to account the work of knowledge brokers in education?", a narrative synthesis review was undertaken, which highlighted that educational knowledge brokering remains under-researched, with key roles for interpersonal relationships and social contexts, a variety of current models and metaphors, and an urgent need for clear definitions and evaluation frameworks.
2. To answer the question "What themes, discourses and boundaries are elicited for me from the process of creating art as knowledge brokering in mathematics education?", art-based methods alongside reflexive thematic analysis were used to critically examine knowledge brokering processes, identifying themes such as storytelling, boundary negotiation, and the balance between accessibility and gatekeeping.
3. Further examination of the data from the art-based inquiry explored the challenges of navigating truth in knowledge brokering, focusing on the question "What themes, discourses, and boundaries related to truth and truth-telling emerged for me through the process of creating art as a form of knowledge brokering in mathematics education?" and emphasising ethical considerations and the risks of mis- and dis-information, arguing that knowledge brokering is political, and adding to theory in this area.
4. To answer the questions "What problems are brought to an educational knowledge brokering clinic?"; "In what ways did I respond to issues brought as an educational knowledge broker?" and "How does educational knowledge brokering work in a research clinic model?", a mixed-methods study using a *research clinic* model revealed the

complex dynamics of brokering interactions, including identity shifts, systems thinking, and the critical transgressions that happen at the intersection of research and practice.

**Conclusion**: This thesis underscores the complexity and potential of educational knowledge brokering processes, advocating for further theoretical and empirical investigation, particularly into the ethical dimensions and evaluation of knowledge brokering practices. The work also demonstrates that innovative methods such as art-based inquiry and knowledge brokering *research clinics* offer valuable perspectives for understanding and potentially improving knowledge brokering in education. This work makes a substantial contribution to the field of educational knowledge brokering by exploring important tensions, boundaries and dilemmas in the work of knowledge brokers, suggesting the need for better conceptualisation of their activities, including training, support and accountability.

# Acknowledgements

With thanks and appreciation to my partner, Dan, who has supported this work in a thousand ways: thank you for picking up dead rats in the garden, for loading the dishwasher, for showing my daughter where her fog lights were, for doing the washing, for making me coffee every single day, for laughing with me when my health was ridiculously terrible, for caring for me and for my ideas so I could write about them. Thank you for the daily conversations which have rubbed at the tensions in this work until they came out or could be named. Thank you for taking me seriously and not-so-seriously at exactly the right times. Thank you for reminding me we are all just simians wearing clothes and writing about things that don't exist and that this research, while important, is not life and death. Thank you for your care when I was sick, which was often. We need better ways of making this labour visible.

Thank you to my best friend and PhD partner-in-justice Darren Macey for your support and solidarity. This journey would have been that much more difficult and lonely without a companion cowboy on the road with me at every step. Looking forward to reading yours, very much.

Thank you to my children Belle and Millie for your love, humour and badassery. I am so proud of you, and thankful for your understanding that the PhD was a long game in terms of parenting payoffs.

Thank you to all who constitute my chosen family.

Thank you to my supervisor Dr Julie Alderton for your support and supervision, and to my advisor Professor Andreas Stylianides for your guidance. Thank you to my examiners for saying yes, and for taking the time to engage with these ideas. Thank you to the many, many researchers and professionals who have talked to me about this work and collaborated with me. Thank you to all who participated in the study: you were perfect. Especial thanks to Joe Howlett-Reeves, previous dance partner and current composing partner, whose ideas about music and teaching and the way they interacted made such an important contribution to several of the papers in the thesis. This WAS a real nice clambake.

Thank you to Lynne McClure, who encouraged and supported me to begin this work. Thank you to Anne Watson, Christian Bokhove and Hugh Burkhardt (now sadly passed away) for your illuminating conversations at important times. Thank you to the members of various Facebook, WhatsApp and BlueSky support groups of women academics who shared with me what it is to navigate the contested space of womanhood and academia. Thank you to the Faculty of Education Research Students Association, especially those who joined me in the chilly Saturday mornings in late 2024 for writing and support.

Thank you to all the students I supervised and taught while doing this doctorate: your ideas, inspiration and challenge have taught me much in return.

Thank you to Cambridge Mathematics, who funded this PhD, although the ideas (and IP) remain solely mine.

## Anti-acknowledgements

I am a first-generation doctorate. I have had no family support or help from my family of origin in the five years I was studying and writing this work; in fact, I have undergone significant abuse. I have completed this work despite two people, in my life without my choice, who have tried very hard to see me fail, to undermine me, to create roadblocks and manufacture crises and to tell lies that I have had to spend untold time and effort unravelling. I anti-acknowledge these people: I did it anyway, and you are not important to me. I anti-acknowledge the systems I have interacted with that have failed me and my children, that have taken up so much of my time and energy too. You were not enough to stop me, and you won't ever be. My love is stronger than your hate, your incompetence, and your unwillingness to do the work.

I anti-acknowledge, too, the chronic illness and disability which has frustrated me so much during this work. You were not enough to stop me, either.

I anti-acknowledge all the people who I went to see lecture or give workshops or who attended conferences with me and who turned out to have put almost no effort into their presentations, questions or feedback; who gave repetitive, lazy, incoherent and arrogant talks, who spoke over women and other minoritised people, who laughed at or humiliated people who had questions, and who centred themselves, ran over time, used up breaks, and handed over labour to others

carelessly. You wasted my time, devalued my contributions, and prevented me hearing from other people who should have had your platform. We need to get better as a research community at holding these people accountable.

I anti-acknowledge all those who refused to engage with hybrid event planning, who didn't want to the do the work to include me and many, many others, and who often still called their event or their organisation 'accessible'. There is what we call an 'action gap' between the thing you profess to care about and what you actually do about it. Please do better and be better.

I include this section in the hope that we all begin to think more carefully about supports and barriers for researchers, and invent more thoughtful ways to make the invisible visible.

I include it because otherwise, how would you know?

***For those of us who live at the shoreline***

***"I want to be part of the people that make meaning, not the thing that's made. I want to be the one imagining, not the idea itself." —Barbie***

# Contents

# List of tables

# List of figures

# Publications and presentations

## Papers comprising this doctoral research

- Rycroft-Smith, L. (2022). Knowledge brokering to bridge the research-practice gap in education: Where are we now? Review of Education, 10(1).
- Rycroft-Smith, L. (under review). Using art-based methods to explore processes of knowledge brokering in mathematics education.
- Rycroft-Smith, L. (under review). Navigating boundaries: an art-based inquiry into 'truth' and bullshit in educational knowledge brokering.
- Rycroft-Smith, L. (under review). 'It's nice to just have reassurance that I'm not crazy and that there isn't an easy answer': Knowledge brokering in mathematics education through a *research clinic* model.

## Papers, presentations and talks arising directly from this doctoral research

**2021**

- Rycroft-Smith, L., & Macey, D. (2021). Deep questions of evidence and agency: How might we find ways to resolve tensions between teacher agency and the use of research evidence in mathematics education professional development? Proceedings of the British Society for Research into Learning Mathematics, 41.
- Macey, D., & Rycroft-Smith, L. (2021). White and black: The personal politics of research methodologies. In R. Marks (Ed.), Proceedings of the British Society for Research into Learning Mathematics 41 (3). BSRLM.

**2022**

- *Summarising research for mathematics teachers: art or science?* Invited talk, Loughborough University, 2022
- *Between the swamp and the ivory tower: practice and research in maths education*, keynote, Association of Teachers of Mathematics Online October Conference, 2022
- *Maths is More – so what now?* keynote, Maths is More consortium, 2022. YouTube

**2023**

- *Making research accessible: How can professional development create a bridge and banish the tolls (and trolls)?* Invited talk for South West Maths Hub, February 2023

**2024**

- *Art as data*: invited talk for University of Cambridge Data Champions, July 2024
- *Using mathematics education research to inform practice: The tricky case of algebra*: invited workshop for PGCE students at the Faculty of Education, University of Cambridge, June 2024
- *Singing maths in the early years: composing maths songs for Early Years students and teachers*, invited talk, Association of Teachers of Mathematics/Mathematical Association joint Primary Committee, June 2024
- *Early maths songs:* invited talk, Early Childhood Maths Group, July 2024
- *Mathematics education knowledge brokering*: invited talk, Mathematics Potential Lab, University of Missouri, October 2024
- *Value and values in creative research*: keynote speech, Cambridge Creative Research conference, October 2024
- *Creative ways to analyse video: a repertoire,* invited workshop at Cambridge Creative Research conference, October 2024

**In press**

- Malin, Joel R., Rycroft-Smith, L. and Ward, V. (2025). The Role of Knowledge Brokering in Fostering Connections Between Educational Research, Policy, and Practice. In *The BERA-Sage Handbook of Research-Informed Education Practice and Policy*, edited by Dominic Wyse, Vivienne Baumfield, Nicole Mockler, and Martin Reardon. BERA-Sage.
- Rycroft-Smith, L. The Undeniable Bullshit of Ofsted: a case study in disinformation in educational knowledge brokering, *Evidence & Policy*

## Related publications and presentations completed during this doctoral research

**2020**

- *Board gaming in the mathematical classroom*, invited talk, MathsConf25, 2020
- *Confident maths lessons at home: a guide for parents*, invited talk for Homeschooling Association, 2020

- *Who gets to be a mathematician?* Invited schools consortium talk, 2020

**2021**

- Rycroft-Smith, L., & Crisp, B. (2021). Thinking more creatively about maths assessment. *Impact; Chartered College of Teaching*.
- Mathematics Curriculum Conversations: invited recorded discussions, 2021. YouTube
- *Mathematics education and 'race': some important conversations*, workshop, Mathematical Association annual conference, 2021
- *LGBTQIA identities and mathematics*: invited talk, LGBTQ+ STEM Day, Department of Mathematics, University College London, 2021
- *Proto-pies: when is a pie chart not a pie chart?.* Invited talk, Talk Math With Your Friends, 2021. YouTube
- *Mathematical art or artistic mathematics?* Exhibition (curator and exhibitor), Mathematical Association Annual Conference, 2021
- *Boundaries, margins and intersections: some interesting things I have found about being a mathematician AND being a researcher AND being queer*, invited talk, Spectra Conference, 2021
- *Numeracy for Reluctant Learners,* invited talk for Homeschooling Association, 2021

**2022**

- Rycroft-Smith, L. & Gould, T. (2022). "And then you just arrive at zero again": Ways that representations of the number line in board games may support or impede a sense of number. In R. Marks (Ed.), *Proceedings of the British Society for Research into Learning Mathematics, 42 (1).* BSRLM.
- Macey, D., & Rycroft-Smith, L. (2022). The Keys to the Kingdom: Why We Can't Ignore Assessment if We Care About Real Improvement in the Teaching and Learning of Statistics. *Bridging the Gap: Empowering and Educating Today's Learners in Statistics. Proceedings of the Eleventh International Conference on Teaching Statistics.*
- *The Equal Classroom: LGBTQ+ identities and schools,* invited talk at Culturally Responsive Communities: A Conference for Educators, July 2022
- *LGBTQ+ students in the secondary maths classroom*, invited talk at University of Worcester, June 2022
- *Mathematical art or artistic maths*? Invited talk for Connecting Bucks Conference, 2022. YouTube

- *Periodic functions: the mathematics of menstruation (or How on earth do we measure periods?)*. Invited talk, *What Can Mathematicians Do* by Newcastle University's School of Mathematics, Statistics and Physics, 2022. Vimeo
- *Board gaming and the number line*, invited session for Professional Development at Loughborough University, 2022. Link
- *Identities and mathematics,* invited session for Professional Development at Loughborough University, 2022. Link
- *Possible futures of computational thinking in mathematics education*, talk, Association of Teachers of Mathematics Online October Conference, 2022

**2023**

- Rycroft-Smith, L. (2023). Conceptions and consequences of mathematical argumentation, justification, and proof. *Research in Mathematics Education, 0(0),* 1–7. DOI
- *Planning your essay: conventional structures for unconventional ideas*, invited talk, Homerton Essay Competition*,* 2023
- *Teaching periods & maths*, invited talk, *the Period Positive Conference,* 2023
- *An ear for research*: UK Knowledge Mobilisation Forum Conference, Knowledge Fayre session, 2023

**2024**

- A Data Feminist Approach to Mathematics Education: A Call to Action (2024). Presented at the American Educational Research Association Conference.
- Rycroft-Smith, L., Müller, D., Chiodo, M., & Macey, D. (2024). A Useful Ethics Framework for Mathematics Teachers. In P. Ernest (Ed.), *Ethics and Mathematics Education: The Good, the Bad and the Ugly (pp. 359–394)*. Springer Nature Switzerland.
- Rycroft-Smith, L., & Watson, F. (2024). The big picture: Designing infographics in mathematics education. *Proceedings of the British Society for Research into Learning Mathematics, 44*.
- *Planning your essay: conventional structures for unconventional ideas*, invited talk, Homerton Essay Competition*,* 2024
- *Ethics for mathematics teachers*: invited talk for Teaching and Learning Mathematics Online*,* November 2024. YouTube

**In press**

- Macey, D., & Rycroft-Smith, L. (in press). Developing guidelines for assessment and resource design in mathematics education to support equity, diversity, inclusion, and belonging. *Educational Designer*.

## Awards during this research

**The Homerton Changemakers Prize (2024)**

*The panel were impressed with the depth, commitment and energy of your work - from working with the Homerton Design and Essay programmes, to outstanding supervisions, to sustained advocacy on issues around access, equality and gender - and felt that the challenges you're addressing and the methods you employ embody Changemakers's approach to intelligent, committed action. The work you are engaged in, and advocating for, feels vital in these times. As does persistent, consistent commitment to difficult conversations.*

**Institute of Mathematics and its Applications Mathematics Communication Grant (2022)**

I was awarded a grant to produce posters including commissioned portraits and accompanying materials celebrating the life and contributions of six mathematicians from traditionally under-represented groups. The materials produced were described as 'beautiful' and 'extremely important.'

# 1. INTRODUCTION TO THESIS

## Background and motivation

I have been involved in education for some twenty years: as a teacher, a writer, a parent, and for the past eight years as a researcher and knowledge broker. I enter research activity, then, from the stance of a practitioner: concerned primarily with the utility of ideas, although appreciating deeply that some ideas can be beautiful and/or important without necessarily being useful. I have experienced first-hand the idea that research and practice communities in education are bafflingly divided, and it has become particularly important to me to consider ways to better connect them. I have never thought, as some do, that this is as simple as a "last mile problem" – that we just need to give teachers *more* research or give it to them *more quickly* or *more easily* or even give it to them in *more forceful ways*. Connecting two communities should always be about understanding the communities themselves: what they care about, what they need, what they value. More recent work in the field of knowledge brokering and/or knowledge mobilisation in education has critiqued this idea of unidirectional, linear movement of knowledge (e.g. Farley-Ripple et al., 2018), giving me hope that a new and more equitable way of thinking about the field is at hand, and I am passionate about being at the forefront of it.

In these twenty years of working in education, one thing I reflect on often is that when I say the word 'research' to education practitioners, the most common reaction is "ugh." This covers a range of negative emotions from boredom to overwhelm through to anger: "ugh, I don't have time for that!" to "ugh, not more mandates" to "ugh, research is unreadable." Most people who might benefit from using research, in my experience, *don't want to* use it. This thesis is concerned with the idea, then, of *knowledge brokering*: not persuading, but **supporting** research use, and specifically a deep investigation of some of the processes that might make up this activity. It is also a thorough consideration of what might make knowledge brokering *good*, both in the sense of "effective" but also "ethical".

The problem, then, that this research addresses is that we know relatively little about knowledge brokering, and in particular how it actually works in practice. There is a current, and urgent, research gap around what knowledge brokers *do*, how we might usefully characterise it as knowledge brokering in the first place; and how to further categorise and evaluate it (is it "good"?). This has great implications for the field of knowledge brokering: brokers are essentially operating in a "Wild West" scenario at present, with almost no guidelines for good practice, regulation, evaluation, support for ethical dilemmas, reward and recognition for doing good, or consequences for causing harm. This in turn creates an environment where those who

wish to use research - either in policy, practice, or somewhere in between - might feel disillusioned, confused, overwhelmed or angry that they don't know who to trust and how to judge. This effectively replicates one of the initial problems knowledge brokering seeks to resolve, shifting the problem from "which research/researchers can I trust to do good and useful work?" to "which brokered work/brokers can I trust to do good and useful work?", and thus needs urgent resolution if knowledge brokers are to be able to do their work with stability, credibility and effectiveness. In particular, without creating frameworks to both **support** knowledge brokers and to **hold them accountable** in their professional practice, we are devaluing the good work that is happening, and undermining the very idea that research *can* be useful and relevant in education, further deepening community divides and adding to mistrust and misunderstanding. In other words, if we cannot be consistently "good" and trustworthy as brokers (and prove that in fair and transparent ways), we cannot expect trust and credibility to be conferred on us, and without those things, knowledge brokering ceases to function.

In this thesis, I draw on my experience, expertise and reputation as a knowledge broker in mathematics education in England and explore the processes of knowledge brokering in detail and from several angles. First, I draw together the literature and consider some of the most significant themes and issues in knowledge brokering – often, but not always, in the context of education. Then I use this work to examine knowledge brokering processes in detail: first through reflexively analysing art-based methods to consider the themes and tensions that arise, and then using this same data but focusing in more detail on the idea of 'truth', which includes the key ideas of informing, misinforming and disinforming. In these two studies, I examine what it means to practise the activity of knowledge brokering; I also take the field forward by examining, too, what it might mean to cross different boundaries into not-knowledge brokering, and why. Finally, I draw on a years' worth of *research clinics,* a brand-new methodology, to critically examine relational knowledge brokering activity in the light of these previous findings: how does it work, what problems are brought, and how did I respond to them? Taken together, these four papers - more a *syn-thesis* than a *thesis* - represent a significant contribution to the literature on knowledge brokering by examining the 'what' in more detail than any research has attempted to do previously, and crucially from the inside out: I draw on my dual identity as a researcher and a knowledge broker to critically examine my own practice, examining boundaries, themes and tensions in the processes of knowledge brokering in my specialist context of mathematics education. I hope you enjoy reading this work – I loved making it, and I hope also this comes across in the thesis. I explore my contribution to the field in more detail in the next section.

## Contribution to the field

The use of research evidence in educational practice has distinct problems due to the fact that communities of producers and users are often dissonant (Farley-Ripple et al., 2018). This has been characterised as a "last mile problem" (Lemons & Toste, 2019; Perry et al., 2020), which unhelpfully suggests the issue is both a linear and an asymmetric one, placing blame on teachers for not simply working harder to 'receive the baton' of research evidence that has come so far already. This view of research dissemination as linear, unidirectional and potentially disempowering to practitioners has been criticised as both ill-conceived and ineffective (e.g. Farley-Ripple & Grajeda, 2020; Malin & Brown, 2020). Other important tensions lie in the characterisation of what **kinds** of research evidence should be used in practice (e.g. Swann & Pratt, 2004); what denotes "good quality" or "robust" in this respect (e.g. Boaz & Gough, 2012); and how to balance this kind of evidence use with teacher agency and professional knowledge (e.g. Rycroft-Smith & Macey, 2021). The many tensions involved suggest this may be a 'wicked' problem involving multiple aspects of the educational ecosystem (Malin & Brown, 2020).

The recency of the field, the proliferation of terminologies, and the transdisciplinary nature of the concept all make it particularly difficult to systematically search for, locate, compare and synthesise research on knowledge brokering. The first article in this thesis therefore attempts to analyse some of the most recent and useful research on knowledge brokering in education (and beyond), summarising the state of the field so far, and make recommendations as to ways to minimise some of these tensions when moving forwards. In particular, it is focused on reviewing evidence around effectiveness of knowledge brokering of educational research into practice and considering ways in which to evaluate the activity of knowledge brokering so its frontiers are not simply colonised by those with the most money, power, or political cachet to do so.

After considering some of the main issues, tensions and important new directions for the field of educational knowledge brokering, the second article of this thesis uses this as a basis to begin to explore the processes of knowledge brokering in detail. Art-based methods (poetry writing, the creation of visual art, and collaborative musical composition) were used to respond to research papers in mathematics education, and video and journals reflecting on the creation of these artefacts were captured as a secondary source of data. The material creation of artefacts was a central part of this paper, drawing on what Colucci-Gray et al. (2023, p. 1) describe as "material sensation as part of coming to know". Critical reflexive thematic analysis then provided a way to make sense of this data and place the themes that were found in the context of the literature. This study is innovative and explorative: no such work has been done

before, and it not only offers new conclusions about educational knowledge brokering but a proof of concept of using art-based methods alongside critical reflexive thematic analysis to examine brokering processes.

The third article in this thesis uses the same data as the second but with a different, more narrow focus: the idea of "truth" (and consequently, misinformation and disinformation) in knowledge brokering, which means there is some overlap between them. While the second article focuses on what knowledge brokering processes *are*, this article focuses on what they *are not,* placing the data within the context of motivating literature around what it may mean to tell the truth with and about research – and more importantly, what it may not. This article was not originally planned; I responded to a call for papers on this theme, and found that there was a great deal to say! It contains the beginnings of a potential new area of the field which, I argue, requires deep and urgent attention.

The fourth article that completes this thesis addresses the important idea from the literature review that knowledge brokering is relational, and again considers process, but this time by using as data a series of videoed *research clinics* in which I, as the knowledge broker, respond to issues and problems brought to the clinic by educators and education professionals. I used mixed methods to analyse the educational knowledge brokering processes and consider the themes that arose, considering them in the light of the previous three studies. The method of holding a free, online *research clinic* to investigate knowledge brokering is also a new one: I drew on clinical models from other fields to construct a space where the agency of the participant was foregrounded and their agendas were prioritised. The four papers are cumulative; as I moved through the work, I gained new perspectives, insights and wonderings, which become more coherent and threaded together over time, culminating in the conclusion section of this work. Table 1.1 shows an overview of the four papers that comprise this thesis.

*Table 1.1 An overview of the papers that comprise this thesis*

| Title of study | Status | Research questions | Main conclusions | Original contribution |
|---|---|---|---|---|
| Knowledge brokering to bridge the research-practice gap in education: Where are we now? | Published | What kinds of knowledge brokering work, processes and products are there in the international education research-practice space and how have they been characterised?<br>What has been found to be effective, and less effective, in knowledge brokering in education?<br>How might we evaluate, critically examine and | Knowledge brokering in education is not yet well conceptualised or understood; there is also a need for reconciling the language used around it. The processes of knowledge brokering are complex, reflecting the landscape in which it is enacted. Social contexts and relational work are important in knowledge brokering. Further research is | A state-of-of-the-art review of educational knowledge brokering in practice (and to some extent policy)<br><br>This paper has now been cited 77 times since its publication in 2022. |

| | | | | |
|---|---|---|---|---|
| | | otherwise hold to account the work of knowledge brokers in education? | needed to define its purposes and evaluate its effectiveness. | |
| Using art-based methods to explore processes of knowledge brokering in mathematics education | Under review | What themes, discourses and boundaries are elicited for me from the process of creating art as knowledge brokering in mathematics education? | Six key themes were uncovered in knowledge brokering processes: storytelling, the duality of rule-abiding and rule-breaking, the inseparability of processes and products, the tension between accessibility and gatekeeping, and the dual roles of boundary-eliciting and boundary-blurring.<br>The importance of artistic methods was highlighted in deepening understanding of knowledge brokering processes.<br>Knowledge brokers should navigate the complexities of their roles with attention to boundaries, in particular a balance of creativity and adherence to established norms. | Innovative methodology (to my knowledge the first to use art-based methods and reflexive thematic analysis to analyse knowledge brokering).<br>Shows proof of concept of methodology. Highlights some of the key themes of knowledge brokering processes, many of which have not been written about in detail before. |
| Navigating boundaries: an art-based inquiry into 'truth' and bullshit in educational knowledge brokering | Under review | What themes, discourses, and boundaries related to truth and truth-telling emerged for me through the process of creating art as a form of knowledge brokering in mathematics education? | Knowledge brokering in education is complex. Art-based methods offer insight into the importance of ethical considerations and the challenges of maintaining 'truthful' knowledge brokering amidst potential incentives for misinformation or disinformation.<br>The nature of what 'truth' might mean in knowledge brokering is an important and urgent focus for future work, and has implications for credibility and trust in the field. | Shows proof of concept of methodology. Highlights one of the most important themes of knowledge brokering processes, which has not been written about in detail before.<br>Adds important theory to the field on informing, misinforming and disinforming in knowledge brokering. |
| 'It's nice to just have reassurance that I'm not crazy and that there isn't an easy answer': Knowledge brokering in mathematics education through a research clinic model | Under review | What problems are brought to an educational knowledge brokering clinic?<br><br>In what ways did I respond to issues brought as an educational knowledge broker?<br><br>How does educational knowledge brokering work in a research clinic model? | The dynamics of educational knowledge brokering in a research clinic model are multi-layered and complex.<br>Knowledge brokers integrate professional knowledge, relationship-building, and navigate research complexities at different levels.<br>Key themes that were surfaced included: decision-making using research, leveraging professional knowledge, relationship-building, critiquing research ideas, exploring research methodologies, and addressing conflicts and tensions in research use. | Innovative methodology (to my knowledge the first to use a research clinic model as well as reflexive thematic analysis to analyse knowledge brokering). Examined in more detail hypotheses around relationships and agency in educational knowledge brokering.<br>Added to the empirical knowledge base in terms of what actually happens during relational knowledge brokering processes. |

My hypothesis for this work, in answer to the question "how does or could knowledge brokering work, and how can we move the field forward?" was, put simply, "it currently relies on the skill, identity navigation, knowledge, knowledge-about-knowledge, understanding of context, and ethics of the broker, and this is likely too inconsistent at present to be trustworthy for the research user". I suspect that, despite high hopes for knowledge brokering as the solution to many problems of educational research use, we have not yet established either a field of research or a field of professional practice that is able to do either in a consistent way, certainly in England (the context for this study). Moreover, even if we had, this is not information we can as a field currently *know*, since we haven't established agreed criteria for evaluating educational knowledge brokering as **being good** or **doing good**. This research aims at clarifying details about what knowledge brokers actually do, why it matters, and what this may mean for the field moving forward. The context of this research is, therefore, three key assumptions:

- Research *can* be useful in educational contexts (e.g. Burkhardt & Schoenfeld, 2003)
- Knowledge brokers can do important work in helping make research useful to users (e.g. Malin & Brown, 2020a)
- This important work *could* and *should* be subject to research, including theoretical and empirical, guidelines, guardrails and frameworks for evaluation (e.g. Cooper et al., 2020; Newman et al., 2020; Ziam et al., 2024)

Many of the studies I read as part of this PhD are from fields outside education (often healthcare), and I consider that the issues I describe here are not limited to educational contexts or bound by disciplinary confines. Hence, many of the ideas I consider and the implications I find are likely generalisable and transferable, which I discuss further in the conclusions of the work.

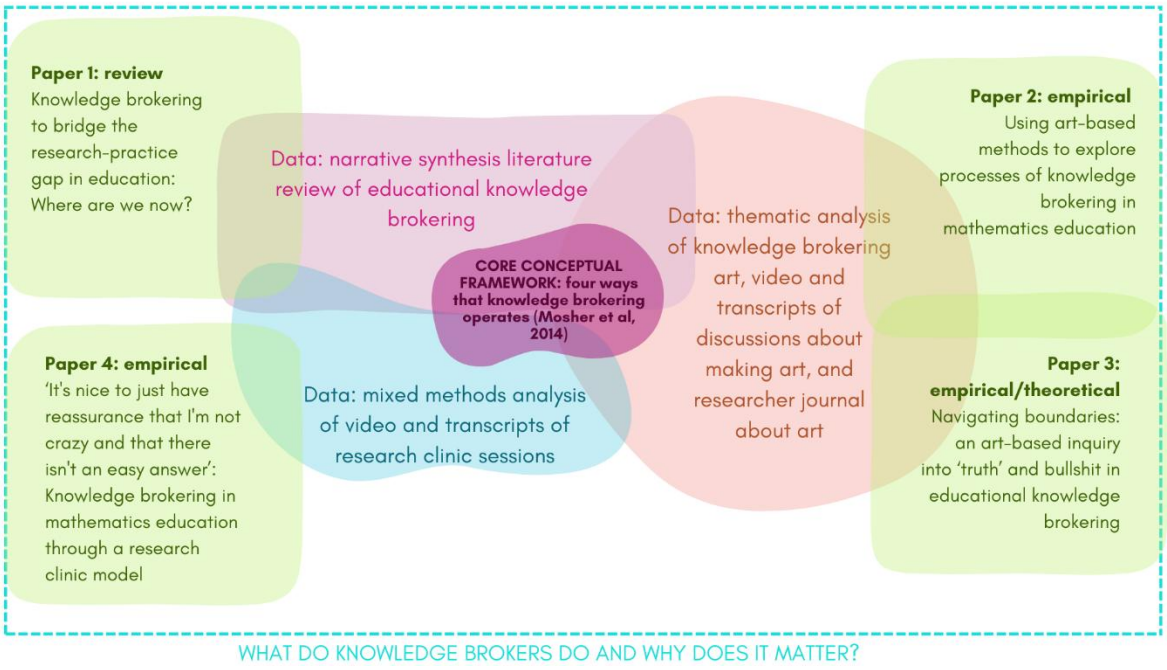
This study design, as befits exploration of a new field, is innovative. It incorporates three distinctly different approaches: a semi-systematic, conceptual saturation literature review, two art-based qualitative studies with different foci, and a brand-new *research clinic* study using mixed methods. This is an intentional attempt to thoughtfully survey a new and emerging field from several complementary angles, including – most significantly - from the inside out. This innovative design reflects, therefore, the youth and fragmentary nature of the field of educational knowledge brokering and also the understanding that I am working within it. The thread that weaves through the narrative of this thesis is reconfiguration, the heart of knowledge brokering, and the heart also of my identity-making as a researcher, which is no coincidence. My embeddedness simultaneously allows me to study the field from within but requires caution and the need to be particularly self-critical and careful when analysing my own practice. It is

this careful need to know-and-know-yourself, as well as the idea that art as enquiry "offers different and complementary ways of knowing" (McNiff, 2013, p. 7) and "systemic wisdom" (Learmonth & Huckvale, 2013, p. 105) that led me to use art-based methods for the two central papers of the thesis. Similarly, the *research clinic* approach offers a complement to this intensely personal, introspective view; it provides opportunities for the "collision and interplay" (Mosher et al., 2014, p. 6) that characterise the more complex, dynamic layers of the Mosher et al. framework and may trouble the discreteness of research and practice in useful ways, focusing on relational processes. A research clinic approach also allows for an intentional focus on equality of status, minimising hierarchy and dominance, and a realist approach (e.g. Maxwell, 2018) and is the first of its kind, contributing to the discourse on knowledge brokering in an original way.

## How are the papers linked?

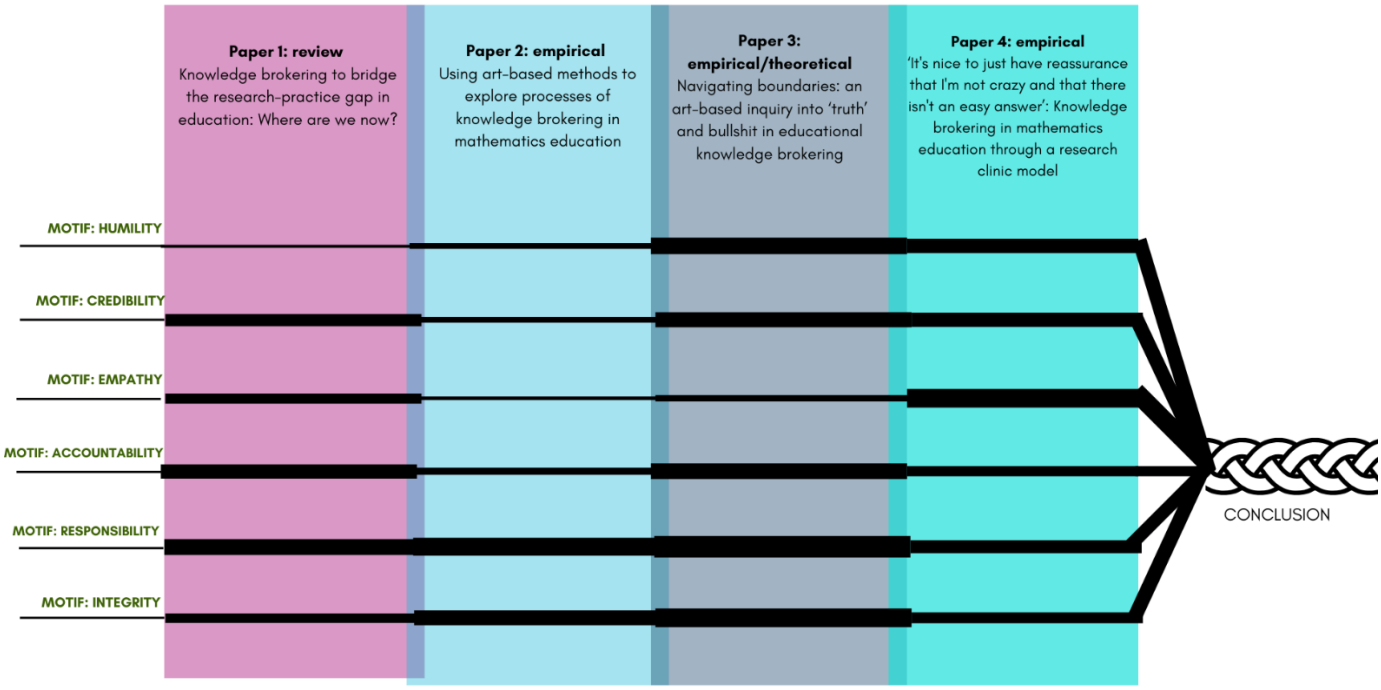
Each of the papers in this thesis is linked in several ways, the most important of which is the core conceptual framework (a paper outlining four ways of conceptualising knowledge brokering by Mosher et al., 2014) and the core question "what do knowledge brokers do and why does it matter?". In Figure 1.1 this is shown visually as a kind of overlapping Venn diagram, with the three datasets and the four papers combining to create something potentially greater than the whole.

*Figure 1.1 A diagram showing the composition of this thesis*



Although the four papers were written (to some extent) chronologically in time (1-4 in order), there is also overlap there: ideas, themes, issues and tensions run throughout, which I have named as **motifs** and captured in Figure 1.2. The different motifs waxed and waned throughout the different studies, with a general trend that they accumulated over time so that by the last paper I was considering them all in some way. These motifs were returned to, probed, considered and amalgamated over the five years of this study, finally resulting in a useful braiding in the Conclusion and Implications sections. I return to these motifs in the Conclusions section, where I address each one in turn as well as weaving them together.

*Figure 1.2 the development of motifs during the thesis*




## Researcher positionality

Being a researcher – dealing in research – is at a surface level perceived as being cerebral, intellectual, highbrow, disinterested, rational, scholarly, professorial, detached from reality, pompous, bombastic, loquacious, self-important, vainglorious, pretentious, imperious, grandiloquent, selfish, egotistical, and conceited; but almost never **emotional**. In the papers and the books that we read, rarely are we reading about struggle, about love, about loneliness, about fascination, about fury, or about depression alongside the more familiar concepts, theories, and experiments. Yet almost certainly these emotions, these states of feeling, are happening – and not just to the researchers, but to the research participants, to the families, to

the students, and to us, the readers. I hadn't realised how fully this divorce had penetrated until I read Jaggar's 1989 *Love and Knowledge Emotion in Feminist Epistemology*, which sets out the case for exploding the myth of dispassionate research, instead revealing that emotion is present in the form of **values** in all research, and yet many Western epistemologies have suggested otherwise. This false binary – as all false binaries – supports the kyriarchy, and maintains the status quo, continuing to suggest as it does that the white Western male point of view is rational, correct and emotion-free, and effectively devaluing everything "other" as hysterical rambling or irrational nonsense (Jaggar, 1989). Everyone, and hence every thing created by humans, contains a point of view; "persuasion is everywhere, even in spreadsheets" (D'Ignazio & Klein, 2020, p. 76). As a mathematician by training, I particularly resist the idea of using numbers, data or mathematics to create this veneer of objectivity (*mathwashing*), and appreciate the use of research methods in which the researcher's situatedness and positionality is present, acknowledged and woven into the research in intentional and beautiful ways, an idea known as *strong objectivity* (Harding, 1992). This requires a strong and robust throughline of *criticality*, which has been defined variously as:

- moving beyond simplistic interpretations and embracing open-ended perspectives that accept contradictions and debates (Chen & Dervin, 2020).
- using "but what if?" thinking by making continual attempts to falsify; "a method of trial and the elimination of errors, of proposing theories and submitting them to the severest tests we can design" (Popper, 1972, p.16 in Stables, 2003).
- Being discriminatory (in the sense of fine judgement): focusing on ascertaining the meaning and value of a work of through rigorous textual analysis and justification (Stables, 2003). I reject this definition due to its inherent elitism and classism, a clash of values with the intersectional feminist underpinnings of this work.
- A focus on emancipatory critique by being socially critical: challenging the status quo by first understanding of the ideological and political forces constituting the present (Stables, 2003)
- Deconstructing: a commitment to probing beneath the surface, understanding that meaning is always deferred, excessive and unfixed (Stables, 2003)
- Avoiding being tied to pet theories, gurus and analytical stereotypes; and resistant to the allure of the idea that one's criticality is better than others (Chen & Dervin, 2020)

Thus the intersectional feminist epistemology of seeing – and valuing - emotion and values as central to research, as well as criticality in its many forms, is a fundamental underpinning of this thesis. Bayley (2022) writes of feminist theory crossing boundaries, breaking out of the ivory

towers of academia, and becoming something we do at home – something I have increasingly considered over the years of doctoral study during a global pandemic. Burnard (2022) suggests that solving problems with and through research in the real world – problems which matter – involves transgression, transdisciplinarity, and even rebellion. More broadly, in all my work I seek to *queer* – to interrogate and blur borders, to challenge categories, especially ones that are used on and about people and identities, and especially also in relation to challenging mathematics and research and science as binary-making, "natural" truth-revealing intellectual activity (Yeh & Rubel, 2020). In this way, this work is shot throughout with intersectional feminist, queer, critical, pragmatist, and interpretivist theory.

This is my positionality as a researcher, and I declare it honestly. Research voices do not come from nowhere; they come from somewhere (Haraway, 2016) and we can pretend otherwise, or be honest about who we are - and about how what we do is also always, always about who we are. I am working on work about margins, without a doubt because I have been marginalised. I seek to queer because I am queer. And yet, because queering is paradoxical (it is a way of categorising non-categorisation), I also believe, paradoxically, that to queer is to remember that what someone *does* is not always equivalent to what someone *is* (Butler, 1990).

In this work, I draw on ideas of criticality in two important ways.

1. *Criticality* in the sense of a theoretical underpinning: "the importance of acknowledging one's social location when doing critical research and highlight..core values of democracy and egalitarianism" (Paradis et al., 2020, p. 842); challenging the status quo in emancipatory ways (Stables, 2003). This means that I set an intention to:

- Acknowledge and outline my researcher positionality
- Draw on feminist, queer and big Q qualitative (see later section on rationale for methods) ideas about research
- Acknowledge and use multiple identities in my research
- Perceive and reconcile multiple research "truths", rejecting positivism
- Commit to uncovering power dynamics within the research
- Question my motivations and rationales for choosing *this research now,* and extend that questioning into all areas of the research: the literature review, the problem framing, the choice of theory, the methodology and methods, the conclusions, and implications
- Acknowledge and attend to the ways that "particular knowledges reproduce structural relations of inequality and oppression" (Mao et al., 2016, p. 1), especially as the field of knowledge brokering deals directly with the constitution of *knowledge as power*

- Understand and note that this work is not just the construction of new knowledge, but a process of *academic identity negotiation* (ibid)

2. *Criticality* in the sense of holding myself to account: "asking questions, questioning, reconsidering one's assumptions and unthinking" as well as "an open-ended perspective whereby educators and researchers must accept contradictions, debates and the symbolic violence of being questioned, of having their criticality critiqued'" and also "thinking for oneself to avoid being enslaved by pet theories, gurus and analytical stereotypes (amongst others) and to stop thinking that 'one's' criticality is better than others'" (Chen & Dervin, 2020, p. 215). This also includes a commitment to careful deconstruction (Stables, 2003). This means that I set an intention to:
    - Bring myself to the work with an open mind and a wide range of possibilities
    - Pay attention to nuance and detail and their possible meanings
    - Examine myself, my actions, my words and my reflections as a knowledge broker from the outside (researcher) standpoint and from the inside (broker) standpoint, and work on analytic reconciliation of these perspectives
    - Notice and note biases as they occur in the work
    - Tolerate and name contradictions, tensions and paradoxes; resist the temptation to resolve them where appropriate
    - Offer the work in this thesis for review at many stages, both formally and informally, and use the feedback to ask deep (and potentially painful) questions
    - Remain open to the idea that my criticality is performative, surface-level, or could be improved

Mao et al. (2016) describe the process of researcher criticality as a type of dynamic spiral in which we interrogate our own positionality and social location, noting that previous conceptions of criticality may have been based on erasing identity as part of the myth of researcher neutrality, and defining instead a distinct kind of feminist constructivist criticality, which accords with my own, where criticality conceptualises "the researcher as an active participant in knowledge reproduction rather than as a neutral bystander"(Hsiung, 2008, p. 212).

## My role as a knowledge broker

I have been working as a knowledge broker in mathematics education in England for the past eight years. My role, based at Cambridge Mathematics as part of the University of Cambridge, involves:

- Considering what topics may be useful to decision-makers such as teachers, designers, or policymakers
- Scoping, finding, sifting, and critically reviewing literature
- Selecting and synthesising ideas from the literature
- Creating, designing and editing artefacts (such as *Espressos* – link; policy briefs; presentations; talks; videos; diagrams; illustrations; tasks; or articles) to explain the overall ideas and implications from the literature in context
- Consulting on the design of other artefacts, products or initiatives that seek to be evidence-informed
- Explaining, exploring and critiquing ideas from literature with a wide range of stakeholders
- Publishing articles and papers focused on reviewing the literature and considering implications in context
- Attending and presenting at mathematics education or education conferences that may be teacher-facing, research- or design-focused, or a mixture of these
- Contributing to projects at small-, medium- and large-scale that seek to audit and improve curriculum, resources, professional learning or assessment in mathematics education, often internationally
- Contributing to working groups, committees, and organisations that seek to use research to improve mathematics education

This work has been ongoing during the research and writing of this thesis and has provided a particularly useful ground in which to test, critique and explore ideas that I have written about here.

## Rationale for alternative format approach

The approach I took to this work – publishing a series of papers and connecting them together – is known variously as a journal format thesis, publication-based thesis, compilation thesis, integrated thesis, Stapler thesis, or alternative format thesis. This research is characterised by

an "alternative" approach in many ways. Of course, then, it makes sense that it is designed around an "alternative" format multiple paper thesis design, which is characterised by:

- Multiple manuscripts (typically 2-4) that are intended for publication, have been submitted for publication, or published
- The centring of all manuscripts on a similar theme, but addressing different questions/ideas
- The thesis being written as a narrative weaving these papers together with a suitable introduction and conclusion (Watson & Nehls, 2016)

The reasons for doing so are as follows:

1. This constitutes a more creative, flexible model of scholarship than one large study/piece of writing (Watson & Nehls, 2016).
2. Writing and submitting research papers for publication as part of the PhD centralises immediate and useful feedback as early on in the process as possible, and is invaluable training in journal paper writing as opposed to "a writing structure [students] will probably never again use" (Krathwohl, 1994, p.30, in Duke & Beck, 1999) which is not generalisable or good training for other academic writing (Duke & Beck, 1999). I have particularly enjoyed getting this immediate feedback on both my communication of ideas and the choice of journal/audience for them, which is a key part of knowledge brokering itself.
3. The focus of my work is research dissemination; the case has been persuasively made that one large PhD thesis is not as effective in terms of research dissemination than smaller published papers, and indeed often to get ideas seen researchers have to "split" their thesis into publishable work after completion which is counterintuitive, counterproductive and unnecessary (Thomas et al., 1986) and "a stylised charade" (Duke & Beck, 1999, p. 32). They are both "unwieldy to read" and "unwieldy to write" (Watson & Nehls, 2016, p. 48). I was therefore particularly keen to publish throughout the doctoral study period, given also that I studied part-time over a period of five years in total.
4. "To engage in a process in which topics are parcelled into smaller ideas worthy of investigation throughout the process may..prepare the doctoral candidate in a more authentic manner as pertains to professional expectations and goals" (Watson & Nehls, 2016, p. 47) and allowed me to be more flexible/agile in my response to the data that came in. This has allowed me to investigate knowledge brokering from multiple, complementary angles, and triangulate my data, which has been especially useful as I have used mixed methods and investigated my own practice as a knowledge broker.

5. Models of creative thinking suggest allowing our unconscious mind to work on issues and entanglements while we move onto other (but related) issues can be very fruitful for breakthrough moments, and this can be applied to doctoral students of education research, in particular allowing them to break up doctoral work into several small related problems/issues and writing them up as papers instead of one large dissertation (e.g. Krathwohl, 1994). I have enjoyed interweaving each paper of this thesis with my own professional practice, allowing the motifs and synthesis to richly emerge and combine over time.
6. Publication of the research prior to its inclusion in the PhD thesis provides a good indicator of the original contribution made by the research (University of Portsmouth, 2024). I am delighted to report that, in particular, the first paper of this thesis has been cited more than 77 times, and I have received a great deal of useful feedback on it from researchers and other knowledge brokers.

# Rationale for methods

## Rationale for choosing mixed methods

I have been interested in methods and methodology in research for some time, and in particular in the hierarchy of method types that seems available in the education discourse, suggesting that quantitative methods (of which RCTS are the "gold standard") are "better" at producing "quality" evidence than qualitative methods. Creative and art-based methods have also been something I have investigated in detail, finding them particularly useful in the activity of reflexively investigating my own practice as a knowledge broker. I have therefore found that the idea of using mixed methods has great appeal, for two reasons. Firstly, using both quantitative and qualitative methods complement and triangulate one another, providing a more complete picture of the phenomenon under investigation. Secondly, I wish to intentionally trouble the hierarchy of method types described above, undermining the stranglehold of mathwashing and quantitative coercion of research on practice in educational contexts.

## Rationale for choosing art-based research

Art-based research can "provoke, challenge and illuminate as it expands perceptions and imagines new innovations that are capable of transforming knowledge" (Moon, 2013, p. 35), which makes it a particularly good fit for exploring a new field that such as educational knowledge brokering. Further, arts-based research can be used at any point in research processes – whether generating, interpreting and/or communicating knowledge - to offer exciting insights, do boundary-crossing work, promote dialogue, challenge assumptions,

examine perspectives, and provoke paradigm shifts (Parsons & Boydell, 2012). "The use of arts-based research is shifting our understanding of what counts as evidence and highlights the complexity and multidimensionality involved in creating new knowledge" (Boydell et al., 2012, p. 1). In particular, "combining art and writing in which each illuminates and furthers the other is a unique discipline that lends itself to the deepest kind of enquiry" (Allen, 2013, p. 11). Since "the only possible way of investigating our cognitive practice is by being part of it" (Friberg, 2010, p. 31), immersing oneself in the practices and processes of thinking out loud artistically may be in some sense seen as the most honest kind of research, and that which yields the deepest and most powerful data.

Critical feminism has provided a cogent and coherent critique of the positivist research paradigm, arguing that its insistence on "rational" social science research models of detachment and objectivity are not only unrealistic and unattainable, but that "the typical research voice expresses masculine interests and privilege" and the choices made at all stages of research are therefore tied to the interests of patriarchy (Malacrida, 2007, p. 1330). All research contains gaps, spaces, silences, edited out parts, scribbled and scratched sections, voices not heard, words swept out of sight and people not seen. What is left is legitimised and sanctified, reified into existence as a supreme type of knowledge at the pointy end of the pyramid. We can acknowledge this and talk about it – either within the research or in discourses around it – or we can pretend it isn't true, that these messy extra knowledges that we have chosen to ignore are now worthless, not rigorous, have now ceased to exist in the 'real' research world we have constructed out of hard crystalline data alone.

My theoretical framework thus draws on complementary emancipatory, critical and intersectional feminist approaches to research use - that is those that are focused on practical meaning and interpretation, and critiquing power and control (Habermas, 2015). In other words: "for scientific purposes, treat people as if they were human beings" (Harré & Secord, in Laycock, 1975, p. 180). In contrast to dehumanising methodologies, I seek approaches rooted in the science of persons, researching in ways that are (to all participants) whole, positive, active, purposive, intentional, and creative (Cohen et al., 2007).

Critical reflexivity plays a crucially important role in this work. In alignment with feminist post-structural criticality, I consider power an integral factor to focus on in knowledge production (e.g. Ramazanoglu & Holland, 2002), meaning that reflexive practice is necessary in order to interrogate both the politics of the research process, the knowledges produced, and the positionality I bring as both a researcher and a knowledge broker (Braun & Clarke, 2021). This, combined with the fact that I am working in the field that I am studying, and that it is an

embryonic field full of uncertainties, leads me to conclude that generating, gathering and examining data that takes full account of critical researcher reflexivity in the sense that Luttrell (Luttrell, 2019, p. 2) defines it as "at once subject, method, and product" is the most useful contribution I can make to this field.

This methodology is an excellent fit with both the field of study and epistemological paradigm of critical feminism because engaging in art-based practice is directly confronting the "problem of knowledge" (Nelson, 2006, p. 105); that is, what counts as knowledge, who decides, and the ways that we (are allowed to) arrive at knowledge. What we define as and value as knowledge is determined by those who have been authorised in some way to do so (legally, intellectually, morally) (Foucault, 1980). In particular, the creation of art is a kind of resistance to Western, Platonic traditions of knowledge perpetuation which favour hierarchies of knowledge expression "in which theoretical and mathematical pursuits were more highly valued than action, emotion, belief and the formulation of images" (Sajnani, 2013, p. 78). Feminist epistemologies such as Hartsock's *abstract masculinity* contend that there is feminist emancipation in resisting patriarchal "academic" conceptions of knowledge, suggesting that "one can only know and appropriate the world (change it and be changed by it) through practical activity" (Hartsock, 1998, p. 88). Kronsell (2005, p. 290) adds that using *critical perception of the everyday* is key: "the insight or consciousness [people] can gain from their activities and interactions in a gendered world.. produces knowledge". Ultimately, people come to knowledge-making processes from multiple positions, each determined by culture and context (Alcoff, 1988); one can acknowledge and use this positionality (feminist research), or ignore and conceal it (anti-feminist research). I choose the former.

Springborg's (2012) focus on art-based methods as *perceptual refinement* emphasises the iterative nature of such practice, suggesting a particularly good fit with investigating knowledge brokering which in itself is a similar process of selecting, filtering, refining and critically synthesising. They break this down into four areas, comprising:

- **concept creation** through creating evocative symbols that highlight perceptual patterns
- **meta- level learning** through the production of artistic objects, without the use of language
- emphasis on both the importance of the **nature** of the medium used to explore experience and participants' **skills** in working with this medium
- maintaining connection to any explored phenomenon through **continued sensing** regardless of what one may become aware of in the process (including instrumental purposes)

This idea of perceptual refinement fits well with my research aims, supporting my intention to investigate from the inside out and yet remain critical and reflexive. The use of art-based methods also develops an area of knowledge brokering I have been interested in for some time – the idea that we could be more innovative than simply recycling text in the ways (formats, modes, and modalities) that we communicate research, and this this might be more effective at reaching more diverse audiences (Rycroft-Smith & Stylianides, 2022). This is an idea that Barone and Eisner express beautifully:

> We tend to think about research being communicated exclusively - and of necessity - in words the more literal, the better. The idea that research reports and sections thereof can be crafted in a way not dissimilar than from the way in which great novelists write and great painters paint is even rarer. (Barone & Eisner, 2011, p. 1).

The existence of "art-based" methods may suggest that there are "science-based" methods, and that they are different – perhaps based on different paradigms of subjectivism and objectivism. However, Haig suggests:

> Scientific research is carried out by fallible creatures who, with limited cognitive resources, labor in imperfect social institutions to make sense of varied and complex subject matters. It should come as no surprise, then, that scientific knowledge is at once presumptive, conjectural, partial, and corrigible. (2023, p. 13).

As I noted earlier, the idea that "science" is logical, rational, value-free and objective, while "art" is defined in opposition to these concepts, has been thoroughly critiqued in the literature for at least forty years, and has often been linked to attempts to discredit ways of thinking termed "feminine" or "other" (e.g. Jaggar, 1989).

Friberg (2010) makes the point that attempting to *legitimise* art-based research is unnecessary in the face of critique about violating ideals of objectivity because all research is subjective – it is just that art-based research is truthful about how this subjectivity operates, and how we can harness it rather than obscure it. McNiff also cautions that people may just be afraid of the ways that art could transform research:

> Do we dare imagine that artistic enquiry can not only address questions and methods of practice in the applied arts professions but perhaps help other disciplines deal with difficult problems in keeping with the transformative role of the arts through history? Just as mathematics has played a key role in science and other disciplines while keeping its essential nature, the same applies to art. (McNiff, 2013, p. 8).

However, there are some important limitations to the use of art-based methods in research. Van Lith et al. (2013) suggest there may be a lack of distinction between identifying

the process itself from the product, or resultant impact, when considering art-based practices in mental health (therapeutic) contexts. While in some ways not comparable to my use of art-based methods to investigate, explore or analyse, this principle may still be applicable: that there is a tension between process and outcome view: in other words, should we focus on "what features and themes emerge as part of the process?" or "what does the method elicit/produce?". In this study I plan to focus emphatically on the former, with the acknowledgement that the latter is unignorable. Another documented limitation of art-based research is the possibility that the researcher is not critically reflective, engaging instead in a kind of academic navel-gazing which does not benefit the community (McNiff, 2013). The use of critical reflexivity is suggested as a counter to this tendency.

The problem of performance use in research has been documented by Rye (2014), who sees it as comprising two parts:

- The inadequacy of capture: the research may be concerned with qualities of the live encounter and the production of embodied knowledges which cannot, by definition, be embedded, reproduced or demonstrated in any recorded document
- The need for capture: if one wishes one's research to have a life beyond its original live manifestation, and thus be available to a broader research community, the practitioner/researcher has to engage with the creation of appropriate performance documents

This presents rather neatly the paradox at the heart of using art-based methods: the tension between creative spontaneity and slow reproduction, which can be seen as a limitation (art is supposed to be a one-off and research needs to be replicated!) or a feature (art allows unique insight, which can be abstracted to be generalisable and replicable), depending on the critical skill of the researcher (Sajnani, 2013).

Overall, art-based research methods offer innovative approaches to knowledge production, translation and investigation in various fields, including education (Hoppe & Holmegaard, 2022). These methods can enhance participant engagement, provide non-verbal communication channels, and balance power dynamics in research (e.g. Bagnoli, 2009) and can provide unique insights into complex phenomena (Eaves, 2014). However, limitations exist, such as the need for critical reflexivity, a deep understanding of the relationship between art and research, quality assessment, and ethical considerations (Boydell et al., 2012).

## Rationale for choosing reflexive thematic analysis

Reflexive critical thematic analysis (as defined by Braun & Clarke, 2021) aligns well with art-based research and feminist critical theoretical standpoints due to its emphasis on researcher

subjectivity, strong objectivity and interpretive approach (Braun & Clarke, 2023; Campbell et al., 2021). This method values the researcher's perspective as integral to the analysis process, encouraging reflexivity and theoretical flexibility, as well as supporting intersectional feminist commitments and narrative practice principles by allowing researchers to engage with data through their theoretical lens while maintaining methodological integrity (Braun & Clarke, 2021). The approach also facilitates the construction of uncovering conceptually-driven themes rather than simplistic categories, promoting depth and complexity in this type of qualitative research (thickness) rather than accepting initial, surface-level or neat explanations for phenomena (ibid). These characteristics make reflexive critical thematic analysis particularly suitable for researchers working within art-based and feminist critical frameworks.

Limitations with critical reflexive thematic analysis can include a lack of methodological coherence, not spending enough time or effort going through each stage, insufficient reflexive openness, and inadequate reporting clarity (Braun & Clarke, 2024). Researchers often confuse themes with topics and treat the methodology as atheoretical, instead of aligning carefully to the theoretical aspects of big Q qualitative research (Braun & Clarke, 2021). There is also a tendency to apply coding reliability measures inappropriately, assuming homogeneity in thematic analysis approaches (ibid). Additionally, researchers may struggle with developing rich, detailed analyses due to the method's flexibility (Trainor & Bundon, 2021). To help address these issues, detailed guidelines have been developed to promote higher standards in this methodology research and encourage more deliberative engagement with the methodology (Braun & Clarke, 2021). For more information on this methodology, see the Methodology section of Paper 2.

## Rationale for innovating a *research clinic* method

For the fourth paper of this thesis, I explored a brand-new method: that of the *research clinic*. I justify this by the need for a space in which to do the relational work of knowledge brokering that satisfies some of the same criteria as clinical models elsewhere in the literature. For instance, Conroy et al. (2013) describe a clinical model of teacher education centred on collaborative inquiry into authentic problems. Similarly, clinical models in law emphasise problem-solving, advocacy, responsiveness to community needs, and social justice (e.g. Carpenter, 2013). These perspectives align with both my theoretical alignment with intersectional feminist and critical standpoints, and the more emancipatory ideas in Mosher et al.'s (2014, p. 7) concept of knowledge brokering as “empowering people and unleashing possibilities”. The literature around knowledge brokering currently does not address the “where” almost at all, a research gap which warrants attention given the importance of

relationships, power and status imbalances, and embedded assumptions about hierarchies of knowledge types evidence in the research. I particularly wanted to emphasise the idea of "clinical" meaning centred on the needs, problems, and contexts of users (e.g. Spencer, 2003). This *research clinic* method directly addresses this gap by establishing an open, accessible space driven by the needs and contexts of research users. It emphasises detailed consideration of research-practice integration while adhering to principles of empowerment, utility, and critique.

Unlike traditional clinical models, the *research clinic* was also intended to leave space to critically interrogate not only how research can illuminate and solve problems but also its limitations—where it falls short, contradicts practice, or is vulnerable to misuse. By acknowledging these dynamics, the *research clinic* method intentionally creates a forum for robust, reflective engagement with both the possibilities and pitfalls of research, fostering a more nuanced and effective relationship between research, policy and practice.

I chose to offer the research clinic through a remote modality for four reasons:

- It improved accessibility and inclusion for participants, allowing them to participate without geographical or other physical constraints, the need for travel time, or other logistical concerns such as childcare
- It fulfilled my own accessibility needs as a disabled researcher who practices zero-COVID transmission as an ethical non-negotiable in my research
- It allowed for easy recording and analysis of the clinic sessions
- It created a third space – not owned or inhabited by either the knowledge broker or the participant – which had a grounding in equity and collaboration

In this study my use of the term *research clinic* thus refers to an open, accessible space where anyone is welcome; discussions are driven by the agenda of the research user; and where research and practice are considered in detail at various levels of zoom. I see this method as filling a research gap in investigating the 'where' of knowledge brokering, especially in relation to key ideas around power and types of knowledge, and I hope that in time this method is used, investigated and critiqued more thoroughly. For more about the *research clinic* model, see Paper 4.

## Theoretical and conceptual framework

In reviewing the literature, I have concluded that Mosher et al. (2014) provide the most coherent and persuasive framework for analysis of knowledge brokering, using four conceptualisations that move beyond the simplistic question-framing and instead focus on the types of knowledge

relationships, intentions, action and impact that may occur in each. Their work is not directly from the field of education but from youth development/ community-university action research. They named their four categories knowledge implementation; capacity enhancement of collaborators; collaborative entanglement and systemic action research, emphasising that they are not necessarily distinct, mutually exclusive, or exhaustive. They are seen as interrelated and related also to the types of knowledge brokered in order to solve particular types of problem or make particular types of decision, and an overview is shown in Table 1.2.

*Table 1.2 Four conceptions of knowledge brokering adapted from ideas in Mosher et al. (2014)*

| **Conceptualisation of knowledge mobilisation** | **Defined as** | **For what type of problem?** | **When does change occur?** | **How do we know change has occurred?** |
|---|---|---|---|---|
| knowledge implementation | a relatively straightforward implementation – the movement into action (be it policy or practice) – of research findings, understood as fixed and transferable. Many barriers to change exists, e.g. ingrained institutional practices, costs, cultural relevance, other competing sources of knowledge, political considerations: it cannot be assumed that simply communicating research findings will generate change. | "bounded problems" with relatively clear solutions | at the end of the linear process | asking whether stakeholder has done new things or done things differently: has there been a productive interaction? |
| capacity enhancement of collaborators | still fixed and transferable, the potential to enhance the capacity of the research collaborators through the new learning that occurs for research partners, for example learning discrete pieces of knowledge or information (e.g. related to research methodologies), new knowledge of the community, appreciation of the varied perspectives and multiple forms of expertise of community members, enhanced skill in establishing relationships of meaning (i.e. using boundary objects) expanding critical consciousness and increasing empowerment. | community-based participatory research projects | throughout and beyond | asking stakeholders about changes to their own agency and understanding of one another's perspectives, as well as changes to practices or services. Considering the relevance of research questions to all stakeholders. |
| collaborative entanglement | a dynamic process in which the thoughts and behaviours proposed by researchers merge with and are altered by the thoughts and behaviours of others, including change | anything involving co-creation/collaboration, in particular the construction of learning environments (because it challenges the | throughout and beyond | harder to measure, as traces of impact or change may occur whenever and wherever ideas and thoughts are |

| | | | | |
|---|---|---|---|---|
| | agents and community actors, where the intentional collision and interplay (as opposed to layering) of the expertise and perspectives of differently situated people shapes what is "known" and by whom. All participants learn, benefit from, and, in some manner, "use" the knowledge of others. | notion of separate domains of research and application/researchers and practitioners) | | exchanged. Asking stakeholders and others about perspectives, knowledges and knowing. Considering long-term effects such as contributions to structural or policy change, or life effects. |
| systemic action research | a shift from a focus on problems to systems, where multiple interconnections and relationships are the subject of inquiry; problems may seem intractable, yet under the surface, attitudes may be changing, innovations may be garnering support, and suddenly there is a phase change. | complex and seemingly intractable social issues whose roots are multiple and intertwined | change happens throughout and beyond, in an iterative and distributed way | ability in this context to make assertions about a causal link between a particular social impact and a specific research undertaking is exceptionally limited; one cannot use traditional, linear, cause-and-effect models. But we can evidence opportunities for, and actual, meaningful contact between those involved in the research collaboration and a host of actors; as traces of impact proliferate, the potential that new ideas may catch hold is enlarged. |

The advantage of this framework is that it allows a zoomed out perspective, which shows that much of the empirical literature on effectiveness of knowledge brokering often focuses on the first conceptualisation of research into use - the linear implementation of knowledge – because it is easy to measure, and because the field is new and therefore long-term or more systemic effects have not yet been considered in depth. For this reason I consider this framework to be the most developed and useful produced in the literature to date when analysing knowledge brokering.

Knowledge brokering in education is more than just communicating research knowledge; it is also transforming it (Sharples & Sheard, 2015). In Mosher et al.'s (2014) framework for conceptualising knowledge brokering, they explore the possibilities of collaborative entanglement as "the intentional collision and interplay (as opposed to layering) of the expertise and perspectives of differently situated people" (p.6). While current conceptions of educational knowledge brokering in the literature are almost entirely limited to traditionally defined roles of "researcher" and "research" and "practitioner" and "practice", (even if they are multidirectional conversations moving beyond linear knowledge flow), these conceptions are failing to capture this crucially important function of knowledge brokering: troubling the hierarchies of knowledge and knowers that exist within and around education.

Good knowledge brokers should seek to go beyond just selecting, evaluating and transforming "quality" research to broker for particular teachers, schools, organisations and contexts and begin to consider knowledge as **agency** (defined by Mosher et al. as the capacity to take action):

> When people have the opportunity to come together, to share and debate ideas and learnings (including research findings), new knowledge - the capacity to take action – is produced. It is not merely that participants learn something more about research or develop new capacities to use research (although these are important), but that the capacity to imagine new possibilities and to take action – to engage in new performance – is enhanced. The source of change is located not in the instrumental deployment of research findings but in the participants themselves. (Mosher et al., 2014, p. 7).

While some researchers have noted this idea of producing new knowledge through the activity of knowledge brokering (e.g. Meyer, 2010), this is limited in conception to the brokered products themselves rather than a wider definition which includes "empowering people and unleashing possibilities" (Mosher et al., 2014, p. 7).

## Note on ethics

I contend that ethical considerations are not just something to attend to when filling in a form for a study, but ideas that are woven delicately throughout all research activity, and in particular constituted by micro-decisions at every stage. As an example, when writing up this study, it came to my attention that one of the researchers whose work I had drawn on, Ben Levin, was a convicted sex offender. In 2015 Levin was charged and convicted of seven counts of child exploitation, including charges of possessing and accessing child pornography, and who had consequently spent three months (of a three-year sentence) in jail. A chance internet search after Ben had approached me to discuss my research meant that I became aware of this only in 2024, when this work was nearly complete. I wrestled with the many options this left me with: to leave the citations referencing Levin's work in the text as they were; to remove the citations from the thesis and explain why; to replace the citations with other relevant work; to alert other members of the research community who may be unaware of the situation and/or may be approached by him similarly. This decision happened alongside trying to negotiate this issue both cognitively and emotionally as a survivor of sexual grooming. I wondered – and continue to wonder - whether this issue was, or should be, a preclusion to further publishing research (particularly as the area of Levin's work was education); to supervision; to collaboration with others; and/or to giving lectures and talks; and how we could address this as a community. I am

thankful to Joe Malin for the time we spent discussing this together. This is an important ethical entanglement which I note here in the hope that it may support others in negotiating the same landscape. In the end, I decided to remove these references to Levin's solo work and replace them with other research which was not carried out by a convicted sex offender, but since I was not aware of Levin's crimes until after publication of some of the work, there remain some references in the earlier text. I left references to Levin's work with Amanda Cooper intact, since it seemed unethical to me to punish a fellow researcher (and female PhD supervisee) for Levin's crimes.

## References

Alcoff, L. (1988). Cultural Feminism versus Post-Structuralism: The Identity Crisis in Feminist Theory. *Signs: Journal of Women in Culture and Society*, *13*(3), 405–436. https://doi.org/10.1086/494426

Allen, P. B. (2013). Art as enquiry: Towards a research method that holds soul truth. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 11–18). Intellect.

Bagnoli, A. (2009). Beyond the standard interview: The use of graphic elicitation and arts-based methods. *Qualitative Research*, *9*(5), 547–570. https://doi.org/10.1177/1468794109343625

Barone, T., & Eisner, E. W. (2011). *Arts Based Research*. SAGE Publications.

Bayley, A. (2022). The Heart of Research: Fictioning and Diffractive Writing as Critical Research Practice. In P. Burnard, E. Mackinlay, D. Rousell, & T. Dragovic (Eds.), *Doing Rebellious Research: In and beyond the Academy* (pp. 282–301). Brill. https://brill.com/view/title/62341

Boaz, A., & Gough, D. (2012). *Complexity and clarity in evidence use*. https://doi.org/10.1332/174426412X620092

Boydell, K., Gladstone, B. M., Volpe, T., Allemang, B., & Stasiulis, E. (2012). The Production and Dissemination of Knowledge: A Scoping Review of Arts-Based Health Research. *Forum*

*Qualitative Sozialforschung / Forum: Qualitative Social Research*, *13*(1). https://doi.org/10.17169/fqs-13.1.1711

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide to understanding and doing* (1st ed.). SAGE Publications.

Braun, V., & Clarke, V. (2023). Toward good practice in thematic analysis: Avoiding common problems and be(com)ing a knowing researcher. *International Journal of Transgender Health*. https://www.tandfonline.com/doi/abs/10.1080/26895269.2022.2129597

Braun, V., & Clarke, V. (2024). A critical review of the reporting of reflexive thematic analysis in *Health Promotion International*. *Health Promotion International*, *39*(3), daae049. https://doi.org/10.1093/heapro/daae049

Burkhardt, H., & Schoenfeld, A. H. (2003). *Improving Educational Research: Toward a More Useful, More Influential, and Better-Funded Enterprise*. https://doi.org/10.3102/0013189x032009003

Burnard, P. (2022). Critical Openings in Performing Transdisciplinary Research as/in Rebellion. In P. Burnard, E. Mackinlay, D. Rousell, & T. Dragovic (Eds.), *Doing Rebellious Research: In and beyond the Academy* (pp. 15–33). Brill. https://brill.com/view/title/62341

Campbell, K., Orr, E., Durepos, P., Nguyen, L., Li, L., Whitmore, C., Gehrke, P., Graham, L., & Jack, S. (2021). Reflexive Thematic Analysis for Applied Qualitative Health Research. *The Qualitative Report*. https://doi.org/10.46743/2160-3715/2021.5010

Carpenter, A. E. (2013). The Project Model of Clinical Education: Eight Principles to Maximize Student Learning and Social Justice Impact. *Clinical Law Review*, *20*, 39.

Chen, N., & Dervin, F. (2020). Afterword: Beyond the Naïve Mantra of Criticality in Education (Research)? In A. Simpson & F. Dervin (Eds.), *The Meaning of Criticality in Education Research: Reflecting on Critical Pedagogy* (pp. 215–221). Springer International Publishing. https://doi.org/10.1007/978-3-030-56009-6_9

Cohen, L., Manion, L., Morrison, K., Manion, L., & Morrison, K. (2007). *Research Methods in Education*. Routledge. https://doi.org/10.4324/9780203029053

Colucci-Gray, L., Burnard, P., & Cooke, C. (2023). *Sensing bodies: Transdisciplinary enactments of 'thing-power' and 'making-with' for educational future-making*. *14*(5).

Conroy, J., Hulme, M., & Menter, I. (2013). Developing a 'clinical' model for teacher education. *Journal of Education for Teaching*, *39*(5), 557–573. https://doi.org/10.1080/02607476.2013.836339

Cooper, A., Rodway, J., MacGregor, S., Shewchuk, S., & Searle, M. (2020). Knowledge brokering: "not a place for novices or new conscripts." In J. L. Malin & C. Brown (Eds.), *The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice* (pp. 90–107). Routledge.

D'Ignazio, C., & Klein, L. F. (2020). *Data feminism*. The MIT Press.

Eaves, S. (2014). *From Art for Arts Sake to Art as Means of Knowing: A Rationale for Advancing Arts-Based Methods in Research, Practice and Pedagogy*. *12*(2).

Farley-Ripple, E., & Grajeda, S. (2020). Avenues of influence: An exploration of school-based practitioners as knowledge-brokers amd mobilizers. In J. Malin & C. Brown (Eds.), *The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice* (p. 193). Routledge.

Farley-Ripple, E., & Grajeda, S. (2020). Avenues of influence: An exploration of school-based practitioners as knowledge brokers and mobilizers. In J. Malin & C. Brown (Eds.), *The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice* (pp. 65–84). Routledge.

Farley-Ripple, E., May, H., Karpyn, A., Tilley, K., & McDonough, K. (2018). Rethinking Connections Between Research and Practice in Education: A Conceptual Framework: *Educational Researcher*, *47*, 235–245. https://doi.org/10.3102/0013189X18761042

Foucault, M. (1980). *Power/knowledge: Selected interviews and other writings, 1972-1977* (C. Gordon, Ed.; 1st American ed). Pantheon Books.

Friberg, C. (2010). Moving Into The Field of The Unknown: A Reflection on The Difference Between Theory and Practice. In *At the intersection between art and research: Practice-based research in the performing arts* (pp. 19–38). NSU Press.

Habermas, J. (2015). *Knowledge and Human Interests*. John Wiley & Sons.

Haig, B. D. (2023). Repositioning Construct Validity Theory: From Nomological Networks to Pragmatic Theories and Their Evaluation by Explanatory Means. *Perspectives on Psychological Science*, 17456916231195852. https://doi.org/10.1177/17456916231195852

Haraway, D. J. (2016). *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press.

Harding, S. (1992). Rethinking Standpoint Epistemology: What Is "Strong Objectivity"? In *Feminist Epistemologies*. Routledge. https://www.taylorfrancis.com/chapters/edit/10.4324/9780203760093-3/rethinking-standpoint-epistemology-strong-objectivity-sandra-harding

Hartsock, N. C. M. (1998). *The Feminist Standpoint Revisited and Other Essays*. Westview Press.

Hoppe, E. E., & Holmegaard, H. T. (2022). Art-based methods in science education research: A systematic review of their prevalence and an analysis of their potentials in addressing complex questions. *Nordic Studies in Science Education*, *18*(3), 3. https://doi.org/10.5617/nordina.9242

Hsiung, P.-C. (2008). *Teaching Reflexivity in Qualitative Interviewing*. *36*, 211–226.

Jaggar, A. M. (1989). Love and knowledge: Emotion in feminist epistemology. *Inquiry*, *32*(2), 151–176. https://doi.org/10.1080/00201748908602185

Krathwohl, D. R. (1994). A Slice of Advice. *Educational Researcher*, *23*(1), 29–42. https://doi.org/10.3102/0013189X023001029

Kronsell, A. (2005). Gendered practices in institutions of hegemonic masculinity: Reflections from feminist standpoint theory. *International Feminist Journal of Politics*, *7*(2), 280–298. https://doi.org/10.1080/14616740500065170

Laycock, H. (1975). [Review of *Review of The Explanation of Social Behaviour*, by R. Harré & P. F. Secord]. *Canadian Journal of Philosophy*, *5*(1), 173–180.

Learmonth, M., & Huckvale, K. (2013). The feeling of what happens: A reciprocal investigation of inductive and deductive processses in an art experiment. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 95–106). Intellect.

Lemons, C. J., & Toste, J. R. (2019). Professional Development and Coaching: Addressing the "Last Mile" Problem in Educational Research. *Assessment for Effective Intervention*, *44*(4), 300–304. https://doi.org/10.1177/1534508419862859

Luttrell, W. (2019). Reflexive Qualitative Research. In W. Luttrell, *Oxford Research Encyclopedia of Education*. Oxford University Press. https://doi.org/10.1093/acrefore/9780190264093.013.553

Malacrida, C. (2007). Reflexive Journaling on Emotional Research Topics: Ethical Issues for Team Researchers. *Qualitative Health Research*, *17*(10), 1329–1339. https://doi.org/10.1177/1049732307308948

Malin, J., & Brown, C. (2020). Joining worlds: Knowledge mobilization and evidence-informed practice. In J. Malin & C. Brown (Eds.), *The role of knowledge brokers in education: Connecting the dots between research and practice* (pp. 1–12). Routledge.

Mao, L., Mian Akram, A., Chovanec, D., & Underwood, M. L. (2016). Embracing the Spiral: Researcher Reflexivity in Diverse Critical Methodologies. *International Journal of Qualitative Methods*, *15*(1), 1609406916681005. https://doi.org/10.1177/1609406916681005

Maxwell, B. (2018). *Mechanisms, contexts and outcomes of interprofessional education in a student-run interprofessional clinic—A realist evaluation approach to developing programme theory*. [Phd, Bournemouth University]. http://eprints.bournemouth.ac.uk/31107/

McNiff, S. (2013). Opportunities and challenges in art-based research. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 3–10). Intellect.

Meyer, M. (2010). The Rise of the Knowledge Broker: *Science Communication*. https://doi.org/10.1177/1075547009359797

Moon, B. L. (2013). Mentoring and other challenges in art-based enquiry: You will figure it out. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 29–36). Intellect.

Mosher, J., Anucha, U., Appiah, H., & Levesque, S. (2014). From Research to Action: Four Theories and Their Implications for Knowledge Mobilization. *Scholarly and Research Communication*, *5*(3). https://doi.org/10.22230/src.2014v5n3a161

Nelson, R. (2006). Practice-as-research and the Problem of Knowledge. *Performance Research*, *11*(4), 105–116. https://doi.org/10.1080/13528160701363556

Newman, K., DeForge, R., Van Eerd, D., Mok, Y. W., & Cornelissen, E. (2020). A mixed methods examination of knowledge brokers and their use of theoretical frameworks and evaluative practices. *Health Research Policy and Systems*, *18*(1), 34. https://doi.org/10.1186/s12961-020-0545-8

Paradis, E., Nimmon, L., Wondimagegn, D., & Whitehead, C. R. (2020). Critical Theory: Broadening Our Thinking to Explore the Structural Factors at Play in Health Professions Education. *Academic Medicine*, *95*(6), 842. https://doi.org/10.1097/ACM.0000000000003108

Parsons, J. A., & Boydell, K. M. (2012). Arts-based research and knowledge translation: Some key concerns for health-care professionals. *Journal of Interprofessional Care*, *26*(3), 170–172. https://doi.org/10.3109/13561820.2011.647128

Perry, T., Morris, R., & Asquith, S. (2020). Mind the gap: Using evidence in education. *Research Intelligence*, *144*, 28–29.

Ramazanoglu, C., & Holland, J. (2002). *Feminist methodology: Challenges and choices*. Sage.

Rycroft-Smith, L., & Macey, D. (2021). Deep questions of evidence and agency: How might we find ways to resolve tensions between teacher agency and the use of research evidence in mathematics education professional development? *Proceedings of the British Society for Research into Learning Mathematics*, *41*. https://bsrlm.org.uk/wp-content/uploads/2021/08/BSRLM-CP-41-2-18.pdf

Rycroft-Smith, L., & Stylianides, A. J. (2022). What makes a good educational research summary? A comparative judgement study of mathematics teachers' and mathematics education researchers' views. *Review of Education*, *10*(1), e3338. https://doi.org/10.1002/rev3.3338

Rye, C. (2014). Incorporating practice: A multi-viewpoint approach to performance documentation. *Journal of Media Practice*, *3*(2), 115–134.

Sajnani, N. (2013). Improvisation and art-based research. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 77–84). Intellect.

Sharples, J., & Sheard, M. (2015). Developing an evidence-informed support service for schools – reflections on a UK model. *Evidence & Policy: A Journal of Research, Debate and Practice*, *11*(4), 577–587. https://doi.org/10.1332/174426415X14222958889404

Spencer, J. (2003). Learning and teaching in the clinical environment. *BMJ*, *326*(7389), 591–594. https://doi.org/10.1136/bmj.326.7389.591

Springborg, C. (2012). Perceptual Refinement: Art-based Methods in Managerial Education. *Organizational Aesthetics*, *1*(1), 1.

Stables, A. (2003). From discrimination to deconstruction: Four modulations of criticality in the humanities and social sciences. *Assessment & Evaluation in Higher Education*, *28*(6), 665–672. https://doi.org/10.1080/0260293032000130270

Swann, J., & Pratt, J. (Eds.). (2004). *Educational research in practice: Making sense of methodology*. Continuum.

Thomas, J. R., Nelson, J. K., & Magill, R. A. (1986). A Case for an Alternative Format for the Thesis/Dissertation. *Quest*, *38*(2), 116–124. https://doi.org/10.1080/00336297.1986.10483846

Trainor, L. R., & Bundon, A. (2021). Developing the craft: Reflexive accounts of doing reflexive thematic analysis. *Qualitative Research in Sport, Exercise and Health*, *13*(5), 705–726. https://doi.org/10.1080/2159676X.2020.1840423

University of Portsmouth. (2024). *COMPILATION STYLE THESIS GUIDANCE (PhD)*. University of Portsmouth. https://guidelines.docstore.port.ac.uk/A1065828.pdf

Van Lith, T., Schofield, M. J., & Fenner, P. (2013). Identifying the evidence-base for art-based practices and their potential benefit for mental health recovery: A critical review. *Disability and Rehabilitation*, *35*(16), 1309–1323. https://doi.org/10.3109/09638288.2012.732188

Watson, D. L., & Nehls, K. (2016). Alternative Dissertation Formats: Preparing Scholars for the Academy and Beyond. In *Contemporary Approaches to Dissertation Development and Research Methods*. https://doi.org/10.4018/978-1-5225-0445-0.ch004

Yeh, C., & Rubel, L. (2020). Queering mathematics: Disrupting binary oppositions in mathematics pre-service teacher education. In N. Radakovic & L. Jao (Eds.), *Borders in Mathematics Pre-Service Teacher Education*. Springer. https://doi.org/10.1007/978-3-030-44292-7_11

Ziam, S., Lanoue, S., McSween-Cadieux, E., Gervais, M.-J., Lane, J., Gaid, D., Chouinard, L. J., Dagenais, C., Ridde, V., Jean, E., Fleury, F. C., Hong, Q. N., & Prigent, O. (2024). A

scoping review of theories, models and frameworks used or proposed to evaluate knowledge mobilization strategies. *Health Research Policy and Systems*, *22*(1), 8. https://doi.org/10.1186/s12961-023-01090-7

# 2. PAPER 1 - KNOWLEDGE BROKERING TO BRIDGE THE RESEARCH-PRACTICE GAP IN EDUCATION: WHERE ARE WE NOW?

## Video abstract


*Please press CTRL and click on the image above to view the video abstract, or go to*

*https://youtu.be/RUjDID3n1Y?feature=shared*

## Context and implications

**Rationale for the study:** This study responds to the need for work to reconcile and curate literature— currently confused, inconsistent and using a variety of terms for apparently similar concepts—in the space of knowledge brokering in education, in particular in bridging research to practice.

**Why the new findings matter:** The findings represent a consolidation of what is known and what is not known about educational knowledge brokering, to enable further work to build on this foundation.

**Implications for researchers, practitioners and policy makers:** Implications for researchers, practitioners and knowledge brokers include the wide variety of activity currently considered knowledge brokering, the need to consider social networks as key to effective knowledge

brokering, and the necessity of clarifying the purposes and design principles of knowledge brokers for transparency, evaluation and accountability.

## Abstract

Connecting research to practice by knowledge brokering in education, which is considered here as functionally synonymous with knowledge mobilization, is currently under-researched, difficult to define, and not well understood. This narrative synthesis review curates recent research concerning characterisations of knowledge brokering in education, considering the models and metaphors that have been used to describe and prescribe its activities, and then goes on to consider the limited evidence on effective knowledge brokering and what this suggests about its evaluation in education contexts. Interpersonal relationships and social contexts are considered key to educational knowledge brokering (Levin & Cooper, 2012), which has also been described as "work at the intersection of worlds"(Meyer, 2010, p. 120). An urgent need is proposed for the evaluation of who can do the work of knowledge brokering, related to issues of trust and credibility and to better understanding what this work is in the context of key questions around the nature of knowledge and its use in education.

## Background

It has long been proposed that educational research *can* be useful to practice (e.g. Adler & Sfard, 2018; Godfrey & Brown, 2019; Moss, 2013) but equally it has long been criticised as weakly linked with practice (McKenney & Reeves, 2013) and "not very influential [or] useful" (Burkhardt & Schoenfeld, 2003, p. 3). Growing interest in building connections between educational research and practice – potentially in both directions – has been matched by growing disappointment in the limited extent to which research appears to be influencing education practice (Levin, 2013) . Partly this may be because the publication of research alone - a kind of "build it and they will come" model – has not emerged as sufficient in education contexts. This is because simply asking researchers to disseminate work better or teachers to engage with research better has not been particularly successful so far. Instead, an information architecture system has been proposed, such as that used in medicine (Goldacre, 2013), comprising established dissemination models, incentives for evidence-informed practice (and perhaps practice-informed research), and structures on which to build relationships between stakeholders, although there is not yet consensus as to how to best achieve this. There have been urgent calls for a greater focus on generating evidence on using

evidence in education (e.g. Gorard et al., 2020), with some even going so far as to wryly suggest "The irony has been noted more than once that the debate over the use of research is itself not well informed by research" (Levin, 2013, p.4).

The use of research evidence in educational practice has distinct problems due to the fact that communities of producers and users are often dissonant (Farley-Ripple et al., 2018). This has been characterised as a "last mile problem" (Lemons & Toste, 2019; Perry et al., 2020), although this suggests the issue is both a linear and an asymmetric one, placing blame on teachers for not simply working harder to "receive the baton" of research evidence that has come so far already. This view of research dissemination as linear, unidirectional and potentially disempowering to practitioners has been criticised as both ill-conceived and ineffective (e.g. Farley-Ripple & Grajeda, 2020; Malin & Brown, 2020). Other important tensions lie in the characterisation of what kinds of research evidence should be used in practice, what denotes "good quality" or "robust" in this respect, and how to balance this kind of evidence use with teacher agency and professional knowledge (Rycroft-Smith & Macey, 2021). The many tensions involved suggest this may be a "wicked" problem involving multiple aspects of the educational ecosystem (Malin & Brown, 2020).

One key solution that has been proposed is the work of *knowledge brokering*, also called knowledge translation or knowledge mobilisation among many other names. In the last few decades, increasing suggestion has been made that individuals (e.g. Geeraerts et al., 2016) teams (e.g. Campbell et al., 2017) initiatives (e.g. Wollscheid et al., 2019) or organisations (e.g. MacKillop et al., 2020) exist whose function is to transfer and transform knowledge between communities, specifically because they have important understandings of both communities (Monod-Ansaldi et al., 2019). National education initiatives with a knowledge-brokering remit have been set up in the United Kingdom, the Netherlands, and Scandinavian countries, as well Canada and New Zealand (Wollscheid et al., 2019).

The recency of the field, the proliferation of terminologies, and the transdisciplinary of the concept all make it difficult to systematically search for, locate, compare and synthesise research on knowledge brokering. This review attempts to analyse some of the most recent and useful research on knowledge brokering in education, summarising the state of the field so far, and make recommendations as to ways to minimise some of these tensions when moving forwards. In particular, it is focused on reviewing evidence around effectiveness of knowledge brokering of educational research into practice and considering ways in which to evaluate the

activity of knowledge brokering so its frontiers are not simply colonised by those with the most money, power, or political cachet to do so.

I aim to map the landscape of research in the field of knowledge brokering in educational research into practice, to provide a thematic analysis of the models, frameworks, questions and tensions that emerge from existing research in this area, to synthesise evidence around effectiveness, and to identify research gaps and an agenda for future research in this area.

## Research questions

It is important to note this review is focused on evidence use in practice, for reasons of scope, and this is considered for this pragmatic purpose as to some extent distinct from research use in policy; but in fact in context they are intertwined, and influence one another (Hubers & Poortman, 2018). My research questions are as follows:

1. What kinds of knowledge brokering work, processes and products are there in the international education research-practice space and how have they been characterised?
2. What has been found to be effective, and less effective, in knowledge brokering in education?
3. How might we evaluate, critically examine and otherwise hold to account the work of knowledge brokers in education?

## Methodology

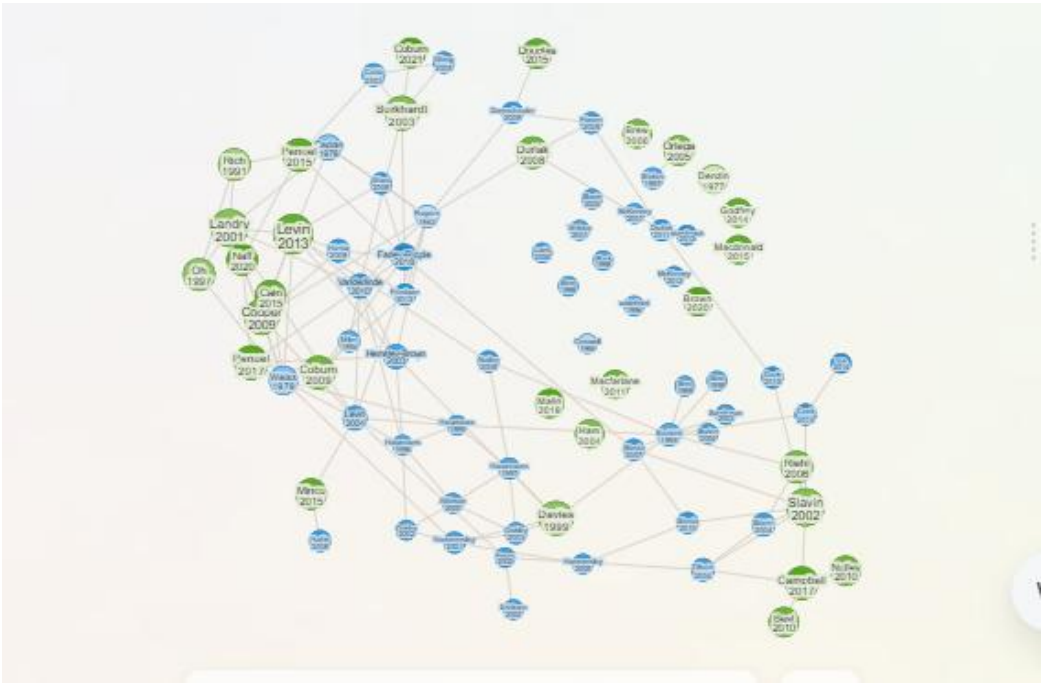
Due to the interdisciplinary, fragmentary and diffuse nature of the field, as well as time and resource constraints, this review was conducted as a narrative literature review, with a methodology of conceptual saturation. This is because there was an expectation of few (and far between) empirical papers focusing on knowledge brokering in educational practice, but potentially some important and useful work from across other disciplines and which may not have been easy to identify immediately as about knowledge brokering. The stages of searching and filtering literature are described below.

An initial search was conducted of the SCOPUS database of texts using the keywords “knowledge” and “brokering” and “education” in the title, abstract, or keywords, limited to items within the category of “social science” and “published since 2011” (132 documents). Retrieved articles were scanned for relevance and some were rejected on the basis of titles and abstracts as being out of scope, for example those that were related to language brokering. Articles which

were not rejected were then added to a coding grid, considering country of origin, type of paper, methodology, theoretical framework, keywords, main findings, and an assessment of relevance to the research questions.

Further, three published volumes of edited works were hand-scanned and added to this coding grid: Malin & Brown (2020a), Bannister & Hardill (2017b), and Fenwick & Farrell (2012). A few works were found that were considered centrally relevant, and most others peripheral. A *snowballing* method (Wohlin, 2014) was used with the works that were considered most relevant, in order to identify other related works of relevance. Finally, the research AI tool Research Rabbit (www.researchraabitapp.com) was used to corroborate these connections, and as a final extraction method. Figure 2.1 shows a visualisation of the graph network database produced when a collection was produced with the edited collection Malin & Brown (2020a) as a starting point, where green nodes represent selected papers that were confirmed as useful ("added to the collection" by the researcher), and blue nodes represented nodes suggested by the AI as potentially useful. The visualisation uses nodes and edges to show connected research papers, where connections (directed edges) represent citations, and papers are spatially near one another according to an algorithm which uses attractive charge forces between clusters, taking connections into account, to represent research papers spatially.

*Figure 2.1 a visualisation of some of the literature surrounding knowledge brokering in education from the research tool Research Rabbit; reproduced with permission*



Works were grouped and examined thematically until conceptual saturation was reached. Here I use Corbin & Strauss' (2014, p. 263) definition of saturation:

> The point in analysis when all categories are well developed in terms of properties, dimensions and variations. Further data gathering and analysis add little new to the conceptualization, though variations can always be discovered.

This idea of finding conceptual saturation is problematic; it must not be rushed, it is nuanced, and it is often hard to gauge richness or completeness of material ( Nelson, 2017) , which is a limitation of this study.

# Narrative synthesis

## Characterising knowledge brokering

In this section I attend to the first research question posed; that is: What kinds of knowledge brokering work, processes and products are there in the international education research-practice space and how have they been characterised? I begin by considering the scope of the question within education policy and practice, before a through discussion of terms used around the movement of educational research into use. I consider the ways in which researchers have defined knowledge brokering specifically in education, looking in depth at some models and metaphors, before examining some frameworks that have been used to describe, prescribe, analyse and evaluate the activity that may be described as of knowledge brokering in educational contexts.

## Policy and practice distinctions

Initially it was intended that this review be focused on evidence use in practice, seeing it as distinct from policy in terms of educational knowledge brokering, and noting that Malin & Brown (2020a) have called for more attention to knowledge brokering into practice as opposed to policy. In a wide-ranging literature review of knowledge brokering across disciplines, MacKillop et al. (2020, p. 343) also criticise papers that "refer to 'policy and practice' as if these two areas were a single entity." However, in terms of knowledge brokering in education, one key finding is that the literature does not make this distinction with any clarity. Further, some sources suggest that not only are policy and practice in education intertwined, and influence one another (Hubers & Poortman, 2018), but that in fact the work of (good) knowledge brokering may necessarily intertwine them further (e.g. Cooper, 2014). This is because one of the key functions of knowledge brokering is to increase *connection* across education systems, facilitating

collaboration and dialogue among diverse stakeholders and increasing awareness of use of evidence at all levels, not just in isolated places (Cooper et al., 2020). However,

> scholars to date have focused more on those aimed at influencing national- and/or state-level policy than on those aimed at directly engaging with or influencing educational practice. The latter entities are thus particularly underexplored, neither well understood nor able to draw upon a well-developed research base to support their work. Moreover.. little empirical work is available regarding such intermediaries' impacts—their influences or effects (Malin, 2020, p. 2).

Thus, while this review focuses on practice first, references to policy are made throughout, with acknowledgement of the complexities of connecting research to one, either, or both:

> research does connect to policy and practice, but that these relationships are both multidimensional and multidirectional. There is no universal pattern, though it is probably more typical that research first acts on people's ideas and beliefs, with those changes later translating into changes in policy or behaviour. Because all elements in this formulation, from ideas to policies to practices, are subject to multiple influences, it is very difficult to sort out the effects of research from other influences such as self-interest, political forces, or external decisions. (Levin et al., 2011, p. 3).

## Terms and their meanings

Many researchers (e.g. Cooper, 2014; Malin & Brown, 2020) use the term "knowledge brokers" alongside descriptions of the work they do as "knowledge mobilisation"/"knowledge mobilization". Some researchers appear to use "knowledge brokering" and "knowledge mobilisation" fairly indiscriminately, without examining their relationship or making a distinction between them (e.g. Rodway et al., 2021). Definitions, where they exist, are also often considerably overlapping, for example knowledge mobilisation refers to "the multiple ways in which stronger connections can be made between research, policy and practice" (Levin, 2011, p. 15); MacKillop et al. found that the most frequently used definition of knowledge brokering suggests it comprises

> all activity that links decision makers with researchers, facilitating their interaction so that they are able to better understand each other's goals and professional cultures, influence each other's work, forge new partnerships, and promote the use of research-based evidence in decision-making. (Lomas,2007 in MacKillop et al., 2020, p. 339).

This is not a problem specific to educational contexts; in healthcare, for example, a recent study "identified 29 terms used to refer to some aspect of the concept to knowledge to action"(Graham et al., 2006, p. 14).

In Figure 2.2 the usage of the terms *knowledge translation*, *knowledge mobilization, evidence-informed practice*, and *knowledge brokering* is shown over time in the corpus of texts Google has access to, showing the prevalence of *knowledge translation* over the other three in these texts, and the rise of *knowledge mobilization* and *knowledge brokering* in recent years alongside the plateauing of *evidence-informed practice*.

*Figure 2.2 a visualisation of the use of the terms knowledge translation (yellow), knowledge mobilization (red), evidence-informed practice (green) and knowledge brokering (blue) over time in the corpus of texts Google has access to; image courtesy Google ngram*

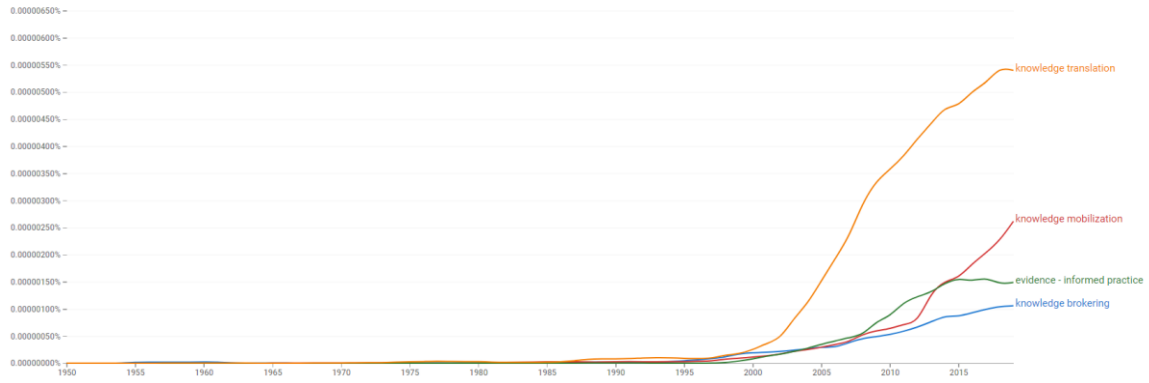



Table 2.1 synthesises the use of some of the key terms around knowledge brokering in educational contexts, exploring in particular which may be treated as equivalent according to current definitions. Some source take care to specifically say that knowledge brokers do the activity of knowledge mobilization (e.g. Malin et al., 2020) rather than knowledge brokering; and others also create a distinction between *knowledge brokering* and *brokerage* - given as a way to focus on the activity rather than agents (Malin & Brown, 2020a) which adds to the confusion. MacKillop et al. (2020) also note that the literature to this point places undue emphasis on individual brokers, perhaps suggesting that the term *knowledge brokering* may have contributed to this, although Zuiker et al. (2019) levy this same criticism at *knowledge mobilization*. MacKillop et al. (2020) also warn that the literature on knowledge brokering uses the term inconsistently and with great variation at present. Rodway et al. (2021) note the confusion and lack of clear definition in the literature and use the terms knowledge brokering, brokerage, and knowledge mobilization interchangeably. There is evidently a need for rationalisation of terms, and a clear definition of knowledge brokering - both in its own right, as in relation to other terms

referred to in Table 2.1, which is focused on education but contains some references that cast a wider net where appropriate. I return to this in the conclusion section.

*Table 2.1 terms used in the educational research-practice movement domain*

| **Term** | **Definition & source** | **Suggested relationship to knowledge brokering** |
|---|---|---|
| *Knowledge brokering* | Contested and at times unclear; see next section | *n/a* |
| *Knowledge mobilization/mobilisation* | Contested and unclear, but some helpful suggestions e.g. knowledge mobilization refers to "the multiple ways in which stronger connections can be made between research, policy and practice" (Levin, 2011, p. 15) and "a shorthand for the range of active approaches deployed to encourage the creation and sharing of research-informed knowledge" (H. Davies et al., 2015, p. 2). KM "in education, therefore, seeks to enhance and optimize the contexts of research production, use, and mediation in the service of educational policy and practice" (Zuiker et al., 2019, p. 3) | **Functionally equivalent;** for example, used in this way in Anderson et al. (2021) |
| *Knowledge translation* | Contested; e.g.<br>Research translators are "adept at speaking the language of both practitioners and researchers and would be able to translate researcher findings into a form that is comprehensible, plausible, and appears potentially fruitful to practitioners"(Hirschkorn & Geelan, 2008, p. 11)<br><br>"knowledge translation is a dynamic and inherently social process which incorporates distinct forms of knowledge which come from both research and practice." (V. Ward et al., 2012, p. 298)) | Knowledge translation is only a small part of knowledge brokering<br>Suggested as part of, but not synonymous with, knowledge brokering as does not capture all aspects<br><br>This definition of knowledge translation appears functionally equivalent to knowledge brokering, but conflicts with the definition above |
| *Knowledge exchange/knowledge transfer* | The Economic and Social Research Council in the UK defines this as "exchanging good ideas, research results, experiences and skills between universities, other research organizations, business, Government, the third sector and the wider community to enable innovative new products, services and policies to be developed" (cited in T. Fenwick & Farrell, 2012, p. 5) | Often used to characterise the activity or processes of knowledge brokers (e.g. Cvitanovic et al., 2017)<br>Often used synonymously with knowledge mobilization (T. Fenwick & Farrell, 2012) |
| *Research utilisation/utilization* | This term is much more common in literature pertaining to medicine, and defined straightforwardly as "use of research in practice" (Rodgers, 2000, p. 280) | Research utilisation is only a part of knowledge brokering<br><br>Suggested as part of, but not synonymous with, research brokering as does not capture all aspects |
| *Brokerage* | Not well defined; given as "a dynamic and complex set of actors, activities, motivation within which research is exchanged, transformed, and otherwise communicated" (Farley-Ripple & Grajeda, 2020, p. 67); or defined as what knowledge brokers do, for example, "facilitate transactions (e.g. sharing of resources, information, etc.) between otherwise unconnected (in terms of access or trust) people, groups, or communities" (Farley-Ripple et al., 2017, p. 5) | **Functionally equivalent** – if either defined as what knowledge brokers do or characterised as facilitation |

| | | |
|---|---|---|
| *Boundary spanning* | "bridg[ing] the gap between research and practice" (Lubienski, 2020, p. 186) | Depends on whether the boundary spanner is a person (agent) or object (artefact) or this activity emphases both ideas |

Weighing the evidence here, I consider the terms knowledge brokering and knowledge mobilisation in education as functionally equivalent, as other have before me (e.g. Anderson et al., 2021), and in this paper when I use knowledge brokering (KB) it also refers to knowledge mobilisation (KM). It is also reasonable to ask, if they are functionally equivalent, why use one over the other; the rationale behind the choice to use *knowledge brokering* over *knowledge mobilization* is shown in Table 2.2.

*Table 2.2 exploring the rationale for using 'knowledge brokering' over 'knowledge mobilization'*

| **Term** | **Suggested advantage** | **Suggested disadvantage** |
|---|---|---|
| *Knowledge mobilization/mobilisation* | Widely used in (some) literature; may suggest focus on *processes* | Implication that knowledge is *moved* without a focus on transformation or relationships; military connotations; suggests an 'implementation' model; knowledge goes to where it is 'needed' (implication of a lack of consent) |
| *Knowledge brokering* | Implication that focus is on relationships and/or transformation of knowledge; suggests a 'mediation' model; knowledge goes to where it is 'wanted' (implication of consent) | Less widely used in (some) literature; commercial connotations; may suggest focus on *people* (although this could equally be seen as an advantage) |

## What is knowledge brokering in education?

Knowledge brokering (KB) is not currently well defined, either outside of or within educational contexts. "Some definitions are circular with KB being defined as the activity that knowledge brokers do, and knowledge brokers as the individuals or organisations that perform KB." (MacKillop et al., 2020, p. 338). It is typically defined as a type of mediation and/or boundary spanning (e.g.. Malin & Brown, 2020) which supports knowledge flow between research, practice, and policy in a variety of ways. One of the sources of variety in definition is the wide range of ways in which "research", "knowledge", "use", "policy" and "practice" can all individually be interpreted; another distinct issue is the lack of clarity around overarching paradigms used when considering the intention of knowledge brokering and how it interacts with the (perceived) education system. I return to these issues when considering key tensions and questions in the final section on evaluation of knowledge brokering.

It can be argued that the substantial beginnings of the research dialogue around knowledge brokering in education can be traced back to Wenger's (1998) ideas of *communities of practice*. Wenger discusses boundary crossing between communities, suggesting two types of connection:

> boundary objects - artifacts, documents, terms, concepts, and other forms of reification around which communities of practice can organise their interconnections
> brokering - connections provided by people who can introduce elements of one practice into another. (Wenger, 1998, p. 105).

This situated learning perspective, emphasising that learning occurs through social practice, has been in some cases ported into research about knowledge brokering in education (e.g. Jusinski, 2021; Hubers et al., 2018) but so far with very little in-depth discussion of the theoretical implications, not least including a thorough analysis of research brokering outputs as boundary objects (some discussion of this may be found in Malin & Brown, 2020). This may be because the discourse has been some time dominated by simplistic, linear models of knowledge flow and similarly simplistic conceptions of what (good) research knowledge is. Speaking of research use in policy more broadly, White (2019) suggests there have been four waves of what they call the "evidence revolution" since the 1990s: the results agenda; the rise of impact evaluation; the rise of systematic reviews; and the rise of knowledge brokering, of which much crossover between the last three are suggested. It is suggested that this also applies to research use in education practice and policy.

In a similar vein, Campbell et al. (2017) draw on Best and Holmes' (2010) three models for knowledge to action processes, suggesting they can apply as much to education as healthcare settings. These are:

- Linear models in which research is produced and then made available for users in a mainly one-way relationship;
- Relationship models (such as network and partnership models) that build on linear models but focus on enhancing relationships between and among researchers and practitioners to facilitate the development and mobilisation of research and practice connections;
- Systems models that move away from linear processes and involve a more complex process involving interaction, co-creation and implementation of evidence throughout all levels of a system, plus identifying and addressing barriers to mobilising research and practice knowledge for evidence use ( Campbell et al., 2017, p. 212).

Campbell et al. suggest a hierarchy of evolution in terms of knowledge brokering within this conceptualisation, where the systems approach is seen as both ideal and the culmination of past iterations or generations of the other two evidence-into-use models. Although some other researchers agree with this approach – for example Ward et al. (2012, p. 297) stated that "it is becoming increasingly unacceptable to conceptualise knowledge translation [in social science] merely as a linear, researcher-driven activity" - it is clear from considering political and educational as well as scholarly discourses that this evolution process has often not moved beyond the first step of linear, one-way models. Further, the use of terms such as *knowledge translation* or *knowledge implementation* may unhelpfully hinder such progress.

In line with this third category of complex system models, Farley Ripple & Grajeda (2020) suggest that trying to understand knowledge brokering by looking at brokers – the *who* of knowledge brokering, only offers a limited perspective, instead focusing on a broader set of ideas which they call *knowledge brokerage*. They define this as "a dynamic and complex set of actors, activities, motivation within which research is exchanged, transformed, and otherwise communicated" (Farley-Ripple & Grajeda, 2020, p. 67).

The idea of *transforming* research knowledge in education comes from theoretical work looking at knowledge brokering across disciplines by Meyer (2010, p. 118), who suggested "knowledge brokers do not only move knowledge, but also produce a new kind of knowledge: brokered knowledge." Research knowledge can be transformed into brokered knowledge in several ways:

- it can be made accessible by changing the language it is encoded in
- it can be made into a different format, medium or modality
- it can be distilled, synthesised, or summarised (what I consider rescaling, although the use of this term is very unclear, for example in (Meyer, 2010))
- implications for practice can be inferred or induced

These are often conflated, or too little attention paid to distinctions and relations between them, in the literature – for example, Farley-Ripple et al. (2017, p. 19) in their coding framework refer to a knowledge brokering activity of "Translate research into understandable language and/or format", which could refer to several of these. A key focus for the field, moving forwards, is to tease out these activities as separate, as well as considering models of how they might affect one another – considering, for example, the effect of clarity of language against whether

the knowledge brokering product is a video, a document, an image, a presentation, a song, a podcast, or a poem; against its length, or time it might take to engage with, or how distilled its messaging is.

However, brokered research products – so often the outputs of transformed knowledge - "such as reports or research briefs, or even practice guidelines, while potentially valuable, do not have very much independent impact…Research has impact through when it becomes part of other social processes." (Levin, 2011, p. 18). Cooper et al. (2020, p. 94) similarly suggest that knowledge brokering "has often been conflated with surface communication strategies…which devalues and obscures a more robust understanding of brokering." Thus knowledge brokering is understood to be much more than just transforming or communicating knowledge; various other strands of activity have been proposed. In Table 2.3 my synthesis of these various strands are shown, along with their emphasis in some of the selected literature, which may not always be an exact match due to difficulties with aligning language and intent with the categories chosen. The categories of activity emerged from a close reading of the examples and activities described in the literature, as well as my own familiarity with knowledge brokering work in education.

*Table 2.3 a synthesis of some of the varied activities of knowledge brokering mentioned in the literature*

| | Theoretical models | | | | Observed characteristics | | |
|---|---|---|---|---|---|---|---|
| | Wollscheid et al. (2019) | Cooper (2013) as cited in Cooper 2019 | Sharples (2015) | Malin & Brown (2020), after Bush (2017) and Ward (2017) | Farley-Ripple et al., (2017) | Farley-Ripple & Grajeda, (2020) | McWhorter et al. (2020) |
| Needs analysis of the user | | | ■ | ■ | ■ | ■ | ■ |
| Sourcing/ selecting of (good quality) knowledge | | | ■ | ■ | ■ | ■ | |
| Provide technical assistance/support | | | | | ■ | ■ | |
| Transformation of knowledge into different forms (synthesis/ summarising/ distillation) | ■ | | ■ | ■ | ■ | ■ | ■ |
| Translation of knowledge into more accessible language | | ■ | | | ■ | ■ | ■ |
| Visualising/mapping knowledge | ■ | | | | | | |
| Evaluation or impact testing of knowledge | | | | ■ | ■ | | |
| Facilitate discussion of knowledge | | | | | ■ | ■ | ■ |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| Develop products/programs, or publish materials based on research | | | | | | | |
| Distribution/ dissemination of knowledge | | | | | | | |
| Ensuring knowledge is used/applied | | | | | | | |
| Convening partnerships/ supporting relationships | | | | | | | |
| Supporting users to critically engage with knowledge | | | | | | | |
| Building capacity for joint work | | | | | | | |
| Identifying knowledge gaps/initiating new research | | | | | | | |
| Explicitly focusing on subject-specific knowledge in depth | | | | | | | |
| Attending to equity and inclusion barriers | | | | | | | |

Table 2.3 shows some of the discrepancies, gaps, and differences in current conceptions of educational knowledge brokering in theoretical and empirical research. Farley-Ripple, Tilley & Tise (2017) suggested that none of the models available covered all the characteristics they found when exploring brokerage in practice, and that a more comprehensive typology was therefore needed. Other ways of framing knowledge brokering activity, for example Ward (2017), may be a useful overview but just contain too little detail to be practically useful in untangling different threads of activity, with only three categories: making connections/brokering relationships; disseminating and synthesizing knowledge; and interactive learning and coproduction.

## Models and metaphors

A variety of metaphors and models have been used to characterise knowledge brokering, with concomitant limitation and affordances. In Table 2.4, I summarise some of the main metaphors or models for knowledge brokers, with inferred characteristics of the associated knowledge brokering activity, activity emphasis, affordances and limitations.

*Table 2.4 a synthesis of some of the models and metaphors of knowledge brokering in education*

| **Model/metaphor** | **Emphasis** | **Affordances** | **Limitations** |
|---|---|---|---|
| knowledge brokering as **mediating**<br><br>knowledge broker as **mediator** or **intermediary**<br><br>(e.g .Levin, 2013) | Facilitating relationships | -emphasises social/relational role<br>-recognises emotional and cultural aspects<br>-highlights awareness of potential dissonances between communities<br>-suggests a focus of moving towards shared goals<br>-highlights considerable expertise needed from broker | -expecting tension may create tension<br>-suggests a negotiation focus which may be too narrow<br>-may minimise role of creating resources and artifacts<br>-may centre the broker |
| knowledge brokering as **straddling**<br><br>knowledge broker as **mixed-terrain Colossus**<br><br>(e.g. Cordingley, 1999) | Crossing boundaries | -emphasises need to inhabit/understand the terrain of two worlds<br>-recognises cultural aspects<br>-highlights the boundaries and barriers that may be present between communities | -expecting community dissonance may create community dissonance<br>- may centre the broker<br>-static model<br>-unlike spanning/bridging model, broker themselves is the only conduit |
| knowledge brokering as **Janusian integration**<br><br>knowledge broker as **dual role player**<br><br>**(**e.g. Lam, 2018) | Being a member of more than one community | -emphasises considerable expertise/experience of broker needed | -suggests two or more identities may be incompatible, or non-simultaneous<br>-others may perceive broker as disingenuous or non-authentic |
| knowledge brokering as **boundary blurring**<br><br>knowledge broker as **permeable membrane**<br><br>**(**e.g. Guston, 2001) | Removing barriers | -suggests researchers and teachers can have blurred/multiple identities<br>-emphasises dynamic flow model | -suggests broker has control over knowledge flow<br>-may centre broker |
| knowledge brokering as **boundary spanning**<br><br>knowledge broker as **bridge between worlds**<br><br>(e.g. Malin & Brown, 2020**)** | Building connections | -focus on creating pathways/connections<br>-suggests researchers/teachers can move between worlds<br>-may suggest knowledge broker becomes obsolete over time<br>-emphasises dynamic flow model | -suggests worlds of research and practice are completely distinct<br>-unlike the boundary blurring model, the boundary spanning redraws/emphasises the boundary itself |
| knowledge brokering as **translating**<br><br>knowledge broker as **code-switcher**<br><br>(e.g. Hirschkorn & Geelan, 2008) | Interpreting | -focus on moving knowledge from one language, form, or format to another<br>-highlights the language/discourse accessibility problems between researchers and teachers | -several possible types of activity may be conflated<br>-may centre the broker<br>-relies on knowledge broker's ability to understand implications of cultural-linguistic decisions |

| | | | |
|---|---|---|---|
| knowledge brokering as **matchmaking**<br><br>Knowledge broker as **nexus**<br><br>(e.g. Sharples 2015) | Introducing | -focus on building connections within system<br>-emphasis that knowledge broker does not need to know everything | -credibility and trust may be diluted<br>-may feed into self-reinforcing White patriarchal narratives of who is seen/privileged |

Several researchers liken knowledge brokering to mediation (Farley-Ripple & Grajeda, 2020; e.g. Gough et al., 2011). Ginsburg & Gorostiaga (2001, p. 186) call this "going beyond the one-way or even two-way transmission and utilisation of knowledge..to a form of interaction referred to as dialogue." Many of the metaphors and models used here have the same obvious focus on dialogue and/or social relationships, strongly suggesting this role is important in the literature. Some of them appear to centre the knowledge broker more than others, giving rise to questions as to whether the role of a knowledge broker could or should allow for their own obsolescence over time, as described by Rodway (2015).

What is missing from Table 2.4 is the important but overlooked characterisation of knowledge broker as *exhibitor* and knowledge brokering as *curating*: gathering ideas on a particular theme to tell a particular story and curating them in one place to allow the practitioner to explore and enjoy them as a collection. This has the advantage of conceptualising research ideas, as well as other knowledges, as flexible artefacts that can be used and reused in the co-creation of different stories. However, no one characterisation in this table is "correct"; they are all useful, and considering them as a whole allows for comparison of the type of complex, overlapping and multidimensional activity knowledge brokering may comprise.

Other researchers make distinctions between the type of activity they consider part of knowledge brokering in different ways. For example, Edwards (2012, p. 51) explores the application of Carlile's (2004) distinction between transfer, translation and transformation in educational contexts, suggesting that there is a hierarchy:

- *transfer* refers to the movement of knowledge a small distance; where the difference between what is known (existing specialist knowledge) and what is new is small, meaning the demands in knowledge held in common is also small, and the difficulty is less
- *translation* refers to the need to move a further distance, which brings with it the need to change knowledge into a different context in some small way; there is more demand on the knowledge held in common, and the difficulty in working with the new knowledge increases

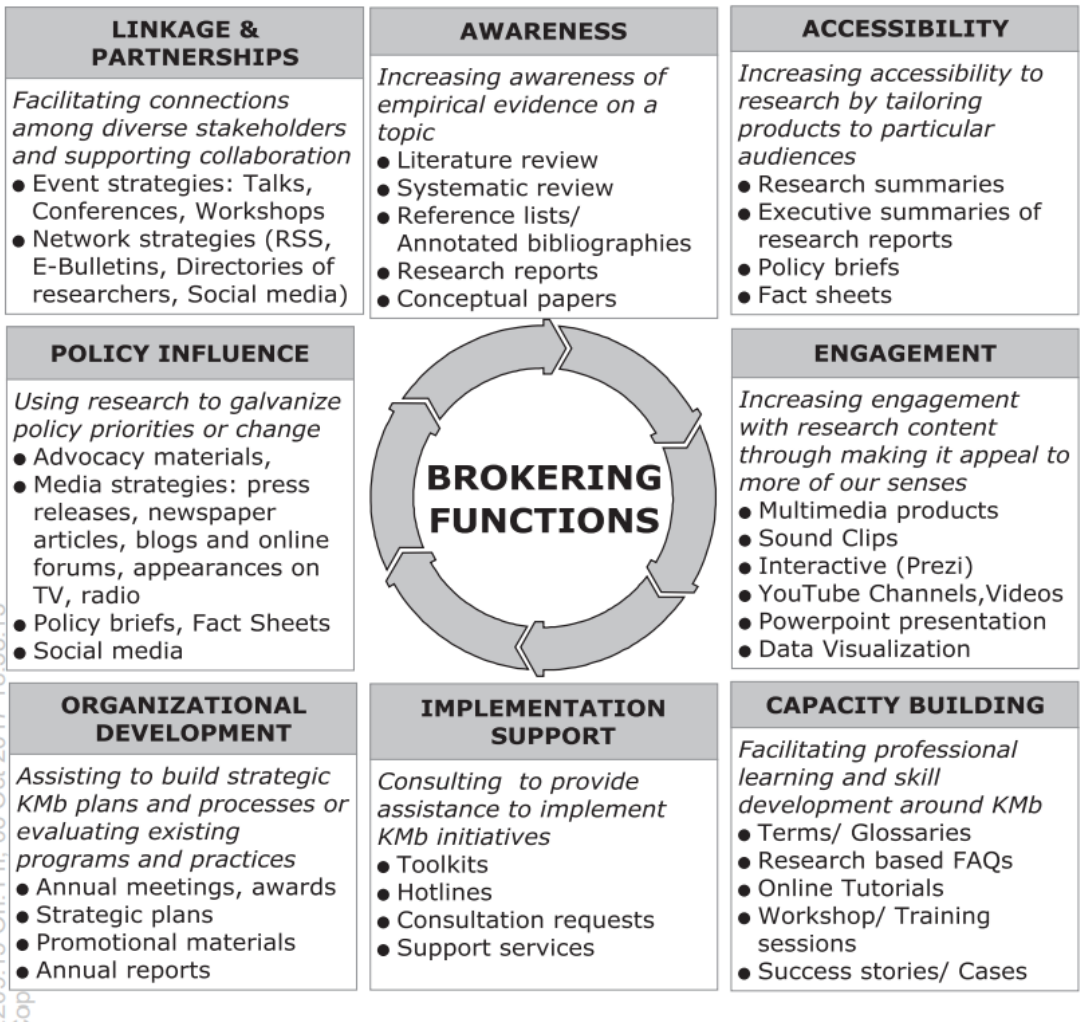
- *transformation* is needed when the distance between what is known and what is new is great – a kind of intellectual bridge-building, or "building common knowledge" – which produces the greatest level of difficulty

This relationship of the type of activity of knowledge brokering to the type of knowledge being brokered is particularly important, and something I discuss further in the next section.

## Frameworks

A variety of frameworks have been proposed with which to characterise, describe, prescribe, evaluate or measure knowledge brokering; and often the purpose of them is not made clear. For example, the framework shown here in Figure 2.3, from Cooper (2014), entitled "brokering functions" which is detailed, but does not necessarily illuminate further than gathering possible activity of knowledge brokerage.

*Figure 2.3 brokering functions of knowledge brokering organisations, from Cooper 2014; permission sought from publisher to reproduce*



By contrast, Ward's (2017) framework, developed out of their analysis of 47 existing knowledge brokering models across different disciplines, is more interrogatory, with four questions as headings:

- *Why is knowledge being mobilised?*

  *• Develop solutions to practical problems • Develop policies/programs or recommendations • Implement defined policies and practices • Change practices and behaviours • Produce useful research/scientific knowledge*

- *Whose knowledge is being mobilised?*

  *• Professional knowledge producers • Frontline practitioners • Members of the public/service users • Decision makers • Product/program developer*

- *What type of knowledge is being mobilised?*

  *• Scientific/factual knowledge • Technical knowledge/skills • Practical wisdom*

- *How is knowledge being mobilised?*

  *• Making connections between knowledge stakeholders and actors • Disseminating and synthesising knowledge • Facilitating interactive learning and co-production*

The advantage of this framework is its questioning nature, probing in particular at the types of knowledge being brokered and the purposes of the brokering in the first place.

I consider Hubers and Poortman (2017, in Malin et al, 2018, p. 8) to have developed the most useful framework of this kind to date; when describing effective professional learning networks in education, they identified boundary crossing as essential and accordingly refined three principles, framed as questions, for effective knowledge brokering:

*1. Given the vision for boundary crossing, what content should be shared? For instance, should the knowledge pertain to a specific subject, programs or new approaches, policy, background information, and so on?*

*2. At what level of detail should knowledge be shared? Specifically, these authors note brokers often remain stuck at the level of informing teachers about certain activities or describing these activities' outcomes. The next level of mobilization, however, involves creating "how-to" schemas and/or explaining underlying principles behind certain strategies (Why should you do it? Why should it work?).*

*3. What knowledge-sharing activities could be used? It is most effective to share knowledge via active personal engagement. This type of activity is preferred because it gives educators a concrete idea about what is expected. However, it is scarcely employed because of the level of resources required to achieve change at scale. Besides providing active personal engagement,*

*personal communication can be used (e.g., formal presentations, updates during a meeting, even lunch conversations). However, the most often-chosen activity, yet least likely to be effective, is written communication (e.g., an e-mail or a staff newsletter item). Written text offers a relatively fast way to reach all colleagues, but colleagues will not always read it and/or may not understand it as intended.*

By contrast, Mosher et al. (2014) have provided the most coherent and persuasive framework for analysis of knowledge brokering, using four conceptualisations that move beyond the simplistic question-framing and instead focus on the types of knowledge relationships, intentions, action and impact that may occur in each, shown in Table 2.5. Their work is not directly from the field of education but from youth development/ community-university action research. They named their four categories knowledge implementation; capacity enhancement of collaborators; collaborative entanglement and systemic action research, emphasising that they are not necessarily distinct, mutually exclusive, or exhaustive. They are seen as interrelated and related also to the types of knowledge brokered in order to solve particular types of problem or make particular types of decision.

*Table 2.5 Four conceptualisations of knowledge mobilisations adapted from Mosher et al. (2014)*

| **Conceptualisation of knowledge mobilisation** | **Defined as** | **For what type of problem?** | **When does change occur?** | **How do we know change has occurred?** |
|---|---|---|---|---|
| knowledge implementation | a relatively straightforward implementation – the movement into action (be it policy or practice) – of research findings, understood as fixed and transferable. Many barriers to change exists, e.g. ingrained institutional practices, costs, cultural relevance, other competing sources of knowledge, political considerations: it cannot be assumed that simply communicating research findings will generate change. | "bounded problems" with relatively clear solutions | at the end of the linear process | asking whether stakeholder has done new things or done things differently: has there been a productive interaction? |
| capacity enhancement of collaborators | still fixed and transferable, the potential to enhance the capacity of the research collaborators through | community-based participatory research projects | throughout and beyond | asking stakeholders about changes to their own agency and understanding of one another's perspectives, |

| | | | | |
|---|---|---|---|---|
| | the new learning that occurs for research partners, for example learning discrete pieces of knowledge or information (e.g. related to research methodologies), new knowledge of the community, appreciation of the varied perspectives and multiple forms of expertise of community members, enhanced skill in establishing relationships of meaning (i.e. using boundary objects) expanding critical consciousness and increasing empowerment. | | | as well as changes to practices or services. Considering the relevance of research questions to all stakeholders. |
| collaborative entanglement | a dynamic process in which the thoughts and behaviours proposed by researchers merge with and are altered by the thoughts and behaviours of others, including change agents and community actors, where the intentional collision and interplay (as opposed to layering) of the expertise and perspectives of differently situated people shapes what is "known" and by whom. All participants learn, benefit from, and, in some manner, "use" the knowledge of others. | anything involving co-creation/collaboration, in particular the construction of learning environments (because it challenges the notion of separate domains of research and application/researchers and practitioners) | throughout and beyond | harder to measure, as traces of impact or change may occur whenever and wherever ideas and thoughts are exchanged. Asking stakeholders and others about perspectives, knowledges and knowing. Considering long-term effects such as contributions to structural or policy change, or life effects. |
| systemic action research | a shift from a focus on problems to systems, where multiple interconnections and relationships are the subject of inquiry; problems may seem intractable, yet under the surface, attitudes may be changing, innovations may be garnering support, and suddenly there is a phase change. | complex and seemingly intractable social issues whose roots are multiple and intertwined | change happens throughout and beyond, in an iterative and distributed way | ability in this context to make assertions about a causal link between a particular social impact and a specific research undertaking is exceptionally limited; one cannot use traditional, linear, cause-and-effect models. But we can evidence opportunities for, and actual, meaningful contact |

| | | | | |
|---|---|---|---|---|
| | | | | between those involved in the research collaboration and a host of actors; as traces of impact proliferate, the potential that new ideas may catch hold is enlarged. |

The advantage of the Mosher et al. framework is that it allows a zoomed out perspective, which shows that much of the empirical literature on effectiveness of knowledge brokering often focuses on the first conceptualisation of research into use - the linear implementation of knowledge – because it is easy to measure, and because the field is new and therefore long-term or more systemic effects have not yet been considered in depth. I consider this framework to be the most developed and useful produced in the research to date, and return to it in subsequent sections when considering the second and third research questions.

## Summary

In this section I explored the first research question posed; that is: What kinds of knowledge brokering work, what processes and products are there in the international education research-practice space and how have they been characterised? I found that:

- it was difficult to distinguish between policy and practice in educational knowledge brokering
- there are a variety of terms used in the research-into-use space in education in confusing and non-distinct ways, which is holding the field back; I proposed reconciling knowledge mobilisation and knowledge brokering, but preferred knowledge brokering
- knowledge brokering in education is not well defined, but is often regarded as a process of transforming knowledge from research into practice by crossing or spanning boundaries
- various models and metaphors have been proposed, such as knowledge brokering as mediating, straddling, Janusian integration, boundary blurring, boundary spanning, translation and matchmaking, all with various connotations about the type of work involved
- several frameworks have been proposed to characterise, describe, prescribe, evaluate or measure knowledge brokering, but they often lack detail, clear aims, or a wide perspective of the field; I suggested Mosher et al. (2014) as the most useful for analysis at the level that this paper seeks to take.

# Effectiveness of knowledge brokering

In this section I attend to the second research question posed; that is: What has been found to be effective, and less effective, in knowledge brokering in education? I first summarise the strength of the empirical evidence of this emerging field as weak overall. I then consider the kinds of knowledge brokered, as this necessarily affects ways to measure effectiveness, before giving critical synthesis of existing evidence within educational contexts. I then consider social and relational networks, a special case of knowledge brokering practice which is generally agreed to be effective, in more detail. Finally, as this research base is thin, I explore research from out-of-field, in particular healthcare, that may be useful, with appropriate examination of the limitations of doing so.

## Lack of good evidence

It has long been an assumption in educational research that stronger connections between research and practice will result in improved teaching and learning; yet evidence to support this is "emerging" (Malin & Brown, 2020, p. 1), leading some to question whether a more critical view is required (e.g. Gorard et al., 2020). The detail of the somewhat nebulous notion of "stronger connections" is also important, which is why evidence from knowledge brokering is needed.

However, "[d]espite the importance of intermediary brokers in linking research to practice, there are surprisingly few empirical studies examining their roles and impact" (Sharples & Sheard, 2015, p. 578). Knowledge brokers connecting research and practice in education "operate in relative obscurity and are, consequently, both poorly understood and themselves unable to consult a substantive research base regarding how to perform this work"(Malin et al., 2018, p. 1). This may be partly due to the lack of clarity surrounding how knowledge brokering functions as a way of stimulating knowledge flow through research and practice contexts in general, but also perhaps because the education context is a particularly tricky one in which to examine knowledge brokering. For example, Cooper (2014) suggests education has been slower to adopt evidence use in policy and practice in comparison with other public services such as health and criminal justice, and Zuiker et al.(2019) suggest that education research is the hardest science, in particular in the context of knowledge brokering efforts. This is because of the wide range of contexts, variables and human factors involved, suggesting that knowledge brokering in education in particular demands a focus on needs analysis, local adaptation, sustainability, and interactive processes (ie listening to practitioners

and other stakeholders). They also suggest that this means that knowledge brokering (here referred to as knowledge mobilisation or KM) in education is particularly important:

> '(T)he dynamic local contexts of education complicate the efforts of researchers and practitioners, respectively. Without KM efforts, neither researchers nor practitioners can navigate the wide-ranging contexts that research targets, underscoring the importance of context-dependent optimization.' (Zuiker et al., 2019, p. 3).

The lack of robust empirical research base in educational knowledge brokering is likely also just a feature of the youth of the field; as MacKillop et al. (2020, p. 342) suggest: "the KB literature is still relatively young and lacks the necessary spread of empirical work to assess impact or effectiveness."

If we accept that an instrumental, linear model of research use is neither accurate nor desirable (Davies et al., 2008), that the routes knowledge take can often be indirect (Oancea, 2005) or troubled (Moss, 2017), and that measuring the impact of sharing ideas which may (or may not) lead to change at an individual, team or organisational level is likely to be challenging (Nutley et al., 2007), it follows that evaluating impact in knowledge brokering is not straightforward.

However, of the studies that exist so far, tentative implications can be drawn, and these should be collected and synthesised; first, to inform and support the development of the direction of this new field in general, and second, to inform and support the development of evaluation frameworks in particular. Without evaluating the effectiveness of knowledge brokering, we risk work taking place that may be poor quality, careless, and ineffective; but also politicised, highly biased, unethical, and/or actively do harm (Lubienski, 2020).

## Measuring effectiveness: what kinds of knowledge?

> no study to date has quantitatively demonstrated the value of using knowledge brokers to connect scientists and decision-makers in relation to environmental challenges, nor comprehensively documented the ways in which knowledge brokers can add value to knowledge exchange processes. This is, in part, due to the lack of established methods to evaluate the effectiveness and ef fi ciency of knowledge brokers, or the types of activity they undertake (Cvitanovic et al., 2017, p. 2)

As Cvitanovic et al. suggest, the problem across many fields, not just education, is that defining and evaluating knowledge brokering in practice has something of the whiff of chicken and egg

about it. Others have commented similarly: "one's understanding of knowledge in processes of mobilization is affected by how one views its purpose, and the purpose of its uses" (Fenwick & Farrell, 2012, p. 8).

While there is not currently an agreed universal framework for evaluation of knowledge brokering in education (which I address in the third section), several researchers have suggested linking the effectiveness of knowledge brokering to what is being brokered. As previously mentioned, Edwards (2012) draws on Carlile's (2004) work in organisational science to suggest that knowledge management ideas of transfer, translation and transformation could equally apply to educational contexts, defining them by the relative distances between what is known and the new knowledge. This is, however, still an implementation model at its core; remaining at the first stage of Mosher et al.'s (2014) four conceptualisations of knowledge into use: knowledge implementation; capacity enhancement of collaborators; collaborative entanglement and systemic action research. Mosher et al.'s framework stands as a reminder that if we want to solve "wicked problems" in education, we need to value different types of knowledge and different types of knowledge flow, and these bring with them a need for innovative ways to evaluate impact, including problematising the very ideas of impact, efficiency and effectiveness themselves. Fenwick and Farrell (2012, p. 7) suggest that "the multiplicity of variables affecting any outcome in education…prohibit a meaningful causal linkage to one particular study or to the mobilization of particular knowledge."

However, it is obvious that not all knowledge brokering is good, or well carried out (Levin, 2008), and there is a need for knowledge brokering activity and knowledge brokers themselves to be held to account – not just in terms of impact, but also from an ethical standpoint. Without a clear set of aims for knowledge brokering activity – agreed by stakeholders, not done to them – the field is simply spinning its wheels. I return to these issues in the third section on evaluating knowledge brokering.

## Critical synthesis of existing evidence

The overall research enterprise in education remains "small and weak", and "even where compelling research evidence is available, the systems for bringing it into practice are poorly developed" (Levin & Cooper, 2012, p. 17). Levin (2008, p. 4) suggested, somewhat ironically, that the work of knowledge mobilisation is not itself well guided by the available knowledge. Ten years ago, Levin et al. (2011) described a consistent finding in the literature: that simply providing information about research findings and/or implications does not change behaviour –

i.e. giving people evidence does not necessarily translate into policy and practice change. Gorard et al. (2020, p. 570) in their meta-analysis of evidence use in educational practice and policy similarly found that "providing access to raw research evidence or even slightly simplified evidence is not generally an effective way of getting it used, even if that evidence is presented to users by knowledge-brokers, in short courses or similar".

Gorard et al. (2020) also report that there is little evidence to suggest research champions/research leads (teachers as knowledge brokers) are effective in raising student attainment, but some evidence to suggest they may change teacher beliefs and attitudes, and engagement with research may increase. Once again, without clear aims for knowledge brokering, it is difficult to measure 'effectiveness' – and without clear definitions for what (good) knowledge brokering is, anyone may be defined as such in the literature.

Sharples (2015), explored "an evidence-informed support" for schools in the UK, by creating tailored research summary materials for schools, and developing an iterative process of engagement, whereby leadership teams interacted with this information and related it to practice. They found that a key factor in their successful role as knowledge broker was in "matchmaking": directing teachers to trusted third parties that could help them apply the evidence usefully, such as disseminators of evidence-based programmes (although they found a limitation was a shortage of these), relevant academic researchers, and other schools. They suggest that this is both efficient and successful, in particular because it continued after the knowledge broker finished their work with the school, and that it is a promising model.

Cooper (2014) examined 44 knowledge brokering organisation across Canada, finding that the organisations varied widely across a number of organisational variables including size, resources, operating expenditure and output, although most of the organisations seemed focused on creating resources rather than events and networks.
They suggest that this may be a problem because:

> The sparse evidence that does exist seems to suggest that product strategies are potentially less powerful avenues for practice change than face-to-face interaction and professional networks, especially if they mimic passive dissemination strategies of the past. If more evidence reinforces the initial trends, a shift will be needed away from merely tailoring products and posting them online towards building more robust and sustainable KMb networks. (Cooper, 2014, p. 49).

A suggestion is made that future studies should investigate fidelity of research brokering products, considering what accurate representations of the research would look like.

Rodway et al. (2021) suggest that "there is a tendency to assume that brokering activity always yields positive outcomes, which has been shown to not always be the case." They give as an example Moolenaar et al. (2010, p. 654) who found that when school leaders were positioned "in between" others in the network, thus having the potential to control the flow of work- related knowledge and information, their schools' climates were perceived as less oriented towards innovation. "Brokering principals may have interrupted and inhibited the development of new ideas and risk-taking behavior by controlling the dissemination of work-related advice." However, it is not at all clear here what kind of knowledge are being brokered, and to what extent they are research-based; this is another one of the key problems stemming from the lack of definition in the field.

Malin et al. (2018), in a case study of three organisations in the US, found that they sought to fill different structural knowledge brokering holes, ultimately considering them successful at doing so based on ideas of reach, appreciation of users, and opportunities to create partnership where educators are co-creators of knowledge rather than mere consumers of it. They used Ward's (2017) framework to analyse the knowledge brokering activity, comprising the four questions: "Why is knowledge being mobilised? Whose knowledge is being mobilised? What type of knowledge is being mobilised? How is knowledge being mobilised?" Malin et al. use Ward's three categories of knowledge being mobilised (scientific/factual knowledge, technical knowledge, and practical wisdom) to argue that a mixture "means brokerage efforts are more likely to result in applicable knowledge" as well that " knowledge is more likely to become socially robust when/if various stakeholders are drawn upon" (p.3) – both of which sound sensible, but both of which are claims made without supporting evidence, a recurring problem in this field.

## The importance of social and relational networks

The rhetoric of a particular kind of research discourse centres on the rationality of simple/simplistic research use – that characterised by Mosher et al. (2014) as *research implementation*. "The simple idea that research would have direct effects on policy and practice has long been abandoned by those who study these issues, even though it may still be held by some researchers, who seem surprised or even dismayed that their work is not immediately adopted into policy or practice" (Levin, 2011, p. 17); what Davies, Nutley, and

Walter (2008) call "the rational linear model of research use". Brown & Zhang (2016) similarly pose the question "if evidence-informed practice is rational behaviour, why aren't all teachers engaged in it?". The answer, at least in terms of knowledge brokering paradigms, is that knowledge brokering has emerged an inherently social process: complex, relational, interpretative, and affected by issues such as trust, credibility, personal relationships, and power and identity, as succinctly put by Levin several years ago:

> Knowledge takes shape and has effect in a wide variety of ways, but is always mediated in some way through various social and political processes… Knowledge by itself is not enough to change practice, since practices are social and therefore reinforced by many elements such as norms, cultures, and habits. Simply telling people about evidence and urging them to change what they do is clearly ineffective. (Levin, 2008, p. 9).

"The literature suggests that research use is an interpretive process and is affected by more than research information alone." (Lysenko et al., 2016, p. 36). Teachers need to connect, not just intellectually, but also "practically and emotionally with the knowledge they are offered in research accounts if they are to take it on board" (Cordingley, 2008, p. 37). This suggests theories of effectiveness that are tentatively borne out by the literature, such as it exists: "interpersonal relationships and social contexts are the key to shaping policy and practice..people are more influenced by their own experience and by their colleagues than they are by external evidence" (Levin, 2011, p. 18); "a condition that appears to be a powerful predictor of [research] use is direct contact between researchers and potential users." (Dagenais et al., 2012). In other words, "[k]nowledge brokering is an inherently relational activity, and whether or not knowledge brokering activity is happening depends on whether or not people are connecting with one another." (Rodway et al., 2021, p. 158).

Cooper (2010) examined knowledge brokers themselves and found five common characteristics of effective facilitators of research use: an understanding of research methodology; a broad overview of the literature; a track record within academia and practice; sound interpersonal skills; and an ability to translate complex information into meaningful materials for users. Thus it appears to matter who does the work of knowledge brokering, which I discuss in the next section. However, once again much of this literature appears limited to the first or in some cases the second aspect of the Mosher et al. framework, considering effectiveness only in the instrumental sense of research implementation, with some discussion of capacity enhancement. Recognition that effective knowledge brokering is dependent on social and relational connections is only half of the story; it is therefore necessary to measure

effectiveness, where appropriate, using frameworks that take into account conceptions of knowledge brokering as not just facilitating, but also troubling the routes that knowledge takes into practice; and just as fundamentally, troubling the fixed notions of research production and utilisation that underpin knowledges in education.

> In this process of knowledge construction, the boundaries of "producers" and "users" (or "production" and "use") are permeable and porous; change agents, community members, and others are as integral to the production of knowledge as are academic researchers, and all participants learn, benefit from, and, in some manner, "use" the knowledge of others. (Mosher et al, p.6)

In other words, in order to fully examine the effectiveness of knowledge brokering networks as boundary spanning, boundary blurring and boundary creating, it may be necessary to stop poring over the old maps and allow for new ones to be created.

## Research from healthcare that may be useful

Lavis et al. (2003), in their paper on measuring the impact of research in healthcare, make useful suggestions which may translate into educational contexts, although they are careful to also make caveats:

> not all research can or should have an impact. Many research studies will not generate a 'take home' message, either because they were not conducted with an application in mind (as mentioned earlier) or because single studies rarely yield a definitive conclusion (as has been demonstrated in the systematic review literature). (2003, p. 169)

They suggest three ways of conceptualising and hence measuring impact:

***Producer-push:*** *researchers' active efforts to make their research available to decision makers; measured by, for example*

*-items such as the number of products published targeted at specific decision-makers (process);*

*-decision-makers' awareness and knowledge of, and attitudes towards research and its source (intermediate outcomes); and*

*-decision-makers' actual use of research in the context of competing influences on the decision-making process (outcomes)*

***User-pull:*** *decision-makers' active efforts to identify research and research expertise; measured by, for example*

*-number of information requests for specific research by decision-makers (process);*
*-decision-makers' awareness of research organizations' expertise (intermediate outcomes)*
*- decision-makers' actual use of researcher organisations as an information resource*

***Exchange:*** *joint active efforts by researchers and decision-makers to ask and answer more decision-relevant questions; measured by, for example*
*-research organizations involve decision-makers in the research process (i.e. establishing the research agenda, conducting research, and/or identifying implications of the research findings (process)*
*-Researchers' and decision-maker's assessment of how they were involved in the decision-making process Intermediate outcomes)*
*-Decision-making organisations' decisions reflect (at least in part) the research available to them (outcomes)*
This framework, while only as good as its implementation in practice, has some encouraging features: it makes a clear attempt to focus on capacity enhancement as well as implementation, moving beyond just an 'outcomes' model to thinking about processes, intermediate outcomes, and consideration of the perspectives and expertises of others.

Ward et al. (2012) conducted a study where they embedded a knowledge broker in mental health practice contexts, who then collected fieldnotes on the problem-solving work that emerged; they also interviewed the team members that worked with the knowledge broker. They initially characterised this knowledge brokering activity in three ways: information management (helping teams find, package and disseminate information); linkage and exchange (facilitating discussions between the teams and relevant experts) and capacity building (helping teams develop their capacity to exchange knowledge into the future). One particular point of interest was that the type of knowledge brokered itself crossed boundaries – "since the knowledge which healthcare teams draw on is not limited to research findings our definition included ordinary and professionally-generated knowledge from research, expert opinion, recognised best practice and the current practices of other healthcare teams" (Ward et al., 2012, p. 298). This kind of analysis suggests a possible movement into the crucial third conception of the Mosher et al. (2014) framework, that of collaborative entanglement, where knowledge and knowers begin to be less bound by boundaries. Practitioners reported that, for example, the knowledge broker helped them to reflect on their ideas, to work out what was realistic and manageable, and focus on sustained change, as well as turning evidence into "everyday talk." They found that problem definition was a crucial aspect of the process. After

detailed analysis, they produced a refined conceptual framework of knowledge exchange, with five interlinked elements (p.301):

***Problem**: identifying, reviewing, clarifying, evolving, focusing*

***Context:** exploring, influences, characteristics, personal, interpersonal, organisational, professional*

***Knowledge:** locating, tailoring, assessing, classifying, usability, relevance*

***Intervention:** iterative, integrating, clarifying, negotiating, linkage, managing information, developing capacity, supporting decisions*

***Use**: spreading, sustaining, practicalities, direct, conceptual, political*

These elements are conceptualised as fluid, interconnecting streams, symbolising uncertainty and messiness, which I suggest may equally apply to education contexts.

There is, however, a tendency in the literature to hold medicine up as the standard (e.g. Goldacre, 2013) and therefore to take ideas wholesale from the use of evidence in healthcare and port them into education, one which has been resisted by education researchers who argue that this is a naïve view, and that there are many differences between healthcare and education which make this unhelpful. There are many issues with evidence-based practice in healthcare: commercial interests produce conflicts of interest (e.g. Ioannidis, 2016); medicine has a churn problem with new studies frequently contradicting/reversing previous guidelines (e.g. Prasad et al., 2013); serious ethical tensions arise between applying evidential standards to populations and caring for people (e.g. Greenhalgh, 2018). Ungerleider (2012) notes that the flow from evidence to policy and practice is faster in healthcare than education, that there are more incentives for research use, and the notion of protection from harm seems better understood. These issues provide yet more argument that knowledge brokering is specialist, complex work (Cordingley, 2008) that requires a critical understanding of research and metaresearch in the particular field of interest.

## Summary

In this section I considered the second research question posed, that is: What has been found to be effective, and less effective, in knowledge brokering in education? I found that:

- there is a lack of good quality empirical evidence around educational knowledge brokering, particularly with regards to practice
- there is a suggestion that measuring effectiveness of knowledge brokering in education is difficult; connecting what is being brokered with effectiveness is proposed

- the scant evidence that exists suggests just providing practitioners access to research knowledge, even if transformed, is not usually effective
- it is suggested that effective knowledge brokering may involve social and relational networks
- evidence from healthcare tentatively supports ideas of boundary-blurring and relational activity at the heart of effective knowledge brokering; but caution is suggested when applying ideas from healthcare contexts in education.

## Evaluating knowledge brokering

In this section I attend to the third research question posed; that is: How might we evaluate, critically examine and otherwise hold to account the work of knowledge brokers in education? First, I return to the question of characterising the activity of knowledge brokering by considering the question: What problems does knowledge seek to solve? I examine the issue of trust and credibility, exploring then related questions of who could or should do the work of knowledge brokering. I then outline key tensions and questions that remain important to move forward with in the pursuit of accountability of knowledge brokering in education, which is necessary and important.

### What problems does knowledge brokering seek to solve?

Hering (2016), speaking about the science-policy-interface as a whole, suggests knowledge brokering aims to solve four main problems:

- Scientific research is not written in ways that are accessible to users
- Scientific research fails to provide usable information for decision-making
- Even relevant and accessible research outputs may not be available at the time when they would be needed to support decision-making
- Those writing research and those using it are culturally mismatched and often do not understand one another's priorities

What is missing here in transforming educational research into practice are two further important aspects:

- Making decisions requires skilfully combining competing knowledge sources, including but not limited to research
- Without time, space and frameworks to evaluate/ analyse decisions post-hoc, it is difficult to improve decision-making

Similarly, there is good evidence on the barriers to practitioners using research in education, which should inform the work of knowledge brokering; for example, "shortage of time, lack of skills to process research, an overload of information, insufficient contextualised information, and few incentives to encourage an engagement with research" (Sharples & Sheard, 2015, p. 577). However, this depends on the cause of such barriers, some of which are more straightforward than others, as shown in Table 2.6.

*Table 2.6 barriers to research use, causes and possible solutions that may be offered by knowledge brokers in education*

| **Identified barrier to practitioners use research in education** | **Possible cause** | **Identified solution that may be offered by knowledge broker** |
|---|---|---|
| Practitioners are time-poor (Drill et al., 2013 | Institutional culture does not value research<br><br>Teachers are overworked | Work with senior leaders towards culture change<br><br>Unlikely to have an impact |
| Practitioners cannot access research due to language used (Ion & Iucu, 2014; See et al., 2016; van Schaik et al., 2018) | Research uses language that is not appropriate for a practitioner audience | Translate the research ideas themselves, or support the researchers in doing so<br><br>Broker discussions between researchers and practitioners |
| Practitioners are confronted with an overload of information | Lack of information on portals, hubs, or curation sites that offer syntheses; lack of research literacy | Provide list of good-quality resource portals, hubs or curation sites |
| Practitioners do not see research as useful or relevant (Hering, 2016; Malin & Brown, 2020) | Lack of research literacy<br><br>Rational response to some types of research | Capacity building/training on research interpretation offered by broker, or signposting towards good-quality courses that offer this |
| Practitioners do not know how to apply research ideas in context (Whitehurst, 2003) | Lack of research literacy | Capacity building/training on research interpretation offered by broker in context, or signposting towards good-quality courses that offer this |
| Practitioners do not have access to research (Levin, 2013; Malin & Brown, 2020; Martinovic et al., 2012) | Paywall/technology<br><br>Language<br><br>Disabilities | Support teacher/school to find solution<br><br>Recommend use of syntheses<br><br>Support teacher/school to find solution |

| | | |
|---|---|---|
| Practitioners do not have access to good-quality syntheses of research ideas (Cordingley, 2008; Malin & Brown, 2020) | Practitioners have not been able to find these – or they do not exist | Provide list of good-quality resource portals, hubs or curation sites<br><br>Work with practitioners to co-create such resources |

Access and accessibility stand out as crucial here. When considering the characterisations of knowledge brokering so far there is a clear lack of detail in teasing out distinct differences in activities that have been conflated in some researcher's work. One significant critique of the field at present is that despite the identification of the problem of accessibility of research to teachers (e.g. Levin, 2013; Malin & Brown, 2020; Martinovic et al., 2012), multiple and layered meanings of this term have yet to be fully interrogated. For example, practitioners may struggle to access research ideas in education (ie find them inaccessible) in a number of distinct ways:

1. Finding language used in academic publication difficult to understand or interpret;
2. Being unable to find and/or read publications that may be hard to discover, in specialist locations, or behind paywalls;
3. Being unable to navigate research publications because they are poorly structured, designed, or formatted;
4. Finding research publications too long/of the wrong scale, resolution or size for their needs;
5. Being gatekept from research products, events or spaces due to issues of power and status, which disproportionately affects those who are minoritised
6. Being unable to access research product, events or communities due to disabilities such as colour blindness, social anxiety, mobility issues, or dyslexia; 19% of people in the UK have a disability (McDermott, 2014).

Bundling all these issues up into "making research more accessible" masks the detail and nuance of the solutions needed to address each of them as part of the work of knowledge brokering, and some of them are currently underrepresented or not addressed at all in the literature. I return to this issue of accessibility in the final section on implications.

It seems clear that evaluating whether knowledge brokering is effective depends on what its goals are, which in turn depends on sifting through the tangle of current thinking to determine "the purposes for which knowledge in assembled, synthesised, borrowed and appropriated" (Moss, 2017, p. 238) in educational practice . It would be easy to get caught in an ever-widening eddy of recursive thinking here, with deeper questions at every turn; one way to

sidestep the need to agree a definition of the purpose of using research in practice is simply to ask knowledge brokers to define what they are using it for as part of their role. This would have the added benefit of laying bare their intentions in terms of conflicts of interests, political and ethical considerations, and assumptions, and adding a layer of transparency to their work which would support critical feedback from all communities they seek to support.

## Trust and credibility

Knowledge brokering is not neutral (Malin et al., 2018), and it is expert, difficult work (Cordingley, 2008). There is a risk of the Dunning-Kruger effect (Dunning, 2011) when working with research and evidence in evidence; it is easy to oversimplify, overstate and overuse 'low hanging fruit', such as neat results from cognitive neuroscience (e.g. Bennett in Rycroft-Smith & Dutaut, 2018). Knowledge brokers act as gatekeepers (Malin et al., 2018), and this is an important responsibility:

> [t]here is clearly a significant level of responsibility for any intermediary broker when filtering the evidence base and deciding which research is of suitable quality and relevance to highlight. There is also responsibility in ensuring that this research is summarised accurately, so it does not distort the original findings. (Sharples & Sheard, 2015, p. 582).

Gorard et al. (2020, p. 591) agree, suggesting that "Conduits must be firm, honest, independent and credible to all parties, which is rare.. [and present evidence] both fairly and usefully."

The risks associated with this responsibility therefore are that knowledge brokers can be:

- poor at selection of research
- poor at communication of research findings
- poor at communication of research paradigms or ideas of what research and evidence actually is
- poor at understanding or communicating their own biases
- susceptible to commercial or political interests

all of which may be unintentional; however, they may also be using their position as knowledge broker to persuade or advocate in a way that is intentionally misleading, suggesting trust in them is misplaced:

> Advocacy organisations can also pursue an agenda that is not clearly related to the overall evidence, taking a partial view but using their political and media expertise to influence policy outcomes. There is a danger that any intermediaries are subject to the same pressures as users, and so may distort or cherry-pick evidence to suit their user clients. It is not always

> clear whether think tanks, based on an ideology, are using evidence accurately or not. (Gorard et al., 2020).

Cooper (2014) found that some think tanks misrepresented research, but that it was beyond the scope of their research to consider what an accurate portrayal of the research might look like. Some have suggested that since knowledge brokers should be independent and authoritative providers of research information, as well as perceived as trusted and credible, they should come from universities (Sharples & Sheard, 2015). It is an urgent priority to establish the responsibilities as well as the aims of knowledge brokers in education (Fenwick & Farrell, 2012).

## Who can or should do the activity of knowledge brokering?

There is a "need to see the activity of interpreting evidence developed by others as a high status activity which is central to reflective practice" (Cordingley, 1999, p. 190). Debate exists as to who should currently of the work of knowledge brokering, and who can do it best, related of course to the debate surrounding what it actually is and how we could measure it.

> There is a growing body of research that suggests that many university academics are attempting to move beyond knowledge production in universities to knowledge mobilization or knowledge brokering, which in basic terms involves efforts by individuals and organizations to make academic scholarship more relevant beyond universities. Some research on knowledge brokering focuses on the complex relationship of academic research to professional practice. (Anderson et al., 2021, p. 3).

However, Hering (2016, p. 367) suggests "it is not necessary, and perhaps not even desirable, for scientific experts to take the full responsibility for knowledge brokering." If knowledge brokers are to be boundary spanners, bridgers of worlds, merchants, Januses, hybrids, and/or code-switchers with "double peripherality" (Meyer, 2010, p. 118) it is reasonable to assume they should have a background in both research and practice. Cooper (2020) suggests so, counting this as one of their five characteristics of educational knowledge brokers along with. an understanding of research methodology; a broad overview of the literature; sound interpersonal skills; and an ability to translate complex information into meaningful materials for users. Lubienski makes the case that calling knowledge brokers "boundary spanners" divides the landscape of research and practice too much, suggesting that there is a long history of those who defy these categories – "institutional trespassers" (Lubienski, 2020, p. 186) – who may already wear these amphibious identities. It is suggested that boundaries are

not boundaries for everyone in the same way, and sometimes for individuals to understand that a boundary *can be crossed*, it is useful to see another crossing the threshold.

Malin & Lubienski (2015) ask key questions about who has expertise, who has leverage, and who has media penetration in educational research to policymaking contexts, many of which issues pertain too to practice. In particular, there is a suggestion that use of blogs, op-eds and social media can be used to connect researchers with decisions-makers on a large scale, but that they may be hesitant to do so because of fear of criticism, or lack of training or incentives at their institution to do so. The question of who fills that gap instead – and whether they indeed have the knowledge brokering expertise to do so – is important.

Knowledge brokers are currently "varied, widely placed and loosely characterised, including external bodies such as the media, think tanks and lobby groups, through to practice-facing brokers such as professional organisations, government agencies, private companies and local authorities" (Sharples & Sheard, 2015, p. 578), and there are at least two problems with this. First, some of these knowledge brokers clearly have what is known formally as a conflict of interest; less formally as 'skin in the game'. The second, related, issue is that some of them may not have the requisite amphibious expertise, alongside a particularly deep understanding of the complexities of power and politics in education from multiple angles. In short: without any kind of regulation or evaluation, anyone can (claim to) be a knowledge broker.

## Key tensions and questions

Central to the idea of knowledge brokering – stimulating use of research in practice – are the two underlying questions of what constitutes research (knowledge), and what constitutes use, both contested (Levin, 2013; Levin & Cooper, 2012) with multiple legitimate meanings (Levin & Cooper, 2012).

Not only are there "risks that one can be too certain about knowledge" (Levin, 2013, p. 8) but what counts as knowledge and the owner of it is a question of power and status (Gutierrez, 2013). Lubienski (2020) echoes these concerns, asking whose knowledge is to be brokered and whose needs privileged: is it that of researchers, practitioners, parents? Ward et al. (2012) criticise some knowledge brokering literature for sidestepping these questions.

One of the most appealing narratives in knowledge brokering is the use of the randomised controlled trial, which is "grasped with all the gullibility of accepting a good story"(Bannister & Hardill, 2017a, p. xvi); however these tidy narratives ignore the limited

applicability of the RCT to many real world problems including important, but complex and messy ones in education (ibid).

Lysenko et al. (2016) summarise the most recent thinking on research use, suggesting research use is a multidimensional construct, comprising:

- instrumental use (change to concrete practice where research findings are transmitted and applied intact)
- conceptual/ enlightenment use (change in understanding or thinking about an issue that affects practice indirectly)
- symbolic/strategic/persuasive/legitimising use (use of research findings to influence decisions, justify actions, or support a decision that has already been made)

To these three, Levin and Cooper (2012) add a fourth that has emerged in the literature: imposed research use, when those with power give mandates to practitioners to use research evidence. This is particularly problematic, because

> quality research is about broadening understanding—including theoretical understanding—rather than about providing predigested tips and tricks for practitioners to implement.. . Teachers tend to resist the provision of teacher-proof externally mandated curricula and to defend their professional judgment and autonomy. This means that they are likely to resist external prescriptions for their practice. At the same time, however, they often have little patience for theory and for discussions that challenge them to rethink their practice in fundamental ways, and do request "practical" and directly applicable results from research. (Hirschkorn & Geelan, 2008, p. 5).

One of the biggest tensions inherent in educational knowledge brokering to support research use in practice is the potential conflict between short and long-term goals, which may also be conceptualised as the tension between impact and teacher autonomy. Do we want the best-quality research (presuming we can agree on such a thing) to reach teachers as fast as possible in as concise as format as possible and in the most accessible language possible, so they can use it now; or do we want to spend more time and resource building in capacity (and potential obsolescence) into the knowledge brokerage function so that teachers can critically appraise research without brokering – or without brokers, variously - in the future?

Knowledge brokering is not just about translating findings from research into 'takeaways' for practice, and there is a real danger it is seen straightforwardly as such. Knowledge brokering in education seeks to fulfil many functions and solve many problems, but one key area is that of opening up the black box of research to teachers:

> The disciplines of systematic enquiry; the identification of clear questions, the collection and triangulation of relevant evidence and the rigorous interpretation of evidence on a systematic basis have a special contribution to make at two levels. First, many of these skills related to specific aspects of teaching. Secondly, the disciplines of research have the potential to reveal implicit practice and distil into bite size pieces, those aspects which may be critical to effectiveness. In other words, studies carried out by teachers and others that make explicit the different aspects of the detail of teachers internalised pedagogic knowledge and practice have the capacity to support teachers through the difficult business of matching reality and rhetoric, and of revealing and reassessing previous understanding. This should enable teachers rapidly to become discerning users and interpreters of research findings, provided that research reports are accessible, and make it possible for teachers to see the connections between what is being studied and the realities of classroom life. (Cordingley, 1999, p. 185).

This means a real investment in time and resources, but the suggestion is that this will pay dividends: "research engagement can shift school behaviours from a superficial 'hints and tips' model of improvement to a learning culture in which staff work together to understand what appears to work, when and why"(Brown & Zhang, 2016, p. 4). However, this does rely on the skill of knowledge brokers, not just in adapting and translating research materials, but in the fidelity of representation of the field of research itself (Sin, 2008).

Another key tension lies in the fact that it is difficult – likely impossible – for any one person, team or organisation to do all the work of knowledge brokering possible in the space (ie all the *types* of work described in Table 2.3 in the first section of this paper). If we accept this, and that "various KMb approaches can be justifiable depending on one's specific purposes" (Malin et al., 2018, p. 10), then we may arrive at a somewhat problematic conclusion: that some knowledge brokers may be only limited to the activity of knowledge translating, producing, or disseminating – those potentially linear, disempowering knowledge flow models that were conceptualised as unevolved, and potentially damaging, earlier on in this analysis.

## Summary

In this section I explored the third research question posed, that is: How might we evaluate, critically examine and otherwise hold to account the work of knowledge brokers in education? I found that:

- it is suggested we begin to consider evaluating knowledge brokering efforts by measuring how they address barriers to research use for practitioners, which are described in the literature as: time; usefulness/relevance; information overload; applying research ideas in context; access to research; and access to good quality syntheses of research
- knowledge brokers have a responsibility to be fair, honest, ethical, trustworthy and credible; currently it is not clear how, if at all, they are being held to account for being so
- it is suggested that knowledge brokers should have to have double identities, with deep contextual knowledge of both research and practice
- since misrepresentation or misinformation could have potential to cause harm, it is an urgent priority to establish who can or should do the work of knowledge brokering
- the idea of research use is contested and politicised, and knowledge brokers without a clear sense of the issues, in particular power and status, risk ineffective practice or harm
- there is an important question surrounding the capacity-building activity of knowledge brokers, who may, for example, aim for their own obsolescence over time.

## Conclusion

In Mosher et al.'s (2014) framework for conceptualising knowledge brokering, they explore the possibilities of collaborative entanglement as "the intentional collision and interplay (as opposed to layering) of the expertise and perspectives of differently situated people." While current conceptions of educational knowledge brokering in the literature are almost entirely limited to traditionally defined roles of 'researcher' and 'research' and 'practitioner' and 'practice', even if they are multidirectional conversations moving beyond linear knowledge flow, conceptions are failing to capture this crucially important function of knowledge brokering: troubling the hierarchies of knowledge and knowers that exist within and around education. Good knowledge brokers should seek to go beyond just selecting, evaluating and transforming 'quality' research to broker for particular teachers, schools, organisations and contexts and begin to consider knowledge as **agency** (defined by Mosher et al. as the capacity to take action):

> When people have the opportunity to come together, to share and debate ideas and learnings (including research findings), new knowledge - the capacity to take action – is produced. It is not merely that participants learn something more about research, or develop new capacities to use research (although these are important), but that the capacity to imagine new possibilities and to take action – to engage in new performance – is enhanced. The source of change is located not in the instrumental deployment of research findings but in the participants themselves. (Mosher et al., 2014, p. 7).

While some researchers have noted this idea of producing new knowledge through the activity of knowledge brokering (e.g. Meyer, 2010), this is limited in conception to the brokered products themselves rather than a wider definition which includes "empowering people and unleashing possibilities" (Mosher et al., 2014, p. 7).

A thorough examination is needed, not only of the nature of knowledge production but the forms and formats through which it moves, which does not have to be – but seems to default to - textual form, as Fenwick and Farrell suggest:

> What is knowledge when it moves? Increasingly, knowledge is reified and mobilized as language. Texts make knowledge portable. In many respects knowledge seems, or used to seem, unambiguously situated – in the practices of disciplines, professions, industries, times, places, histories, cultures and so on. The contemporary domination of communications technologies, and especially Web2.0 technologies, has challenged and transformed the practices associated with specific forms of knowledge, re-emphasising the textual character of knowledge. (T. Fenwick & Farrell, 2012, p. 3).

The potential of different formats and modalities to trouble the very nature of research 'knowledge' and what it may mean in education has yet to be investigated in detail. There are many issues around dealing with delocated, relocated and refocused knowledge (Bernstein, 2000) and equally many complexities surrounding the process of converting domain-specific knowledge into school knowledge (McCuaig & Hay, 2014), all yet to be explored more fully in both theory and practice in the literature. Similarly, many of the key tensions and questions explored here are still only just emerging in the literature, and yet to be considered in depth. In Figure 2.4, an iceberg diagram shows a conception of the field as it currently stands, with some ideas, methods and lenses firmly established in the discourse; others only just emerging; and still others deep below the surface, only hinted at so far, but identified in my analysis as important.

*Figure 2.4 a conceptualisation of the field of educational knowledge brokering as an iceberg diagram*


## Implications

In the previous section on evaluation, I examined in particular the use of the term "accessible" and the ways in which separate meanings need to be explored more fully in future work on knowledge brokering in education (and beyond). If we see knowledge brokering activity as making research more accessible to practitioners, then we should separate these meanings in order to ensure we do this work more fully, in particular attending to the last two points which have been neglected in the literature so far with the exception of treatment by a few scholars such as van der Wey (2012) and to some extent Cooper et al. (2020). The meanings of inaccessibility I identified were: language; finding publication; navigating publication; scale of publications; gatekeeping; and disability. A thorough examination of power and knowledge brokering in education is needed, with a particular focus on how knowledge brokers can support practitioners to both access and create knowledges by examining *accessibility* with respect to the six aspects shown in Table 2.7.

*Table 2.7 six aspects of accessibility that educational knowledge brokers should attend to*

| Aspect | Focus | Example |
|---|---|---|
| 1. **changing languages** | how can knowledge be *translated* into useful and familiar language for practitioners? | Using simple, clear and readable language in summary texts, images, videos or explanations; explicitly relating research terms to classroom terms; defining unfamiliar terms wherever used, using |

| | | |
|---|---|---|
| | | analogy and metaphor to support contextual meaning-making |
| 2. **changing locations** | how can knowledge be *curated* and collected so that research that may be otherwise difficult for practitioners to find or read is brought to them? | Creating summaries of useful research on a similar subject; printing or providing documents that are behind digital walls or in particularly rural internet locations; collecting research ideas from a variety of sources that offer different perspectives and offering an overview that helps practitioners to choose between them |
| 3. **changing structures** | how can knowledge be formatted, organised and *designed* for useability by practitioners? | Using principles of effective graphic design (and other media design) to organise information intuitively, such as: bullet points, bold and italics, varied font size, colour, negative space, summary boxes, infographics, use of audio, tooltips, drop-down boxes etc; changing the order that information is presented in to make thematic sense/tell a meaningful story |
| 4. **changing scales** | how can knowledge be *transformed* so that it is of the appropriate scale, resolution or level of detail for practitioner needs? | Reducing (or sometimes expanding) the amount of information into, for example: a summary sentence; a short video; an abstract; a poem; a research summary; a question or series of questions; an infographic; a dialogue; a song; an image; an example lesson plan; a task; or a talk |
| 5. **changing thresholds** | how can knowledge be *presented* to make practitioners feel welcome and safe, that they belong in the space, and that they have the power to not only receive but critique, manipulate, subtract from and add to the knowledge? | Using principles of accessible graphic design and language and attending to power and status cues in design decisions; for example, allowing space to/encouraging practitioners to write on materials; having comments or a forum in digital spaces; allowing space and time for critical discourse |
| 6. **changing norms**: | how can knowledge be *filtered* or condensed so that practitioners with a range of needs are supported in connecting with it? | Attending to dyslexia-friendly fonts and graphic design, using colour-blindness filters, and using alt-text thoughtfully/intentionally on images; considering/listening to practitioner needs very carefully when planning events and talks; providing closed captioning as standard |

With each of these aspects of research accessibility, there is another direction in which the flow travels: knowledge brokers can communicate with those producing knowledge to help communicate the needs of those using the knowledge where they are not able or not allowed to, and this is most crucial in the latter two.

One of the ways in which knowledge brokerage has yet to be scrutinised is its function as enculturation into tribalism, or the creation of shibboleths: informal demarcation activity which separates rather than connects, moving rehearsed and ritualising tribal education discourses from research to practice without making them useful. It is easy to see how

insecure or inexperienced knowledge brokers could do this unintentionally, and the lack of current standards, codes of ethics and evaluation criteria in the field leaves space for blunders into harm in this and many other ways discussed here. The use of shibboleths as dog-whistles – "telltale terms that immediately separate one group from another" – has been documented in contexts such as arts-based research (Pariser, 2009, p. 2). This is an urgent priority for future work, in particular focusing on the potential for knowledge brokering to leverage and exploit ideology (Lubienski, 2020).

Another suggestion that has been made is that knowledge brokering may inherently change social science research as we know it:

> [T]he pathways to ensuring that social science has an impact are paved with many hazards..the paths are neither straightforward nor without possible negative consequences. Nor do they move in only one direction. Once social scientists..'dance with new partners'..the very nature of what it means to be scientific can become confused. What is needed to increase knowledge mobilisation may also challenge the ethics, independence, integrity, rigour and objectivity of the social science research carried out with practical uptake in mind. (Bannister & Hardill, 2017a, p. xv).

While this quote suggests this may be a negative development; the use of the terms "rigour" and "objectivity" when applied to research should always be regarded with suspicion. Research is never neutral or objective (Swann & Pratt, 2004) and always contains embedded values at every stage, including choice of doing that particular research in the first place (Jaggar, 1989). If one development of the maturing of the field of educational knowledge brokering is the dismantling of the old "research is objective" paradigm in the minds of practitioners, this is potentially a positive for two reasons: because it is untrue, and because it may help to puncture the inflated authority research may hold for them.

One aspect that is clear from this synthesis is that knowledge brokering involves design at multiple levels – design of products, processes, and pathways. Good knowledge brokering is hence about good design: it should be ergonomic, functional, and beautiful. It should also have a balanced blend of that which is expected and that which is surprising: the commonsensensical and the unpredictable, the head-nodding and the eye-opening, the in-the-grey and the from-the-blue. It should feel nice to the user in these ways:

- Naming that which is known or felt already
- Connecting ideas across boundaries of time, space and culture
- Opening doors to scholarship (access to knowledges) for everyone

It should feel uncomfortable to the user in these ways:

- Finding, naming and challenging own assumptions
- Working hard to empathise and understand another's point of view
- Dealing with complexities, risks and uncertainties

This last is important, as it suggests a general goal of increasing probability literacy, and supporting the development of critical and informed stakeholders at all levels of education. Interestingly, increasing the use of expert knowledge brokers for successful, meaningful, and myriad connections between research, practice and policy may be a case of 'be careful what you wish for' for those with political power, for "[c]alling for more instrumental and conceptual uses of research helps to move decision-makers towards accountability, not camouflage"(Lavis et al., 2003, p. 167). However, not all researchers agree; Lubienski (2020, p.187) asks:

> in an increasingly post-truth age where evidence is questionable, malleable, or often just irrelevant…Will we see an increase in "boundary spanners" that bridge the research-practice divide, or just "spinners" that promote a practice based on image more than evidence?

Mosher et al. (2014) suggest that, while research can be moved into action in relative direct and predictable ways, these linear and instrumental models are of little use when it comes to the kind of complex, large scale and wicked problems we see in educational contexts. For those, we require collaborative entanglements - systemic approaches. They conclude:

> while we can generate intentional knowledge through research, and while we can plan multiple opportunities to broaden collaborative entanglements beyond the partners to the research project, we ultimately cannot control – nor should we desire to control – the trajectories or the range of impacts of these entanglements. We can seed ideas, but how they grow, and what changes they ultimately spawn, cannot be fully known in advance or clearly traced retrospectively. We can design our research and knowledge mobilization processes in ways that maximize opportunities to develop the capacities of all participants to become agents of change, and this maybe the most important legacy. (Mosher et al., 2014, p. 14).

## References

Adler, J., & Sfard, A. (2018). Research for educational change: Transforming researchers' insights into improvement in mathematics teaching and learning.

Anderson, G., Gray-Nicolas, N., & Payton, M. (2021). Education faculty as knowledge brokers: Competing for access to new york state print media and policy influence. Education Policy Analysis Archives, 29, 1–22. Scopus. https://doi.org/10.14507/epaa.29.5648

Bannister, J., & Hardill, I. (2017a). Knowledge mobilisation and the social sciences: Dancng with new partners in an age of austerity. In Knowledge Mobilisation and the Social Sciences (p. 206). Academy Social Sciences.

Bannister, J., & Hardill, I. (2017b). Knowledge mobilisation and the social sciences research impact and engagement. Routledge.

Bernstein, B. (2000). Pedagogy, Symbolic Control, and Identity: Theory, Research, Critique. Rowman & Littlefield.

Brown, C., & Zhang, D. (2016). Is engaging in evidence-informed practice in education rational? What accounts for discrepancies in teachers' attitudes towards evidence use and actual instances of evidence use in schools? British Educational Research Journal, 42(5), 780–801. https://doi.org/10.1002/berj.3239

Burkhardt, H., & Schoenfeld, A. H. (2003). Improving Educational Research: Toward a More Useful, More Influential, and Better-Funded Enterprise. https://doi.org/10.3102/0013189x032009003

Campbell, C., Pollock, K., Briscoe, P., Carr-Harris, S., & Tuters, S. (2017). Developing a knowledge network for applied education research to mobilise evidence in and for educational practice. Educational Research, 59(2), 209–227. https://doi.org/10.1080/00131881.2017.1310364

Carlile, P. R. (2004). Transferring, Translating, and Transforming: An Integrative Framework for Managing Knowledge Across Boundaries. Organization Science, 15(5), 555–568. https://doi.org/10.1287/orsc.1040.0094

Cooper, A. (2014). Knowledge mobilisation in education across Canada: A cross-case analysis of 44 research brokering organisations. Evidence & Policy: A Journal of Research, Debate and Practice, 10(1), 29–59. https://doi.org/10.1332/174426413X662806

Cooper, A., Rodway, J., MacGregor, S., Shewchuk, S., & Searle, M. (2020). Knowledge brokering: "not a place for novices or new conscripts." In J. L. Malin & C. Brown (Eds.), The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice (pp. 90–107). Routledge.

Corbin, J., & Strauss, A. (2014). Basics of Qualitative Research: Techniques and Procedures for Developing Grounded Theory. SAGE Publications.

Cordingley, P. (1999). Constructing and critiquing reflective practice1. Educational Action Research, 7(2), 183–191. https://doi.org/10.1080/09650799900200089

Cordingley, P. (2008). Research and evidence-informed practice: Focusing on practice and practitioners. Cambridge Journal of Education, 38(1), 37–52. https://doi.org/10.1080/03057640801889964

Cvitanovic, C., Cunningham, R., Dowd, A.-M., Howden, S. m., & van Putten, E. i. (2017). Using Social Network Analysis to Monitor and Assess the Effectiveness of Knowledge Brokers at Connecting Scientists and Decision-Makers: An Australian case study. Environmental Policy and Governance, 27(3), 256–269. https://doi.org/10.1002/eet.1752

Dagenais, C., Lysenko, L., Abrami, P. C., Bernard, R. M., Ramde, J., & Janosz, M. (2012). Use of Research-Based Information by School Practitioners and Determinants of Use: A Review of Empirical Research. Evidence & Policy: A Journal of Research, Debate and Practice, 8(3), 285–309. https://doi.org/10.1332/174426412X654031

Davies, H., Nutley, S., & Walter, I. (2008). Why "knowledge transfer" is misconceived for applied social research. Journal of Health Services Research & Policy, 13(3), 188–190. https://doi.org/10.1258/jhsrp.2008.008055

Davies, H., Powell, A. E., & Nutley, S. M. (2015). Mobilising knowledge to improve UK health care: Learning from other countries and other sectors – a multimethod mapping study. NIHR Journals Library. http://www.ncbi.nlm.nih.gov/books/NBK299400/

Dunning, D. (2011). Chapter five - The Dunning–Kruger Effect: On Being Ignorant of One's Own Ignorance. In J. M. Olson & M. P. Zanna (Eds.), Advances in Experimental Social Psychology (Vol. 44, pp. 247–296). Academic Press. https://doi.org/10.1016/B978-0-12-385522-0.00005-6

Dyck, I. (2012). Finding common persepctives: Knowldge mobilization in a transnational museum project. In T. J. Fenwick & L. Farrell (Eds.), Knowledge mobilization and educational research: Politics, languages and responsibilities (pp. 115–127). Routledge.

Edwards, A. (2012). User engagement and the processes of educational research. In T. J. Fenwick & L. Farrell (Eds.), Knowledge mobilization and educational research: Politics, languages and responsibilities (pp. 44–58). Routledge.

Farley-Ripple, E., & Grajeda, S. (2020). Avenues of influence: An exploration of school-based practitioners as knowledge-brokers amd mobilizers. In J. Malin & C. Brown (Eds.), The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice (p. 193). Routledge.

Farley-Ripple, E., & Grajeda, S. (2020). Avenues of influence: An exploration of school-based practitioners as knowledge brokers and mobilizers. In J. Malin & C. Brown (Eds.), The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice (pp. 65–84). Routledge.

Farley-Ripple, E., May, H., Karpyn, A., Tilley, K., & McDonough, K. (2018). Rethinking Connections Between Research and Practice in Education: A Conceptual Framework: Educational Researcher, 47, 235–245. https://doi.org/10.3102/0013189X18761042

Farley-Ripple, E., Tilley, K., & Tise, J. (2017). Brokerage and the Research-Practice Gap: A Theoretical and Empirical Examination. AERA Annual Meeting. http://tinyurl.com/hvlr6kt

Fenwick, T., & Farrell, L. (2012). Introduction: Knowledge mobilization the new research imperative. In T. J. Fenwick & L. Farrell (Eds.), Knowledge mobilization and educational research: Politics, languages and responsibilities (pp. 61–72). Routledge.

Geeraerts, K., Vanhoof, J., & Van den Bossche, P. (2016). Teachers' perceptions of intergenerational knowledge flows. Teaching and Teacher Education, 56, 150–161. https://doi.org/10.1016/j.tate.2016.01.024

Ginsburg, M., & Gorastiaga, J. (2001). Relationships between Theorists/Researchers and Policy Makers/Practitioners: Rethinking the Two-Cultures Thesis and the Possibility of Dialogue. Comparative Education Review:, 45(2). https://www.journals.uchicago.edu/doi/10.1086/447660

Godfrey, D., & Brown, C. (Eds.). (2019). An ecosystem for research-engaged schools: Reforming education through research. Routledge.

Goldacre, B. (2013). Building evidence into education. http://dera.ioe.ac.uk/17530/1/ben%20goldacre%20paper.pdf

Gorard, S., See, B. H., & Siddiqui, N. (2020). What is the evidence on the best way to get evidence into use in education? Review of Education, 8(2), 570–610. https://doi.org/10.1002/rev3.3200

Gough, D., Tripney, J., Kenny, C., & Buk-Berge, E. (2011). Evidence Informed Policymaking in Education in Europe: EIPEE Final Project Report.

Graham, I. D., Logan, J., Harrison, M. B., Straus, S. E., Tetroe, J., Caswell, W., & Robinson, N. (2006). Lost in knowledge translation: Time for a map? Journal of Continuing Education in the Health Professions, 26(1), 13–24. https://doi.org/10.1002/chp.47

Greenhalgh, T. (2018). Of lamp posts, keys, and fabled drunkards: A perspectival tale of 4 guidelines. Journal of Evaluation in Clinical Practice, 24(5), 1132–1138. https://doi.org/10.1111/jep.12925

Gutierrez, R. (2013). The sociopolitical turn in mathematics education. Journal for Research in Mathematics Education, 44, 37–68. https://doi.org/10.5951/jresematheduc.44.1.0037

Hering, J. G. (2016). Do we need “more research” or better implementation through knowledge brokering? Sustainability Science, 11(2), 363–369. https://doi.org/10.1007/s11625-015-0314-8

Hirschkorn, M., & Geelan, D. (2008). Bridging the Research-Practice Gap: Research Translation and/or Research Transformation. Alberta Journal of Educational Research, 54(1). https://journalhosting.ucalgary.ca/index.php/ajer/article/view/55207

Hubers, M. D., Moolenaar, N. M., Schildkamp, K., Daly, A. J., Handelzalts, A., & Pieters, J. M. (2018). Share and succeed: The development of knowledge sharing and brokerage in data teams’ network structures. Research Papers in Education, 33(2), 216–238. Scopus. https://doi.org/10.1080/02671522.2017.1286682

Hubers, M. D., & Poortman, C. L. (2018). Establishing sustainable school improvement through Professional Learning Networks. In C. Brown & C. L. Poortman (Eds.), Networks for Learning: Effective Collaboration for Teacher, School and System Improvement (pp. 194–204). https://research.utwente.nl/en/publications/establishing-sustainable-school-improvement-through-professional-

Ioannidis, J. P. A. (2016). Evidence-based medicine has been hijacked: A report to David Sackett. Journal of Clinical Epidemiology, 73, 82–86. https://doi.org/10.1016/j.jclinepi.2016.02.012

Ion, G., & Iucu, R. (2014). Professionals’ perceptions about the use of research in educational practice. European Journal of Higher Education, 4(4), 334–347. https://doi.org/10.1080/21568235.2014.899154

Jaggar, A. M. (1989). Love and knowledge: Emotion in feminist epistemology. Inquiry, 32(2), 151–176. https://doi.org/10.1080/00201748908602185

Jusinski, M. M. (2021). Knowledge broker teachers and professional development. Teacher Development, 25(2), 178–195. https://doi.org/10.1080/13664530.2021.1879922

Lavis, J., Ross, S., Mcleod, C., & Gildiner, A. (2003). Measuring the Impact of Health Research. Journal of Health Services Research & Policy, 8, 165–170. https://doi.org/10.1258/135581903322029520

Lemons, C. J., & Toste, J. R. (2019). Professional Development and Coaching: Addressing the "Last Mile" Problem in Educational Research. Assessment for Effective Intervention, 44(4), 300–304. https://doi.org/10.1177/1534508419862859

Levin, B. (2008). Thinking About Knowledge Mobilization A discussion paper prepared at the request of the Canadian Council on Learning and the Social Sciences and Humanities Research Council.

Levin, B. (2011). Mobilising research knowledge in education. London Review of Education. https://doi.org/10.1080/14748460.2011.550431

Levin, B. (2013). To know is not enough: Research knowledge and its use. Review of Education, 1(1), 2–31. https://doi.org/10.1002/rev3.3001

Levin, B., & Cooper, A. (2012). Theory, research and practice in mobilizing research knowledge in education. In T. J. Fenwick & L. Farrell (Eds.), Knowledge mobilization and educational research: Politics, languages and responsibilities (pp. 19–29). Routledge.

Levin, B., Cooper, A., Arjomand, S., & Thompson, K. (2011). CAN SIMPLE INTERVENTIONS INCREASE RESEARCH USE IN SECONDARY SCHOOLS? Canadian Journal of Educational Administration and Policy, 126, 29.

Lubienski, C. (2020). Conclusion: The future of research use? In J. Malin & C. Brown (Eds.), The role of knowledge brokers in education: Connecting the dots between research and practice (pp. 182–188). Routledge.

Lysenko, L. V., Abrami, P. C., Bernard, R. M., & Dagenais, C. (2016). Research use in education: An online survey of school practitioners. Brock Education Journal, 25(1), 35–54. https://doi.org/10.26522/brocked.v25i1.431

MacKillop, E., Quarmby, S., & Downe, J. (2020). Does knowledge brokering facilitate evidence-based policy? A review of existing knowledge and an agenda for future research. Policy & Politics, 48(2), 335–353. https://doi.org/10.1332/030557319X15740848311069

Malin, J. (2020). Mediated, Evidence-Informed Practice as Impact. International Journal of Education Policy and Leadership, 16. https://doi.org/10.22230/ijepl.2020v16n8a955

Malin, J., & Brown, C. (2020). Joining worlds: Knowledge mobilization and evidence-informed practice. In J. Malin & C. Brown (Eds.), The role of knowledge brokers in education: Connecting the dots between research and practice (pp. 1–12). Routledge.

Malin, J. L., Brown, C., & St. Trubceac, A. (2020). Educational brokerage and knolwedge mobilization in the United States: Who, what, why how? In The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice (p. 193). Routledge.

Malin, J. R., Brown, C., & Trubceac, A. S. (2018). Going for Broke: A Multiple-Case Study of Brokerage in Education. AERA Open, 4(2), 2332858418769297. https://doi.org/10.1177/2332858418769297

Malin, J. R., & Lubienski, C. (2015). Educational Expertise, Advocacy, and Media Influence. Education Policy Analysis Archives, 23, 6. https://doi.org/10.14507/epaa.v23.1706

Martinovic, D., Wiebe, N., Ratkovic, S., Willard-Holt, C., Spencer, T., & Cantalini-Williams, M. (2012). “Doing Research Was Inspiring”: Building a Research Community with Teachers. Educational Action Research, 20(3), 385–406. https://doi.org/10.1080/09650792.2012.697402

McCuaig, L., & Hay, P. J. (2014). Towards an understanding of fidelity within the context of school-based health education. Critical Public Health, 24(2), 143–158. https://doi.org/10.1080/09581596.2013.840718

McDermott, V. (2014). Disability in the United Kingdom. Papworth Trust. https://www.base-uk.org/sites/default/files/uk_disability_facts_and_figures_report_2014.pdf

McKenney, S., & Reeves, T. C. (2013). Chapter 1: About educational design research. In Conducting educational design research (pp. 7–30). Routledge. http://books.google.com/books?hl=en&lr=&id=CpcnCEQlfL0C&oi=fnd&pg=PR3&dq=%22concludes+with+considerations+of+what+distinguishes+educational%22+%22design+research+is+potentially+very+powerful,+it+is+also+recognized%22+%22and+the+spread+of+interventions+that+embody+certain%22+&ots=5N0bHVXUrA&sig=Aytwi4ZGsCI7MuYTs0vnLMDHYVE

McWhorter, D., van Roosmalen, E., Kotsopoulos, D., Gadanidis, G., Kane, R., Ng-A-Fook, N., Campbell, C., Pollock, K., & Sarfaraz, D. (2020). Fostering improved connections between research, policy and practice: The knowledge network for applied education research. In The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice (p. 193). Routledge.

Meyer, M. (2010). The Rise of the Knowledge Broker: Science Communication. https://doi.org/10.1177/1075547009359797

Monod-Ansaldi, R., Vincent, C., & Aldon, G. (2019). Objets frontières et brokering dans les négociations en recherche orientée par la conception. Education didactique, Vol. 13(2), 61–84.

Moolenaar, N. M., Daly, A. J., & Sleegers, P. J. C. (2010). Occupying the Principal Position: Examining Relationships Between Transformational Leadership, Social Network Position, and Schools' Innovative Climate. Educational Administration Quarterly, 46(5), 623–670. https://doi.org/10.1177/0013161X10378689

Mosher, J., Anucha, U., Appiah, H., & Levesque, S. (2014). From Research to Action: Four Theories and Their Implications for Knowledge Mobilization. Scholarly and Research Communication, 5(3). https://doi.org/10.22230/src.2014v5n3a161

Moss, G. (2013). Research, policy and knowledge flows in education: What counts in knowledge mobilisation? Contemporary Social Science, 8(3), 237–248. https://doi.org/10.1080/21582041.2013.767466

Moss, G. (2017). Research, policy and knowledge flows in education: What counts in knowledge mobilsation? In J. Bannister & I. Hardill (Eds.), Knowledge mobilisation and the social sciences: Research impact and engagement (pp. 71–82). Routledge.

Nelson, J. (2017). Using conceptual depth criteria: Addressing the challenge of reaching saturation in qualitative research. Qualitative Research, 17(5), 554–570. https://doi.org/10.1177/1468794116679873

Nutley, S. M., Walter, I., & Davies, H. T. O. (2007). Using evidence: How research can inform public services. Policy Press.

Oancea, A. (2005). Criticisms of Educational Research: Key Topics and Levels of Analysis. British Educational Research Journal, 31(2), 157–183.

Pariser, D. (2009). TROJAN HORSES AND SHIBBOLETHS. 18.

Perry, T., Morris, R., & Asquith, S. (2020). Mind the gap: Using evidence in education. Research Intelligence, 144, 28–29.

Prasad, V., Vandross, A., Toomey, C., Cheung, M., Rho, J., Quinn, S., Chacko, S. J., Borkar, D., Gall, V., Selvaraj, S., Ho, N., & Cifu, A. (2013). A Decade of Reversal: An Analysis of 146 Contradicted Medical Practices. Mayo Clinic Proceedings, 88(8), 790–798. https://doi.org/10.1016/j.mayocp.2013.05.012

Rodgers, S. E. (2000). A study of the utilization of research in practice and the influence of education. Nurse Education Today, 20(4), 279–287. https://doi.org/10.1054/nedt.1999.0395

Rodway, J. (2015). Connecting the dots: Understanding the flow of research knowledge within a research brokering network. education policy analysis archives, 23(0), 123. https://doi.org/10.14507/epaa.v23.2180

Rodway, J., MacGregor, S., Daly, A., Liou, Y.-H., Yonezawa, S., & Pollock, M. (2021). A network case of knowledge brokering. Journal of Professional Capital and Community, 6(2), 148–163. https://doi.org/10.1108/JPCC-11-2020-0089

Rycroft-Smith, L., & Dutaut, J.-L. (Eds.). (2018). Flip the system UK: A teachers' manifesto. Routledge.

Rycroft-Smith, L., & Macey, D. (2021). Deep questions of evidence and agency: How might we find ways to resolve tensions between teacher agency and the use of research evidence in mathematics education professional development? Proceedings of the British Society for Research into Learning Mathematics, 41. https://bsrlm.org.uk/wp-content/uploads/2021/08/BSRLM-CP-41-2-18.pdf

See, B. H., Gorard, S., & Siddiqui, N. (2016). Teachers' use of research evidence in practice: A pilot study of feedback to enhance learning. Educational Research., 58(1), 56–72.

Sharples, J., & Sheard, M. (2015). Developing an evidence-informed support service for schools – reflections on a UK model. Evidence & Policy: A Journal of Research, Debate and Practice, 11(4), 577–587. https://doi.org/10.1332/174426415X14222958889404

Swann, J., & Pratt, J. (Eds.). (2004). Educational research in practice: Making sense of methodology. Continuum.

Ungerleider, C. (2012). Affairs of the smart: Will education researchers and decision-makers "hook up"? In T. J. Fenwick & L. Farrell (Eds.), Knowledge mobilization and educational research: Politics, languages and responsibilities (pp. 61–72). Routledge.

van der Wey, D. (2012). Explicating a shared truth about a colonial past: Knowledge mobilization, coalition building, Aborigial literature and padagogy. In T. J. Fenwick & L.

Farrell (Eds.), Knowledge mobilization and educational research: Politics, languages and responsibilities. Routledge.

van Schaik, P., Volman, M., Admiraal, W., & Schenke, W. (2018). Barriers and conditions for teachers' utilisation of academic knowledge. International Journal of Educational Research, 90, 50–63. https://doi.org/10.1016/j.ijer.2018.05.003

Ward, V. (2017). Why, whose, what and how? A framework for knowledge mobilisers. https://doi.org/10.1332/174426416X14634763278725

Ward, V., Smith, S., House, A., & Hamer, S. (2012). Exploring knowledge exchange: A useful framework for practice and policy. Social Science & Medicine, 74(3), 297–304. https://doi.org/10.1016/j.socscimed.2011.09.021

Wenger, E. (1998). Communities of Practice. Learning, Meaning, and Identity. Cambridge University Press.

White, H. (2019). The twenty-first century experimenting society: The four waves of the evidence revolution. Palgrave Communications, 5(1), 47. https://doi.org/10.1057/s41599-019-0253-6

Wohlin, C. (2014). Guidelines for snowballing in systematic literature studies and a replication in software engineering. Proceedings of the 18th International Conference on Evaluation and Assessment in Software Engineering, 1–10. https://doi.org/10.1145/2601248.2601268

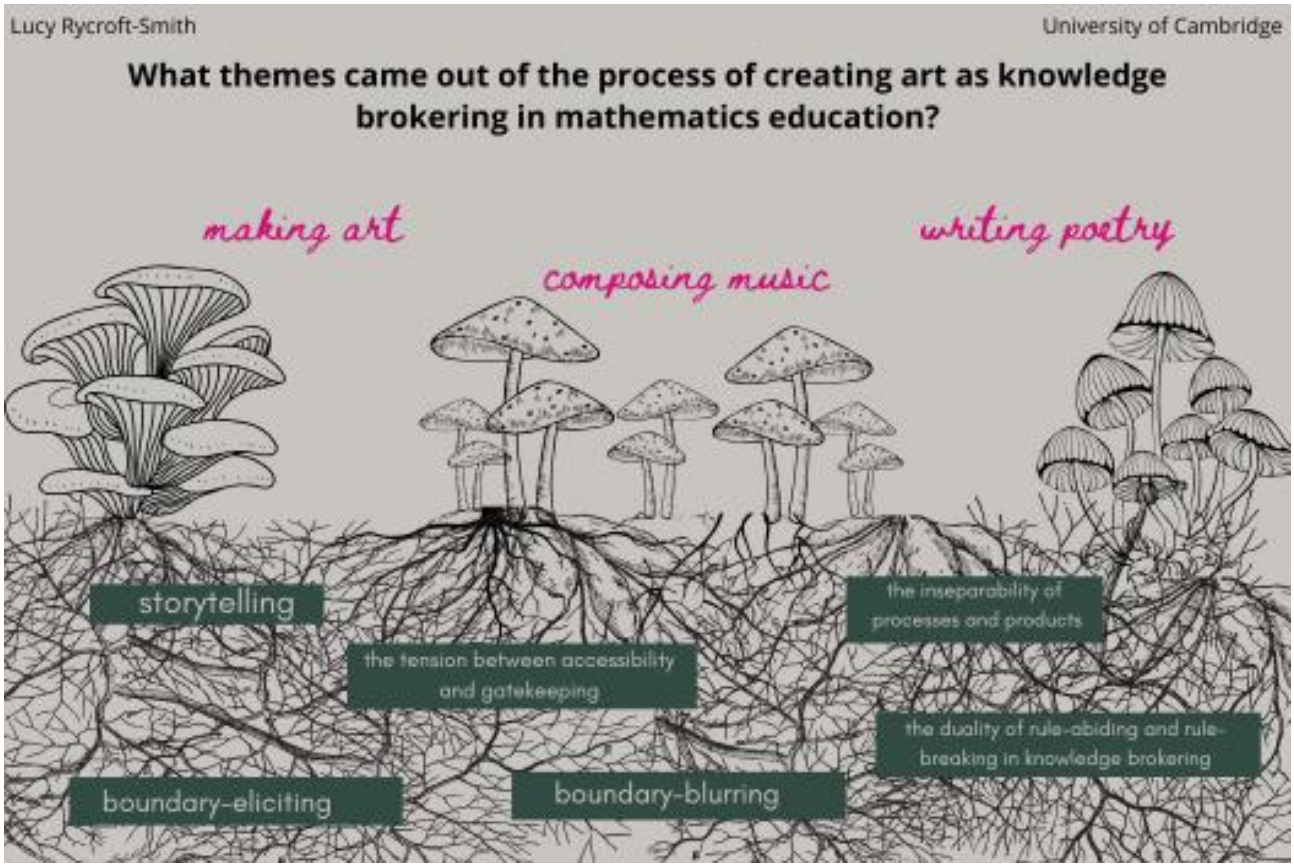
Wollscheid, S., Stensaker, B., & Bugge, M. M. (2019). Evidence-Informed Policy and Practice in the Field of Education: The Dilemmas Related to Organizational Design. European Education, 51(4), 270–290. Scopus. https://doi.org/10.1080/10564934.2019.1619465

Zuiker, S. J., Piepgrass, N., Tefera, A., Anderson, K. T., Winn, K., & Fischman, G. (2019). Advancing Knowledge Mobilization in Colleges of Education. International Journal of Education Policy and Leadership, 15(1). https://eric.ed.gov/?id=EJ1208566

# *3.* PAPER 2 - USING ART-BASED METHODS TO EXPLORE PROCESSES OF KNOWLEDGE BROKERING IN MATHEMATICS EDUCATION

## Visual abstract

*Figure 3.1 Visual abstract for Paper 2 of this thesis*




## Abstract

Knowledge brokering in education, particularly its application in practice and policy contexts, remains underexplored. Defined as a form of mediation and boundary spanning that facilitates knowledge flow between research, practice, and policy (Rycroft-Smith, 2022), the specifics of who engages in this work, their motivations, and methodologies are still unclear (Malin & Brown, 2020). This study used art-based approaches to critically and reflexively examine the processes of knowledge brokering within educational contexts. By integrating artistic methods, this research delves into the themes, discourses, and boundaries that emerge for the knowledge broker (the author) through the creation of art as a form of knowledge brokering in mathematics

education. The analysis revealed six key themes: storytelling; the duality of rule-abiding and rule-breaking in knowledge brokering; the inseparability of processes and products; the tension between accessibility and gatekeeping; and the dual roles of boundary-eliciting and boundary-blurring in knowledge brokering. These findings offer significant implications for the field of educational knowledge brokering and advocate for the broader application of art-based methods in this domain.

## Introduction

Knowledge brokering has been defined as the work of individuals, teams, initiatives, or organisations whose function is to transfer and transform knowledge between communities, specifically because they have important understandings of both communities (Rycroft-Smith, 2022). To date, there is very little research on the processes of knowledge brokering, especially in educational contexts. This study aims to explore this research gap by connecting general theories about knowledge brokering to asking what actually happens when one who is already working in the knowledge brokering space – that is, transforming knowledge from research to practice or policy contexts – reflexively examines their own work. I have been working as a knowledge broker in mathematics education in the UK for the last eight years and am therefore well placed to conduct this study.

Since the research area of knowledge brokering is still not well understood, more evidence has been called for on various aspects, such as what brokers do as part of their "repertoires" (Bandola-Gill, 2022); establishing criteria for "effective" or "good" knowledge brokering (Creaby & Haslam, 2020; Ward et al., 2009) and the construction of useful metaphors or models for knowledge brokering (Auld et al., 2022; Rycroft-Smith 2022). This study focuses on the processes of knowledge brokering, which have been described by Rycroft-Smith (2022) as *transforming* knowledge, by: changing the language it is encoded in; making it into a different format, medium or modality; distilling, synthesising or summarising (rescaling); and/or inferring implications for practice. In this study, I explore the process of transforming knowledge, as an experienced knowledge broker myself, from the inside out, asking about the themes, discourses and boundaries of knowledge brokering that emerge. Asking further questions about the products or outcomes, uses, efficacy and impact on audiences are beyond the scope of this research; the focus is tightly on the processes and the possibilities.

This study responds to the need for deeper and richer understanding in the field of knowledge brokering in education (Bannister & Hardill, 2017a; Malin & Brown, 2020b; Rycroft-Smith, 2022). The finding are intended to develop the field of educational knowledge brokering,

as well as knowledge brokering more widely, by troubling the scientific/artistic research false dichotomy, examining themes that are elicited from techniques and practices, especially as related to types of knowledges, and developing understandings of discourses related to processes of knowledge brokering. As such, the study makes use of art-based research, which is ideally suited to deepening and enriching understandings (e.g. Barone & Eisner, 2011; Wang et al., 2017) and reflexive critical thematic analysis, which is designed to explore richness, complexity and nuance, utilising researcher positionality as a strength (Braun & Clarke, 2021) in pursuit of such focus on "thick" analysis. Whereas some education research exists that uses the arts to disseminate findings - for example Hill's (2018) "troubling" the hegemony of research dissemination by using *cabaret for research* – the use of arts-based methods as I have here to explore educational knowledge brokering is entirely innovative.

The question posed for this research is: What themes, discourses, and boundaries are elicited for me from the process of creating art as knowledge brokering in mathematics education?

## Conceptual framework

I agree with Ferguson (2023) that it is not only academics who inquire into their inquiries – I trouble the dichotomy of "scientist" and "artist" as part of the parallel development of my identity in "research science" and "research art". This act of queering echoes my identity as a queer researcher, and functions as a reminder that we are never only performing a single identity in a singular way. Throughout this study, I continued to work on many aspects – seemingly unrelated – of my own artistic practice, and these rehearsals, outlines and resonances have no doubt made their way into this work. Most of all, I contend that the joy and excitement of artistic practice can and should be part of the wide range of practices we call 'research', and I offer mine here as part of the case for exploding the myth of dispassionate research, instead revealing that emotion is present in the form of values in all research, and yet many Western epistemologies have suggested otherwise (Jaggar, 1989). This false binary – as all false binaries – supports the kyriarchy, and maintains the status quo, continuing to suggest as it does that the white Western male point of view is rational, correct and emotion-free, and effectively devaluing everything "other" as hysterical rambling (ibid). In line with this, Ferguson (2023) reminds us that "poking and prodding" in unexamined assumptions and metatheory is therefore a significantly feminist task: further, we seek not to fill in the gaps in a male-ordered conceptualisation of reality, but to fundamentally reorganise it.

## Mosher's four categories of knowledge brokering activity

I support Mosher et al. (2014) in their assertion that research can and should ignite change or action, although I also contend that, paradoxically, this action may be rejection (which may, on the surface, look like inaction) as well as critique, questioning, adaptation, and dialogue (Rycroft-Smith & Macey, 2021).

Mosher et al. (2014) suggest a rich connection between action research as the co-creation of knowledge and its movement into action, and knowledge brokering which aims to ensure that the research will have an impact, that it will make a difference. However, they also problematise the idea of impact, suggesting that that which is measurable is not always that which is important, and drawing on Bennet and Bennet's (2007) conceptualisation of knowledge mobilisation as a rich, powerful and complex process of collaborative entanglement. A summary of the four levels of research brokering activity suggested by Mosher et al. (2014) is provided in Table 3.1.

*Table 3.1 four conceptualisations of knowledge mobilisation adapted from Mosher et al. (2014)*

| **Conceptualisation of knowledge mobilisation** | **Defined as** | **For what type of problem?** | **When does change occur?** | **How do we know change has occurred?** |
|---|---|---|---|---|
| knowledge implementation | the straightforward movement into action (be it policy or practice) – of research findings, understood as fixed and transferable | "bounded problems" with relatively clear solutions | at the end of the linear process | asking whether stakeholder has done new things or done things differently: has there been a productive interaction? |
| capacity enhancement of collaborators | still fixed and transferable, the potential to enhance the capacity of the research collaborators through the new learning that occurs for research partners, for example learning discrete pieces of knowledge or information; new knowledge of the community; appreciation of the varied perspectives and multiple forms of expertise of community members; enhanced skill in establishing relationships of meaning (i.e. using boundary objects) expanding critical consciousness and increasing empowerment | community-based participatory research projects | throughout and beyond | asking stakeholders about changes to their own agency and understanding of one another's perspectives, as well as changes to practices or services |
| collaborative entanglement | a dynamic process in which the thoughts and behaviours proposed by researchers merge with and are altered by the thoughts and behaviours of others; intentional collision and interplay (as opposed to layering) of expertise and | anything involving co-creation/collaboration, in particular challenging the notion of separate domains of research and application, or | throughout and beyond | Asking stakeholders and others about perspectives, knowledges and knowing; considering long-term effects such as structural or policy change; traces of impact or change may occur whenever |

| | | | | |
|---|---|---|---|---|
| | perspectives | researchers and practitioners | | and wherever ideas and thoughts are exchanged |
| systemic action research | a shift from a focus on problems to systems, where multiple interconnections and relationships are the subject of inquiry; problems may seem intractable, yet under the surface, attitudes may be changing, innovations may be garnering support, and suddenly there is a phase change | complex and seemingly intractable social issues whose roots are multiple and intertwined | change happens throughout and beyond, in an iterative and distributed way | establishing causal links between a particular social impact and a specific research undertaking is exceptionally limited; traditional, linear, cause-and-effect models do not apply; we can only evidence opportunities for, and actual, meaningful contact between those involved in the research collaboration and a host of actors; as traces of impact proliferate, the potential that new ideas may catch hold is enlarged |

The value of using this framework to inform my work is not necessarily that I aim to use these four categories to delineate types of knowledge mobilisation/brokering in-use, but more that I am able to see beyond the single paradigm of knowledge brokering – the first category, designated *knowledge implementation* and explore different types of processes, problems, changes and impacts in my work. In other words, the Mosher et al. framework is not used here to limit the processes investigated to one type or another, but as a theoretical acknowledgement that many types of knowledge brokering exist, and that they are not at all necessarily distinct, as Mosher et al. acknowledge.

# Materials and methods

## Data collection

The process of data gathering involved collating the multiple drafts, sketches, notes and versions of art created as part of, around, and about brokering ideas from a total of nine mathematics education research papers; recording video conversations between myself and collaborators while composing songs and discussing those compositions; and writing in the reflexive researcher journal at least once a week. The reflexive researcher journal was collected electronically (to facilitate ease of searching, collating and analysis), and was written in an open-ended, unstructured diary format; this decision was made after piloting various structured question formats and finding them too restrictive.

**Visual art**

For this study I created three pieces of visual art, with associated notes, sketches, and photographs. I began by assembling six research papers on the same topic (mathematical creativity), chosen because the topic appealed to me as apt, and because I had not completed any thorough knowledge brokering activity in this particular area before. I was focused on the process of responding artistically to the research, which meant I did not spend time selecting the papers themselves (I simply took the first six that appeared in a keyword search on Google Scholar). This is because although selecting and accessing research is a key part of knowledge brokering, this study was narrowly focused on using art-based methods to consider, refine, summarise and communicate ideas from research, so choosing the research itself was outwith the scope of, and hence to some extent irrelevant to, this study. I read the papers and responded to them - often by making use of the materiality of the paper-ness of the printed paper – by folding, shredding, decomposing and recomposing, using glue, water and other liquids to 'bathe' and reconfigure ideas, words and fragments, and allowing layers to dry, air and fuse together as I made meaning with my hands and my brain simultaneously. These art pieces were completed by me over a period of five months, between March and July 2023, and are summarised in Table 3.1.

*Table 3.2 Artworks produced in the study*

| Title | Medium | Processes |
|---|---|---|
| *A bunch of research papers (2023)* | Paper, glue, elastic bands | Cutting paper, folding paper, manipulating paper, bunching paper, gluing paper |
| *Synthesis (2023)* | Paper, glue, copper leaf paint | Making paper, painting, assembling, constructing |
| *Western hemisphere (2023)* | Paper, napkins, copper leaf, glue, lamp | Tearing paper, papier mâché, building up, making layers |

All three of these pieces used the same set of six research papers, on the theme of creativity in mathematics, as their starting point:

- *Chamberlin, S. A., Liljedahl, P., & Savić, M. (Eds.). (2022). Mathematical Creativity: A Developmental Perspective. Springer International Publishing.* https://doi.org/10.1007/978-3-031-14474-5
- *Hansen, E. K. S. (2022). Students' agency, creative reasoning, and collaboration in mathematical problem solving. Mathematics Education Research Journal, 34(4), 813–834.* https://doi.org/10.1007/s13394-021-00365-y

- *Joklitschke, J., Rott, B., & Schindler, M. (2022). Notions of Creativity in Mathematics Education Research: A Systematic Literature Review. International Journal of Science and Mathematics Education, 20(6), 1161–1181.* https://doi.org/10.1007/s10763-021-10192-z
- *Kattou, M., Kontoyianni, K., Pitta-Pantazi, D., & Christou, C. (2013). Connecting mathematical creativity to mathematical ability. ZDM, 45(2), 167–181.* https://doi.org/10.1007/s11858-012-0467-1
- *Kroesbergen, E., & Schoevers, E. (2017). Creativity as Predictor of Mathematical Abilities in Fourth Graders in Addition to Number Sense and Working Memory. Journal of Numerical Cognition, 3, 417–440.* https://doi.org/10.5964/jnc.v3i2.63
- *Sriraman, B. (2004). The Characteristics of Mathematical Creativity. The Mathematics Educator, 14(1), 1.* https://ojs01.galib.uga.edu/tme/article/view/1868

I created these pieces of art in three stages:

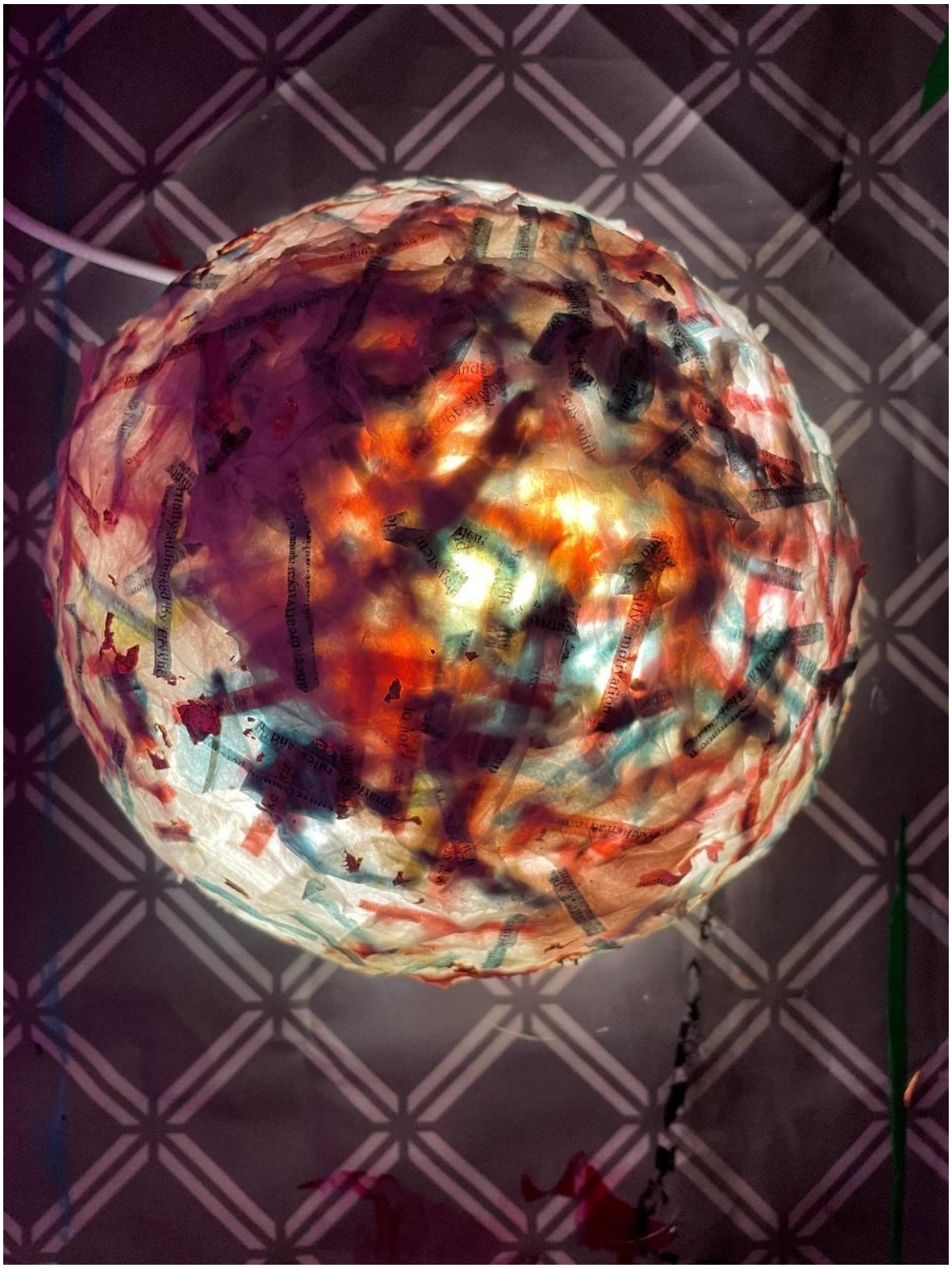
1. I searched for and collected six research papers on the theme of mathematical creativity; I used the first six that came up in the Google Scholar search, not wanting to spend time selecting and refining this list of papers for any particular purpose
2. I read the research papers and reflected on my understandings of the content, especially in the context of my practice as a teacher and as a mathematical artist
3. I responded to the papers by creating art, using techniques and processes that felt important in terms of further illuminating the knowledge brokering process. I followed the thread of 'what *could* I create with and about this research?'.

Images of these pieces are shown in Figures 3.3, 3.4 and 3.5, and the reader is invited to consider what themes and discourses emerge for the viewer, and whether these pieces would be useful or even recognisable in terms of 'better using and understanding research'.

*Figure 3.2 A bunch of research papers, an artwork produced in the study*

*Figure 3.3 Synthesis, an artwork produced in the study*

*Figure 3.4 Western hemisphere, an artwork produced in the study*



**Musical compositions and discussions**

During the study I co-wrote three songs with a composer, friend and teacher. For this part of the artistic inquiry we began with the *types* of music we felt compelled to write, recording our emotions, thoughts and resonances as we made these decisions. I then intentionally searched for research that might support - or indeed detract from – writing music in this genre, and wrote a brief for each of the three pieces which we discussed and used as starting point for composing with over a period of several months, from February 2023 to October 2023. These discussions, rich with connections, allusions and references, were recorded and transcribed and also formed part of the data of the study.

The three pieces of music we wrote, resulting in sheet music and various recorded forms, are summarised in Table 3.2.

*Table 3.3 Music written in the study*

| Piece | Genre | Source paper |
|---|---|---|
| *Five Little Slugs* | Nursery rhyme/children's song | Meng, R., Yeo, A., Ding, M., & Alibali, M. W. (2023). Linking representations of equality in first-grade mathematics lessons in China. *Educational Research for Policy and Practice*. https://doi.org/10.1007/s10671-023-09334-7 |
| *Ostinato (The Rules of the Game)* | Choral piece written for four voices | Guerra, P. L., & Wubbena, Z. C. (2017). *Teacher Beliefs and Classroom Practices*. *26*(1). |
| *Time to Learn* | Dramatic folk/musical theatre song | Kopparla, M., & Saini, A. K. (2022). "Science Is My True Villain": Exploring STEM Classroom Dynamics through Student Drawings. *European Journal of STEM Education*, *7*(1). https://eric.ed.gov/?id=EJ1341163 |

We also completed a pilot for the process of collaboratively composing songs from research before beginning the data collection for the study. Sheet music and demos for these songs, including the pilot, can be found here: https://lucyrycroftsmith.com/music/ and the reader is again invited to listen and consider the songs, considering the themes and discourses that emerge for, and whether these pieces would be useful or even recognisable in terms of 'better using and understanding research'.

**Videos and transcripts**

As previously discussed, videos and associated transcripts from collaboration meetings, held between February 2023 and December 2023, were collected as part of the study.

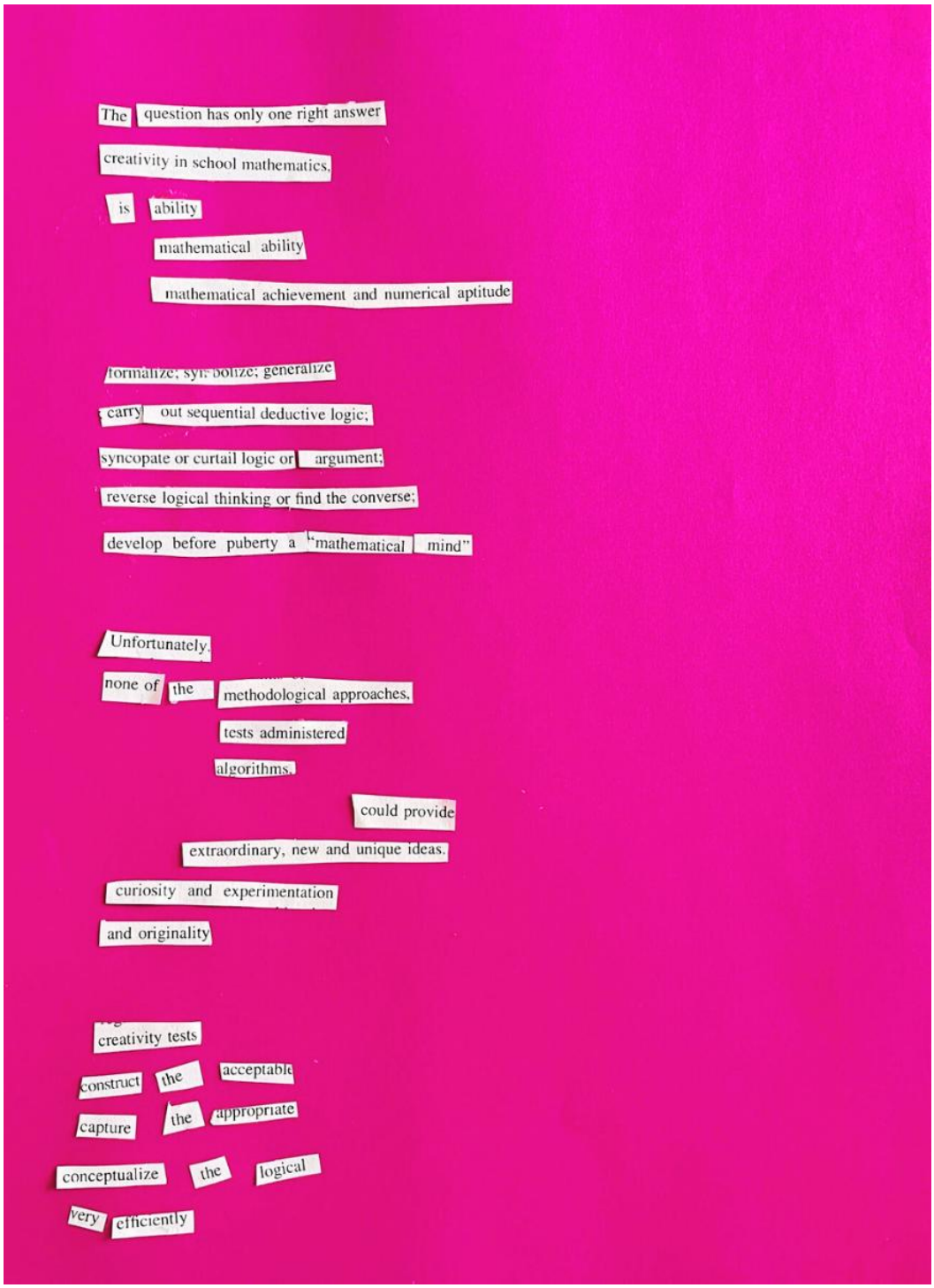
The collaborators were: a professional composer and teacher who was also a friend (nine meetings were recorded between me and this collaborator as we wrote the three songs previously mentioned); a group of peers who were engaged in art-based methods of communicating mathematics and science. One meeting/workshop was recorded between me and these collaborators, which was the happy confluence of their interest in the subject and my offering to bring them together to collect data for this study. The participants were self-selected – they were involved on the basis of previous acquaintance to me, their interest in using art to communicate mathematical ideas, and their willingness to participate in the project.

These videos and transcripts provided a huge amount of rich data: words, gestures, songs, lyrics, expressions, and indicators of relationships, all of which were analysed alongside and in parallel with the art that was created as part of them.

**Poetry**

As part of responding to the six research papers on mathematical creativity I felt compelled to create a poem, written by the process of cutting and collating a research paper, entitled *Mathematical creativity* (a cut and collated poem adapted from Kattou et al., 2012). The poem is shown in Figure 3.6, and represents a form of resistance to and critique of the ideas in the research paper, formed by cutting, severing, breaking apart, omitting, and reconstituting the words of the paper.

*Figure 3.5 Mathematical creativity, a poem produced in the study*



**Journal**

Throughout the study I collected data by writing in a reflexive researcher journal (comprising digital text, video and images) between January 2022 and September 2023. This was freeform and written in response to and alongside the rest of the data.

## Data analysis

Art-based research calls for deep thematic analysis; a qualitative organising that helps to harness meaning (Rappaport, 2013). Thematic analysis is described as a way of identifying, analysing and reporting patterns (Water et al., 2017); it is "poorly demarcated, rarely acknowledged, yet widely used" (Braun & Clarke, 2006, p. 77). Thematic analysis is consistent with my feminist post-structuralist constructionist approach, "which examines the ways in which events, realities, meanings, experiences and so on are the effects of a range of discourses operating within society" (Braun & Clarke, 2006, p. 80) as it can be a method that "works both to reflect reality and to unpick or unravel the surface of 'reality'" (ibid). In this study, an inductive approach was taken to identify themes: representations of some level of patterned response or meaning within the data set which is interpreted by the researcher flexibly, but – crucially - written about explicitly and in detail in the research (Braun & Clarke, 2006). I have specifically chosen to use the method of reflexive thematic analysis, defined by Braun & Clarke (2021, p. 7) as a particular type of thematic analysis with:

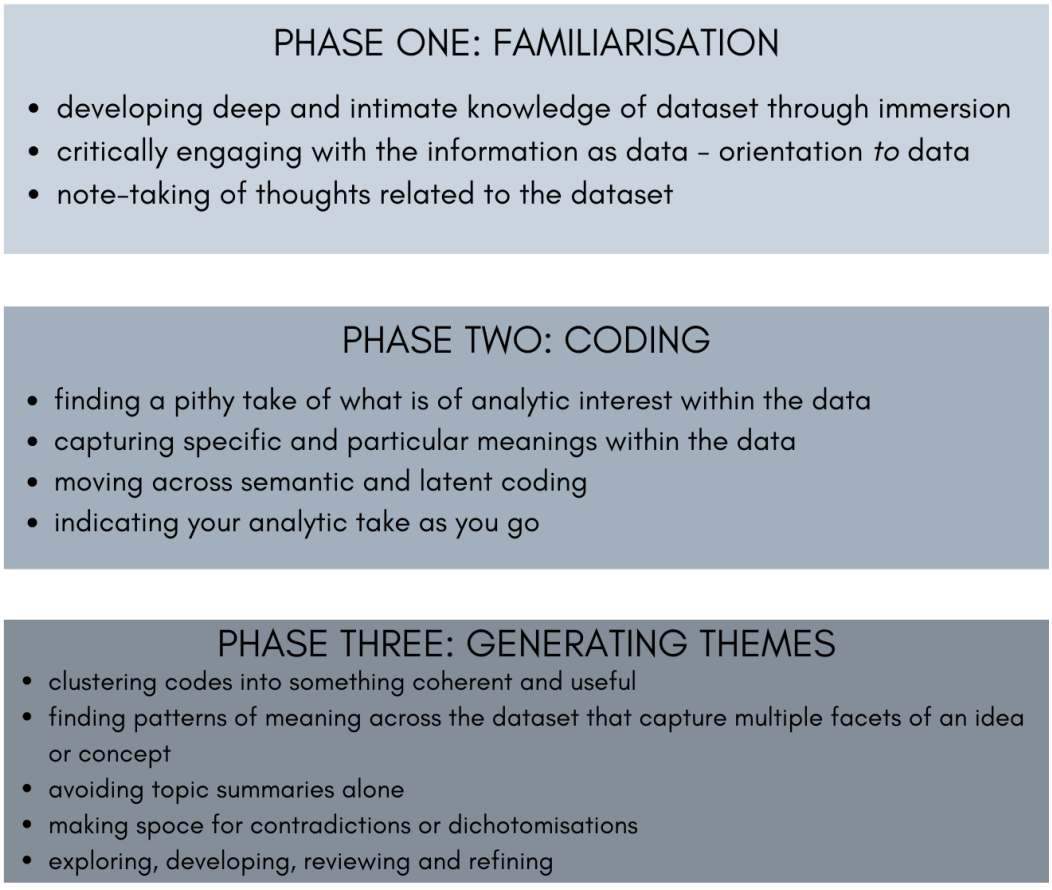
- a fully qualitative sensibility; an interest in process and meaning over cause and effect
- a critical and questioning approach to life and knowledge
- the ability to reflect on the dominant assumptions embedded in one's cultural context (being a cultural commentator as well as cultural member)
- focus on nuance, complexity and even contradiction over tidiness or certainty
- a disinterest in the idea of a singular universal truth to be discovered
- the sense that the researcher's subjectivity is not a problem to be managed, controlled or eliminated, but a resource for analysis
- a focus on data analysis as art not science, with a focus on creativity within a framework of rigour

Braun and Clarke's reflexive thematic analysis has been used here along with a fully qualitative approach, termed "big Q" by Kidder and Fine (1987). This approach is characterised by the use of techniques of qualitative data generation and analysis within a non-positivist framework – in other words qualitative methods informed by qualitative research values and making use of

qualitative research paradigms. Big Q research uses qualitative methods and a qualitative paradigm together, usually broadly focused on meaning; for example interrogating meaning-making practices; seeing elements as only ever partially knowable; seeing the researcher (provided a reflexive approach is taken) as a subjective storyteller where this subjectivity is valued; aiming to gain rich and in-depth understanding and therefore valuing smaller samples (Braun & Clarke, 2021).

This study used both *experiential* and *critical* elements of the big Q approach, combining ideas of meaning, experience and seeking to make sense of knowledge brokering practices (making art, discussing and collaborating in the art-making process) and construction, negotiation and unpacking of that meaning in the analysis stage. I used the three stages outlined Braun and Clarke's methodology, which are shown in Figure 3.7. For each 'piece' of data I created an A3 notes sheet, adding quotes, notes, critique, biases, reflections and commonalities that I noticed. I then put these together to create a literal 'wall of data', connecting, refining, rejecting and sifting until I was able to identify themes that addressed my research question.

*Figure 3.6 the stages of the critical reflexive thematic analysis methodology I used, after Braun and Clarke (2021)*



## Ethics

This research was approved by the University of Cambridge ethics process. Participants gave their consent for the data to be collected and used for research purposes when they agreed to collaborate with me, using – and explicitly naming - the principle of informed consent. Participants were anonymised and, since the focus is on themes and discourses, it was not necessary to use identifying information in the study.

One of the ways in which I attended to ethics in this work, consistent with my theoretical approach as a critical feminist post-structuralist researcher, is to locate myself clearly and transparently within the research – in other words, to use positionality and reflexivity with intention (Kara, 2018). This was expressed in a variety of important ways:

- setting out my viewpoints, research paradigms and epistemological stances in my writing (for example in my registration report, published papers, and here)
- making a commitment not to be anonymous or hide behind institutional identity in my knowledge brokering work
- being transparent about my own specific biases and interpretations, as well as the meta-level general critique of research as a process which contains and creates biases and interpretations at every stage (for example I had a highlighter colour which signified "biases", which I used on my data)
- reflexively analysing the gaps, silences, blind spots and invisibilities that are likely to occur in my work due to my cultural, societal, geographical and linguistic anchors

I have made freely available wherever possible all products generated during this study on my website, appropriately credited where consent is given to do so (which, in the case of the composer I collaborated with, means they are not anonymous, which has been agreed). During the course of this study there arose questions concerning giving credit and value for ideas formulated during the process of co-creation, and subjects who chose to remain anonymous therefore may not be credited appropriately. One of the consequences of this study is that I have developed a suggested protocol for citation in art-based products of knowledge brokering, as part of critically evaluating what it means to "use" research for art, which is explored further in the Implications section.

# Results

I used thematic analysis to develop four main themes related to the themes and discourses, and two further themes explicitly related to boundaries, which were elicited for me from the process of creating art as knowledge brokering in mathematics education. These themes, along

with their characteristics and examples of ways that they were expressed in the study, are shown in Table 3.3.

*Table 3.4 Summary of themes analysed in the study*

| Theme | Characteristics | Examples |
|---|---|---|
| **Storytelling in knowledge brokering** | the multifaceted elements that contribute to narrative richness, especially including structure and narrative techniques, transcending the confines of language/words alone<br>visual and perspective elements—such as framing, texture,, shape, colour, and harmony—used to paint vivid scenes and add depth to the narrative canvas<br>the interplay between base, bass, frame, grid, canvas, background and form; and tune, melody, shape, image, story, foreground and focus – can be aligned or contradictory, coherent or conflicting<br>fidelity to the original ideas in the research in tension with crafting a narrative which is by necessity simpler and leaves things out | 'there is a hero'<br>'The message versus the music – should it be a poem, or a book, instead?'<br>'we should show not tell'<br>'it might veer too far from the original research - how do we decide?'<br>'the colour/texture of the background means the research 'emerges' from the background'<br>'it's not the story I want to tell but it's the truth' |
| **Rule-abiding and rule-breaking as part of knowledge brokering and making art** | Rules and conventions as both guidelines and constraints; adhering to them provides structure, while breaking them fosters innovation<br>The act of seeing rules—truly understanding their reason for existence—allows us to navigate their nuances effectively, also perhaps giving us permission to break them<br>Drawing inspiration from existing works, generating ideas in the image of what came before, can yield fresh perspectives, but also raises questions about authenticity, citation, ownership and credit.<br>Artistry thrives on intuition, emotion, and subjectivity, embracing the derivative, weaving threads of influence into a unique tapestry; so does research (and mathematics?) but do we acknowledge this differently? | 'it's a whole new genre!'<br>'constituting and reconstituting research'<br>'you can make any noise you wish – the stupider the better (blows raspberry)'<br>'don't be constrained by rules!'<br>'the rules of harmony…doubling thirds…moving in parallel octaves'<br>'I went back and read the original paper, which helped'<br>'I made a little reference to the Dies Irae'<br>'There's a part that's Rachmaninoff in there' |
| **The difficulty of separating processes and products in knowledge brokering** | The process is the creative journey, the activity of experimenting and exploring, feeling free to make mistakes and enjoy serendipitous collisions when challenges occur, and we want to focus on this, not the outcome<br>However, when making or creating, the product is the endpoint; it's how we know we have 'finished', and what we primarily use to communicate with others | 'I don't care if I don't perform it as written'<br>'the formality of sheet music'<br>'I don't need to reach a conclusion, just ask questions'<br>'it's more about process than product'<br>'the songwriting process tells us something about the research in the process of brokering'<br>'the aim is not to put on a show where everyone comes along and immediately understands research'<br>'what is my art for? Valued; valuable; to sell, display or exhibit' |
| **The interplay between accessibility and gatekeeping in knowledge brokering** | how information flows, who holds the keys, and the delicate balance between empowerment and misuse<br>since knowledge brokers wield influence over what evidence reaches decision-makers and in what form, their decisions matter<br>the choice of language, what to define and what to translate into different words, as well as the choice of form and format, all tell stories about the seriousness and credibility of the content as well as contributing to increased accessibility | 'Should we translate 'adagio'?'<br>'Is the word refrain or chorus more appropriate?'<br>'I can't think of a time when I have seen both together'<br>'is it okay to laugh?'<br>'there is gatekeeping in the language we use'<br>'too wordy versus too pared-down'<br>'refrain might mean don't do it' |

| | | |
|---|---|---|
| | knowledge brokers have a duty to make their work as accessible as possible – where does this collide with transforming the knowledge itself as well as the modes it flows in? | 'tension between wanting scores to be accessible and also as clean and clear as possible, not too busy' |
| **Boundary-eliciting work as part of knowledge brokering** | To discern the boundaries of knowledge brokering work, knowledge brokers may engage in unconventional practices or venture beyond the familiar, which may also cross boundaries into unsuccessful, unacceptable, or unhelpful<br>Knowledge brokers gain insights into the limits of their field by using processes that are new and unorthodox<br>It may be only by crossing boundaries that we find them – what might this mean in knowledge brokering work and how can we do this without causing harm? | 'we are using art to explore and find limitations'<br>'in many ways this is the opposite of a research summary'<br>'the interplay between the literal and metaphorical'<br>'does the work stand up on its own, or does it need introduction, context or explanation?'<br>'what constitutes successful here?' |
| **Boundary-blurring work** | Challenging established boundaries by trialling new ideas, forms and methods<br>The importance of problematizing dichotomies and exposing false binaries<br>Pushing the limits of conventional thinking through critical examination of assumptions | 'I don't want to put words in anyone's mouth'<br>'knowledge brokering as high quality expert accountable and transparent - the person is the product'<br>'it is not comfortable, but I don't just want to write things I agree with'<br>'we're in the experimental phase you're allowed to play and do weird stuff'<br>'writing music with and about research is a brand-new field'<br>'pushing boundaries in all directions' |

# Discussion

## The importance of storytelling in knowledge brokering

The first theme and discourse that this study focuses on is the idea of storytelling in knowledge brokering. This encompasses: the multifaceted elements, beyond words alone, that contribute to narrative richness; and the interplay between base, bass, frame, grid, canvas, background and form and tune, melody, shape, image, story, foreground and focus, which can be aligned or contradictory, coherent or conflicting. An example of the latter is when analysing the artwork *Synthesis*, I noted that the colour/texture of the background means the research "emerges from the background", pondering on this interplay as representative of the process of selecting and summarising from a much larger underlying whole.

Embedded in this discourse is the idea that part of brokering research is the creation of a clear narrative, and that this narrative should be focused, interpretive and persuasive. Another example of this is the explicit references to storytelling techniques we made, such as "show not tell" and "Chekhov's gun" (the principle that an object/idea introduced early in the narrative should have significance later). Others explicitly shared their frameworks for narrative-making, such as "context, conflict, conduct and conclude". This reflects an important idea embedded in the idea of storytelling, which is the reference to known structures and frames. For example when we were planning the song *Time to Learn*, we used the terms "epic folktale"; "five-act structure" and "denouement". This use of references, frames and familiar structures helped us - and by extension the audience - set the expectations [even if these were later subverted] as to the type of storytelling that might occur and hence give them some familiarity and comfort so that they could pay attention to the details of the story. The skills we both brought as artists in this case meant we were able to bring techniques from art to bear on the process of knowledge brokering, generating rich and insightful data about these processes.

In my research diary I explored the idea of storytelling for impact, noting that "trickles and sparks are important too" in a reference to the Mosher et al. theoretical framework, ruminating on the idea that stories are powerful for persuading, convincing and explaining and yet we don't often ask about the 'impact' of a story in the same was as we might about a piece of research, perhaps understanding instead that the process of 'collaborative entanglement' is more applicable, in particular this conception:

> a dynamic process in which the thoughts and behaviours proposed by researchers merge with and are altered by the thoughts and behaviours of others, including change agents and community actors, where the intentional collision and interplay (as opposed to layering) of

> the expertise and perspectives of differently situated people shapes what is "known" and by whom. All participants learn, benefit from, and, in some manner, "use" the knowledge of others. (Mosher et al., 2014, p. 6).

## Rule-abiding and rule-breaking in knowledge brokering activity

The second set of ideas and discourses that were grouped into a theme in this study were ideas around following and breaking 'the rules'. This comprises ideas about rules and conventions acting as both guideposts and guardrails; the act of seeing rules allowing us to navigate their nuances or break them with understanding; processes of derivation with their inherent questions about authenticity, citation, ownership and credit; and ways that we may acknowledge this in art and research (and mathematics).

At the beginning of the study I explicitly discussed with co-creators that making art with and about research was a brand-new field and so to some extent we "got to make the rules" – we explicitly discussed the freedom that came with the innovative aims of the work, saying "it's a whole new genre!". However as time went on it became clear that rules and expectations continued to deeply colour the nature of what we were doing, and crept into our discourse frequently. For example, there was a constant tension between the composer I worked with speaking about following the rules (one example would be "following the rules of four-part harmonic writing") and my insistence that there was "no need". At one point I explicitly said "the song is about breaking the rules! The PhD is about breaking the rules! So I would strongly advise you to break the rules…write it how you want it and don't be constrained by rules." However, this of course was not the end of it; we continued to have conversations regarding what the convention might be; what we may have seen before; the idea of perfection; and doing things "correctly"; both of us interested in inhabiting identities that belonged as well as transgressed. Despite "don't be constrained by rules!" being part of the dialogue on many occasions, "the rules" continued to make themselves felt as part of structural elements that we saw as part of initiation into a community, as well as useful in their own right in the construction of knowledge brokering art. An example of the former might be "the convention would be…" and the latter "the rules of harmony…doubling thirds…moving in parallel octaves" as illustrations of elements that would contribute to the overall success of the songwriting process – in other words, seeing the purpose behind the rules rather than rejecting them for their own sake, an important theme in artistic endeavour more generally.

A final question around rules that emerged was regarding derivation and citation, and the implications for authenticity and credibility. In research, it is expected that we survey the field before we write, very explicitly and thoroughly referencing the work done by those before

us; not to do so would constitute a severe transgression of the form, as well as an ethical rule-break, perhaps one that may discredit us if uncovered. In many artistic forms however, while allusions and derivations are similarly expected, there is rarely an expected way to acknowledge them. For example, while writing music, we noted "references to the Dies Irae" (a famous succession of notes intended to suggest the trumpet of the last judgment) and "There's a part that's Rachmaninoff in there", but did not make note of these anywhere on the score. This discrepancy prompted interesting thoughts of how to make rules in the new genre of art-based knowledge brokering, which I return to in the Implications section.

## Processes and products in knowledge brokering

The third theme analysed here is the interplay between process and product; while the intention was to focus on process as the creative journey, the activity of experimenting and exploring, feeling free to make mistakes and enjoying serendipitous collisions when challenges occurred, the outcome or product is hard to de-emphasise, and we found often drifted into focus as part of refining, "finishing" or communicating with an imagined audience for an imagined purpose.

At the beginning of the study, as we laid the groundwork for the art-based research, we explicitly said: "let's do the hardest thing we can think of within time and budget - because that creativity is"; and later, when the question of "finding answers" was brought up, I answered "I don't need to reach a conclusion, just ask questions". This suggests a parallel between the idea of process and the activity of asking questions, and by extension perhaps the idea of product and the activity of answering questions.

The phrase "process not product" was repeated so many times in the data it became something of a mantra. One example is "we don't need perfection - it's process not product", where the phrase was used to attempt to shift the focus from "perfection" to the more open, exploratory type of activity that was seen as the richest ground for data collection. Others included: "it's more about process than product"; "the songwriting process tells us something about the research in the process of brokering"; "this isn't about the finished product"; and "the aim is not to put on a show where everyone comes along and immediately understands research", where a particular distinction was made between art for research and/or communication and art for entertainment purposes. However, it was clear that the "process" being referred to was commonly seen as functionally indistinguishable from product-making, and the idea of "performance" or "exhibition" of the art was embedded within the process of creating it for us. These assumptions can be seen in comments such as "I don't care if I don't perform it as written" and the fact that I felt compelled to display many of the '"finished" works, for example "using" the origami bouquet *A bunch of research papers* in my wedding in August

2023 (this can now be seen on display at the Faculty of Education Library, alongside the hung piece *Synthesis*). It is likely that this interplay between process and product is related to the famous artist ego, suggesting that often art is difficult to make without imagining an audience and a purpose (and then feeling compelled to follow through with presenting it to them for feedback). This suggests a level of intertwining between process and product that was not clear to me at the beginning of the study.

## The interplay between accessibility and gatekeeping in knowledge brokering

Accessibility was identified by Rycroft-Smith (2022) as a key focus for future work on examining knowledge brokering; along six distinct lines:

1. Making language used in research easier to understand
2. Improving connections between users and research sources they would usually not be able to find or read because of difficulty locating them, or paywalls
3. Improving access to ideas in research with transformation processes that improve structure, design and/or formatting
4. Changing the scale, resolution or size of research for the needs of the user
5. Attending to issues of power and status which may gatekeep people from research products, events or spaces
6. Work on reducing or removing barriers to research product, events or communities due to disabilities.

In this study, accessibility was found to be a key theme of the knowledge brokering processes investigated; in particular in terms of language (1); scale (3); and, most of all, gatekeeping (5). In particular, the way that accessibility and gatekeeping may be in tension was observed in terms of how information flows, who holds the keys by virtue of being "an expert", and the delicate balance between empowerment and misinterpretation. Since knowledge brokers wield influence over what evidence reaches decision-makers and in what form, their decisions about how to transform knowledge matter: the choice of language, what to define and what to translate into different words, as well as the choice of form and format, all tell stories about the seriousness and credibility of the content as well as contributing to increased (or, possibly, not increased) accessibility.

Embedded in the data for the study is the assumption that knowledge brokers have a duty to make their work accessible. However, it is possible to choose forms, formats and language that risks losing the nuance of the research, oversimplifying the ideas, or making

choices that may encourage misinterpretation, misunderstanding or misuse. We questioned where this duty might collide with transforming the knowledge itself as well as the modes it flows in, and how we could make choices to explicitly influence accessibility. For example, there was much discussion about the Italian musical terms used on the sheet music ("Should we translate 'adagio'"?' "Is the word refrain or chorus more appropriate?") as we navigated ideas of our intended/imagined audience. We explicitly articulated a "tension between wanting scores to be accessible and also as clean and clear as possible, not too busy", and a problem whereby we wanted people to be able to access the music without being put off by unnecessary technical language- a very familiar problem to knowledge brokers in all fields. When I proposed having a "key" or list of Italian terms alongside their translated counterparts, my collaborator initially objected somewhat – "I can't think of a time when I have seen both together" – but eventually declared this "an elegant solution" to the issue. We also discussed this in the light of symbols and symbolism across the art – what constituted useful abstraction and what may instead contribute to unnecessary gatekeeping?

## Boundaries and knowledge brokering

In this study, I found two different significant discourses around boundaries in the process of making art as knowledge brokering: knowledge brokering as boundary-finding, and knowledge brokering as boundary-blurring, especially in the case of 'queering' dichotomies or binaries.

**Boundary-eliciting work**

Often, the process of creative making – and in particular art-based research – explicitly aids in finding boundaries, because artistic practice attends to experimentation and discovery without the same need to stay within that which is acceptable and conventional. It is a feature of boundaries that they may be invisible, difficult to discern or liable to shift; often it is only by transgressing that we can elicit boundaries. In this study, it became clear that to discern the boundaries of knowledge brokering work, knowledge brokers may engage in unconventional practices or venture beyond the familiar, which may also cross boundaries into unsuccessful, unacceptable, or unhelpful. Knowledge brokers also may gain insights into the limits of their field by using processes that are new and unorthodox. Finally, it may be only by crossing boundaries that we find them, and this raises questions regarding what this could mean in knowledge brokering work and how we might proceed therefore this without causing harm.

**Boundary-blurring work**

Within this idea of boundaries, the analysis of the data collected during this study found a cluster of concepts related to boundary-blurring, that is: challenging established boundaries by trialling new ideas, forms and methods; the importance of problematizing dichotomies and

exposing false binaries, and exploring the limits of conventional thinking and conventions around using research, through critical examination of assumptions. Boundaries were explicitly referenced in the context of "pushing' them 'in all directions", and part of the choice of forms and formats for the art depended explicitly on this boundary finding/blurring activity, where perhaps both applied.

## Implications

Kara (2015) suggests that creative research methods can generate rich and insightful layers of data, a view which is borne out by this study. It was found that six main themes were elicited from analysing the processes of art-based knowledge brokering:

- Storytelling in knowledge brokering
- Rule-abiding and rule-breaking as part of knowledge brokering and making art
- The difficulty of separating processes and products in knowledge brokering
- The interplay between accessibility and gatekeeping in knowledge brokering
- Boundary-eliciting work as part of knowledge brokering
- Boundary-blurring work as part of knowledge brokering

The themes described above are intended to generate new thinking on the ways in which knowledge brokering processes operate, and illuminate some tensions, questions and boundaries which may be further investigated, the most urgent of which is "what is (good and ethical) knowledge brokering, and what is not?"

The implications for viewing knowledge brokering as storytelling are significant. For example, one of the discourses around storytelling in knowledge brokering found in this study was the emergence of a tension between selecting, interpreting and moulding information into a form (abstraction), and retaining some sense of "fidelity" or "truth". Since crafting a narrative could be seen to be a process of abstraction which naturally filters and simplifies, storytelling could contribute to these false dichotomies; or it could trouble and dissect them. This will take intention on the part of the knowledge broker, and the deep consideration of the purpose of knowledge brokering which extends further than just replicating or retelling what is in research, but intentionally and carefully crafting a narrative that also attends to wider implications and context. Implications include the need for greater clarity on the purposes and audiences for knowledge brokering processes, and the ways in which crafting narratives using art-based methods could contribute to both greater understanding of the content being brokering and the process of brokering itself. There is also the possibility, not yet explored here, that collaborating with the original author'/s of the research could yield rich brokering opportunities because it

allows the possibility to delve deeper into the purposes and implications of the research beyond that which has been published. This is an area which I recommend as a focus for further research.

The discourse around rule-breaking and rule-abiding suggests an important tension for knowledge brokers – between creating new knowledge and new forms, and operating within audience expectations and structures to best enable flows of knowledge in both directions. The interplay between, and interconnectedness of process and product was also found to be significant int this study. This represented a tension between the idea of the process as a creative journey of exploration, with the concomitant feeling free to make mistakes and enjoying serendipitous collisions when challenges occurred, and concentrating on the outcome or product, with the perhaps contradictory ideas of creating within the constraints of audience and purpose, and trying to make something the "best" by some definition that it could be. Ezra Pound adopted the phrase "an act of art" instead of "a work of art" (Clement, 2011, p.3), which is a nice (albeit false) distinction to make here: what could "an act of research brokering" look like?

In terms of the relationship between accessibility and gatekeeping in knowledge brokering, brokers should be acutely aware of the trade-offs and responsibilities of their actions – choices often veering between detail/depth and accessibility. As Pickering and Kara (2017) suggest, when we have interpretative authority we are often faced with choices between "literal" (empirical, evidence-based) and "real" (authentic, experiential) truths. They conclude that one way of resolving or at least incorporating these dilemmas may be to draw on creative methods of representation, such as poems, songs, plays and dance, which this study suggests is a powerful way forward in the field of knowledge brokering.

It is an embedded assumption in my research question that it is possible to create art as, through, and with knowledge brokering. Throughout the process of the study it became clear that this assumption was realised in three important ways. Firstly, the pragmatic view that since I created art using research and I am a practising knowledge broker, it is therefore clearly possible to create art through knowledge brokering. Whether the art itself has impact or meaning for others, the process of creating the art deepened my understanding of both the original research, the concepts and ideas I was grappling with, and the process of knowledge brokering itself. Secondly, the act of collaborating in order to produce art allowed important discussions, tensions and questions to emerge around using research and other types of evidence to create art, including the purposes and therefore the processes of such activity. Whilst it is not necessary to collaborate to use art in knowledge brokering, this study suggests

that in this case the act of collaborating supported deep discussion, critique, and questioning which has enriched the process of researching knowledge brokering. This collaboration, alongside and in parallel with using a reflexive researcher diary, has provided the best of both worlds: input and ideas from others, but also space to reflect and connect those ideas alone. Finally, this study suggests that it is not only possible but potentially useful to create art as knowledge brokering, because it allows for different modes and modalities of expression, it supports different ways of seeing and operating with research, and it also suggests different ways of connecting and making relationships across communities.

## Generalisability

Braun and Clarke (2021, p. 143) suggest that, rather than generalisability, it may be useful to consider instead the idea of *transferability* when dealing with qualitative research – that is, making sure the research "is richly contextualised in a way that allows the reader to make a judgement about whether, and to what extent, they can safely transfer the analysis to their own context or setting."

This study has generated results that apply not only to art-based knowledge brokering, but knowledge brokering more generally: that all knowledge brokering is inherently artistic in some way; that the creation of art can be used specifically to amplify and investigate some of the processes involved in knowledge brokering, and not to fundamentally change them. In particular: the processes of sourcing and selecting knowledge; transformation of knowledge into different forms (synthesis/summarising/distillation); translation of knowledge into more accessible language or forms; visualising/mapping knowledge; facilitating discussion of knowledge; developing products or materials based on research; distribution/dissemination of knowledge; supporting users to critically engage with knowledge; explicitly focusing on subject-specific knowledge in depth and attending to equity and inclusion barriers.

This research was indeed richly contextualised, and thus I can feel confident that the processes identified above, as examined here, are likely to apply to not only other educational contexts but also "acts of knowledge brokering" from other fields.

## Citing scholarly works in art

Finally, one of the clear implications from this study is a proposed protocol for citing research when creating art. It is desirable not only that art is created with and through research, but also that value and credit is given where due. I propose the following three levels of referencing shown in Table 3.4.

*Table 3.5 suggested protocol for citation of research in art*

| | | **Type of citation** | | |
|---|---|---|---|---|
| | | **Direct use** | **Adapted from** | **Inspired by** |
| **Type of art produced** | **Artwork: painting, illustration, drawing, (traditional/analogue)** | *'This piece draws directly on ideas/quotations from..' (name ideas and /or quotation) + full paper reference/s on caption* | *'This piece uses ideas adapted from..' + full paper reference/s on caption* | *'This piece is inspired by..' + full paper reference/s on caption* |
| | **Artwork: painting, illustration, drawing, model, sculpture (digital)** | *'This piece draws directly on ideas/quotations from..' (name ideas and /or quotation) + full paper reference/s with hyperlink to original paper/s* | *'This piece uses ideas adapted from..' + full paper reference/s on caption with hyperlink to original paper/s* | *'This piece is inspired by..' + full paper reference/s on caption with hyperlink to original paper/s* |
| | **Song/music (written artefact)** | *'This piece draws directly on ideas/quotations from..' (name ideas and /or quotation) + full paper reference/s as title page, or footnote* | *'This piece uses ideas adapted from..' + full paper reference/s on caption as title page, or footnote* | *'This piece is inspired by..' + full paper reference/s on caption as title page, or footnote* |
| | **Poetry/play/screenplay (written artefact)** | *'This piece draws directly on ideas/quotations from..' (name ideas and /or quotation) + full paper reference/s as footnote* | *'This piece uses ideas adapted from..' + full paper reference/s on caption as footnote* | *'This piece is inspired by..' + full paper reference/s on caption as footnote* |
| | **Poetry/ play/screenplay (digital)** | *'This piece draws directly on ideas/quotations from..' (name ideas and /or quotation) + full paper reference/s with hyperlink to original paper/s* | *'This piece uses ideas adapted from..' + full paper reference/s on caption with hyperlink to original paper/s* | *'This piece is inspired by..' + full paper reference/s on caption with hyperlink to original paper/s* |
| | **Performance (e.g. stand-up routine, poetry, song, play)** | *Introduction or post-performance note: 'This piece draws directly on ideas/quotations from..' (name ideas and /or quotation) + full paper reference/s* | *Introduction or post-performance note: 'This piece uses ideas adapted from..' + full paper reference/s* | *Introduction or post-performance note: 'This piece is inspired by..' + full paper reference/s* |

## Acknowledgements

I would like to thank all those who collaborated with me on this work, especially my co-composer, Joe Howlett-Reeves.

## References

Auld, M., Doig, E., & Bennett, S. (2022). Knowledge Brokerage: The Musical: an analogy for explaining the role of knowledge brokers in a university setting. *Evidence & Policy*, *1*(aop), 1–16. https://doi.org/10.1332/174426421X16397424861558

Bandola-Gill, J. (2022). Knowledge Brokering Repertoires: Academic Practices at Science-Policy Interfaces as an Epistemological Bricolage. *Minerva*. https://doi.org/10.1007/s11024-022-09478-5

Bannister, J., & Hardill, I. (2017). Knowledge mobilisation and the social sciences: Dancng with new partners in an age of austerity. In *Knowledge Mobilisation and the Social Sciences* (p. 206). Academy Social Sciences.

Barone, T., & Eisner, E. W. (2011). *Arts Based Research*. SAGE Publications.

Braun, V., & Clarke, V. (2006). Using thematic analysis in psychology. *Qualitative Research in Psychology*, *3*(2), 77–101. https://doi.org/10.1191/1478088706qp063oa

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide to understanding and doing* (1st ed.). SAGE Publications.

Clement, T. (2011). Knowledge Representation and Digital Scholarly Editions in Theory and Practice. *Journal of the Text Encoding Initiative*, *Issue 1*, Issue 1. https://doi.org/10.4000/jtei.203

Creaby, C., & Haslam, J. (2020). Evidence for the frontline: More questions than answers. In J. Malin & C. Brown (Eds.), *The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice* (pp. 40–51). Routledge.

Ferguson, K. E. (2023). *The Man Question: Visions of Subjectivity in Feminist Theory*. University of California Press.

Hill, G. (2018). *Cabaret for research and as research dissemination*. [Monograph]. HEA. https://www.open-access.bcu.ac.uk/5686/

Jaggar, A. M. (1989). Love and knowledge: Emotion in feminist epistemology. *Inquiry*, *32*(2), 151–176. https://doi.org/10.1080/00201748908602185

Kara, H. (2015). *Creative research methods in the social sciences: A practical guide*. Policy press.

Kara, H. (2018). *Research ethics in the real world: Euro-Western and indigenous perspectives*. Policy Press.

Kidder, L. H., & Fine, M. (1987). Qualitative and quantitative methods: When stories converge. *New Directions for Program Evaluation*, *1987*(35), 57–75. https://doi.org/10.1002/ev.1459

Malin, J., & Brown, C. (Eds.). (2020). *The role of knowledge brokers in education: Connecting the dots between research and practice*. Routledge.

Mosher, J., Anucha, U., Appiah, H., & Levesque, S. (2014). From Research to Action: Four Theories and Their Implications for Knowledge Mobilization. *Scholarly and Research Communication*, *5*(3). https://doi.org/10.22230/src.2014v5n3a161

Pickering, L., & Kara, H. (2017). Presenting and representing others: Towards an ethics of engagement. *International Journal of Social Research Methodology*, *20*(3), 299–309. https://doi.org/10.1080/13645579.2017.1287875

Rappaport, L. (2013). Trusting the felt sense in art-based research. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 201–208). Intellect.

Rycroft-Smith, L. (2022). Knowledge brokering to bridge the research-practice gap in education: Where are we now? *Review of Education*, *10*(1), e3341. https://doi.org/10.1002/rev3.3341

Rycroft-Smith, L., & Macey, D. (2021). Deep questions of evidence and agency: How might we find ways to resolve tensions between teacher agency and the use of research evidence

in mathematics education professional development? *Proceedings of the British Society for Research into Learning Mathematics*, *41*. https://bsrlm.org.uk/wp-content/uploads/2021/08/BSRLM-CP-41-2-18.pdf

Wang, Q., Coemans, S., Siegesmund, R., & Hannes, K. (2017). Arts-based Methods in Socially Engaged Research Practice: A Classification Framework. *Art/Research International: A Transdisciplinary Journal*, *2*(2), 2. https://doi.org/10.18432/R26G8P

Ward, V., House, A., & Hamer, S. (2009). Knowledge brokering: The missing link in the evidence to action chain? *Evidence & Policy: A Journal of Research, Debate and Practice*, *5*(3), 267–279. https://doi.org/10.1332/174426409X463811

Water, T., Wrapson, J., Tokolahi, E., Payam, S., & Reay, S. (2017). Participatory art-based research with children to gain their perspectives on designing healthcare environments. *Contemporary Nurse*, *53*(4), 456–473. https://doi.org/10.1080/10376178.2017.1339566

# 4. PAPER 3 - NAVIGATING BOUNDARIES: AN ART-BASED INQUIRY INTO 'TRUTH' AND BULLSHIT IN EDUCATIONAL KNOWLEDGE BROKERING

## Abstract

Knowledge brokering has been defined as the work of individuals, teams, initiatives, or organisations whose function is to transfer and transform knowledge between communities, specifically because they have important understandings of both communities (Rycroft-Smith, 2022). However, knowledge brokering has the potential to do harm, especially in cases where it deviates from truth-telling, and it is argued that knowledge brokering is political, comprising ideas of relationships to evidence and truth. A study was undertaken that employed art-based approaches to reflexively and critically explore the processes of knowledge brokering in mathematics education, contributing to the discourse on research misuse, mis/disinformation, and knowledge translation in education. By adopting the perspective of the author as a knowledge broker, this investigation considered the themes, discourses, and boundaries that emerged from the act of creating art as a form of knowledge brokering. In particular, the themes of storytelling and boundary eliciting/blurring are focused on - themes that reveal the complexity and nuances of knowledge brokering, highlighting the challenges of maintaining the integrity of knowledge while navigating diverse audiences, contexts, and purposes. Particularly significant is the examination of the boundaries between what constitutes intentional, expert, faithful, and useful knowledge brokering (attending to the 'truth') versus instances when it becomes haphazard, inexpert, misleading, or even dishonest. This work has broader implications for the field of education, suggesting that art-based methods offer a unique lens through which to interrogate and understand the processes and responsibilities of knowledge brokering, especially in the face of growing concerns about mis/disinformation in education. It provides a critical framework for examining how knowledge brokers navigate the fine line between accurate knowledge movement and the risk of perpetuating misinformation, calling attention to the need for reflexivity, intentionality, and ethical considerations in knowledge brokering practices.

# Introduction

This study considers the literature on knowledge brokering in education (and beyond) and the ways in which knowledge brokering has been theorised as "truth-telling" activity, and applies these ideas to data collected using art-based methods. The processes of knowledge brokering were critically analysed using reflexive thematic analysis. The question posed for this research was: What themes, discourses, and boundaries related to truth and truth-telling emerged for me through the process of creating art as a form of knowledge brokering in mathematics education?

# Motivating literature

## Knowledge brokering

Knowledge brokering has been defined as the work of individuals, teams, initiatives, or organisations whose function is to transfer and transform knowledge between communities, specifically because they have important understandings of both communities (Rycroft-Smith, 2022). Knowledge brokering, also called brokerage, knowledge mobilisation, knowledge exchange or transfer, and research use/utilisation (Rycroft-Smith, 2022) has been used to refer to processes of exchange, transformation and communication of research (Farley-Ripple & Grajeda, 2020). Definitions are still contested, and the key question of "what constitutes (good and useful) knowledge brokering" is still central to this emerging field. I use Jackson's (2003) definition of the work of brokering as an intentional and purposeful act in which the broker seeks to work in collaborative and creative ways with people, communities, networks, organisations, ideas, knowledge, and resources to develop something new or change something.

More specifically, knowledge brokering aims to respond to several key issues identified in using research; Table 4.1 outlines these issues and how knowledge brokering aims to solve them.

*Table 4.1 How does knowledge brokering seek to solve problems with research use?*

| **Problem with using research** | **Proposed knowledge brokering solution** |
|---|---|
| Research producers fail to make contact with research users such as policymakers, practitioners and the citizenry, meaning they do not have a voice in the application of their research (Bannister & Hardill, 2017a); communities of producers and users are often dissonant and do not understand each other's priorities and practices (Farley-Ripple et al., 2018) | Knowledge brokers **mediate** between research producers and research users, facilitating relationships, connections and sharing information |
| Research project such as reports, summaries or articles, often have limited impact on their own; passive | Knowledge brokers **embed** themselves into practice, or connect more deeply with decision-makers, supporting them to contextualise and question findings as well as 'use' them |

| | |
|---|---|
| dissemination does not seem to work as well as active dissemination (Cooper et al., 2020) | |
| Researchers use language which users find inaccessible (Ion & Iucu, 2014; See et al., 2016) | Knowledge brokers **translate,** define and use analogy and metaphor to explain concepts from research more clearly |
| Research is produced in forms and formats that are too long and detailed, or focusing on the wrong things, to be useful for the user (Hering, 2016; Sharples & Sheard, 2015) | Knowledge brokers **transform** research ideas into differently structured or focused forms and formats, interpreting for decision-making and crafting narratives |

## A focus on knowledge brokering processes

Some, such as a Cvitanovic et al. (2017) claim that no study to date has quantitatively demonstrated the *value* of using knowledge brokers as mediators, nor comprehensively documented the ways in which knowledge brokers can add value to knowledge exchange processes, attributing this partly to the lack of established methods and criteria to evaluate the types of activity they undertake. In the absence of research establishing such a framework for evaluation, there is at least existing work that describes some of the processes of knowledge brokering. For example, Rycroft-Smith (2022, p. 26) reviewed the evidence around knowledge brokering and found that "knowledge brokering has emerged as an inherently social process: complex, relational, interpretative and affected by issues such as trust, credibility, personal relationships, and power and identity.".

Most of the work in the field at present is descriptive rather than prescriptive or possibility-seeking; new theoretical and empirical work is needed in order to map the terrain further, in depth, and in particular at the boundaries, margins and intersections. In particular, questions remain around the *value* of these different processes, and how to evaluate them, especially in the light of claims that knowledge brokering can do harm (Lubienski, 2020; Rycroft-Smith, 2022; Swann & Pratt, 2004). In particular in the next section I explore the literature which relates knowledge brokering to ideas around evidence and truth, often but not exclusively in the context of education.

## The problem of 'evidence-based everything'

One of the key identified problems with the activity of knowledge brokering is that anyone can do it, or claim they're doing it, and it is particularly hard to evaluate whether they are doing it *well*. This is particularly evident in educational contexts. Oakley (2002) suggests that the proliferation of "evidence-based everything" makes it hard to critically assess what evidence has been used and why, because it is easy and common to claim one has "used" evidence for nearly anything; as Rycroft-Smith and Macey (2021, p. 4) suggest, "anyone can use research 'evidence' to claim almost any position, whether by blunder or by plunder". These concerns about the quality and status of educational research in use have led to calls for more

transparent research synthesis, for greater accessibility of sound educational research evidence, and greater respect for the perspectives of the different stakeholders in the educational research process. “Would-be users of research evidence must navigate a complex environment where claims about what is and is not evidence proliferate” (Perry & Morris, 2023, p. 88). In this context, trust and credibility emerge as key factors; but these are often aligned with political beliefs, personal relationships, and who wields the most wealth or status, skewing the idea of “evidence” to mean “trusted knowledge” (Morris et al., 2020). “The ‘what works’ notion should not be seen as unproblematic…there are varied and sometimes contradictory understandings of what ‘what works’ entails.” (MacKillop et al., 2023, p. 950).

This means that “using” evidence in education is not straightforward; it is complex and full of tensions (Rycroft-Smith, 2022). In particular, the idea of “evidence-based” in education has been criticised for the tendency to neglect the importance of context, of professional judgment, and of what teachers, students, and parents can contribute (Joyce & Cartwright, 2020), as well as a façade for political manoeuvring (Collins, 2004) and a way to reduce teacher agency (Rycroft-Smith & Macey, 2021).

Perry and Morris (2023) argue that, to be of value, educational research should be able to generate a knowledge base for policy and practice that is usable, relevant, rigorous, cogent and coherent; what they concede is uncertainty as to how this might happen, including who should create and own this knowledge base, and what form it should take. They distinguish between *evidence-based* practice (treating evidence as its primary basis and seeking to implement effective practices, as determined by research) and *evidence-informed* practice (a broader and more diverse practice which uses any form of research and evidence) to help illuminate the deep divisions in the field of evidence use in education, which contain embedded assumptions about what constitutes knowledge and how powerful it is for transforming practice. This idea of evidence-informed practice acknowledges that there are many types of evidence (not just “research”, or “gold standard research”) and that credibility is not just dependent on factors internal to the research (i.e “rigour”), but a function of human relationships and status-bearing: subjective and interpretative.

The literature suggests that knowledge brokering is a contested yet emerging field focused on the intentional, relational, and creative facilitation of knowledge exchange, transformation and negotiation between research producers and users, addressing challenges such as communication gaps, inaccessible language, and limited impact, while grappling with tensions around evaluating its effectiveness, defining "good" practice, and navigating complex notions of evidence in contexts like education. This does not mean, however, that everything is

evidence-based, nor that anyone could claim to be a knowledge broker, as I explore in the next section.

## Research, brokering, and truth

The activity of research itself is primarily "a truth-seeking activity that contributes to knowledge by describing or explaining the world, and is conducted and governed by those with a high level of proficiency or expertise" (Coryn, 2007, p. 124). MacKillop et al. suggest that those at the boundary between knowledge, policy, and practice aim to link communities and speak truth to power, emphasising the emancipatory nature of knowledge as connection (MacKillop et al., 2023, p. 950). However, truth, evidence, power and knowledge are linked in complex ways, as well as being constituted and reconstituted according to milieux; but this does not mean that there is no such thing as truth, or any truth can be true; "The EBP [evidence-based practice] literature has tended to posit evidence/knowledge as homogeneous 'facts' and 'truths' to be transferred, exchanged or ignored by policymakers, often overlooking the idea that knowledge/evidence is constantly re-made, re-interpreted and contested" (MacKillop et al., 2020, p. 344). We can consider that "a true belief is scientific knowledge, roughly, when one has good enough evidence for it" (Roush, 2005, p. 10) and that this knowledge can and does change with further evidence, according to criteria which we should be transparent and ethical about aligning with: "the deliberate, conscious and systematic pursuit and creation of evidence is one of the things that is distinctive about scientific knowledge" (Roush, 2005, p. 10). In social science, and specifically in education, we accept that this constituting and reconstituting of knowledges is based not only on empirical evidence, but on our very ontology of what can be seen to be evidential: in other words if something is *persuasive* according to the system/s we subscribe to. Those using knowledges are hence "embedded in a set of complex and value-laden relations rather than operating as detached actors", absorbing and reconciling different tolerances of uncertainty at systems level (Duncan et al., 2020, p. 10). There are even arguments (e.g. Smith & Joyce, 2012) that the most important boundaries are not between researchers and users of evidence but between different epistemological and political ideologies within research communities.

> First, research is truth seeking. Truth seeking is the search, or investigation, of or for a body of real things, events, or facts, or the explanation of them. Second, research describes or explains. To describe involves representing or giving an account of. To explain is to give the reason for or cause of. Combined, or separately, these two parts result in a contribution to knowledge. Third, research is conducted and governed by those who have the requisite

> proficiency or expertise. To be proficient or to be an expert means that one is well advanced in a branch of knowledge derived from training or experience. (Coryn, 2007, p. 275).

Knowledge brokering is also therefore truth-seeking, being as it is in the business of searching and investigating, describing, explaining and contributing to knowledges, and connecting and reconciling different knowledge systems.

It is possible to take different positions, draw different conclusions and make different recommendations based on "the available evidence", not just because which evidence is 'available' is person-dependent, but crucially because use of evidence is based also on the way that we *frame* the evidence: we situate evidence within value systems, discourses and heuristic frames to interpret evidence within internally consistent belief systems (Parkhurst, 2012). Social actors and social values thus bring complexity to evidence use (Boaz & Gough, 2012). The roles of knowledge brokers are also heavily shaped by their situation: many knowledge brokers are "influenced by the institutional logics of their organisations' and some are 'directly subordinate to policymakers" (Karaulova & Edler, 2024, p. 5). It has been suggested that "the most valuable knowledge often resides where we are least able to see or control it: on the front lines, at the periphery, with the renegades" (Brown and Gray, 1995, in Vann & Bowker, 2001). Monaghan et al. (2012) are clear that "evidence is always enwrapped in politics".

MacKillop and Downe (2022, p. 24) claim that often this means "scientific authority has been eroded, meaning that what counts as credible varies." In education, this is encapsulated in the idea that "research tells us almost nothing about what to teach and why to teach it. This is because what and why aren't empirical questions; they are normative ones. Their answers derive from beliefs, value systems, and world views" (Ferrero, 2005, p. 426). Davies and Powell (2012) argue that this means we should move from *information-telling* in knowledge brokering towards approaches that are concerned with influencing deeper beliefs, values, assumptions or mental models. However, this has clear drawbacks: without establishing trust, maintaining credibility, and incentives and/or an ethical framework for staying within some theoretical window of reasonable extrapolation, knowledge brokers could be brokering *misinformation* (somehow veering away from this truth-telling activity).

There is widespread agreement, then, that truth-finding and truth-telling are both key principles of knowledge brokering as a practice. Yet "truth" in evidence use is often a politically as well as a socially negotiated phenomenon (Sullivan, 2011) and this very idea of "truth" may be co-opted and kidnapped as part of this process – even by brokers themselves. MacKillop and Downe (2022) suggest that knowledge brokers may deliberately use the term "evidence" rather than "opinion" or "ideas", highlight links with academia, and employ mathwashing (hiding a

subjective reality under a thin layer of 'objective' mathematical processing (Allo, 2018) ), all to confer credibility onto their activities. What does – or could – it mean to "tell the truth" with or about research – what might it mean to lie about or with it?

## Misinformation and disinformation

Chew et al. (2022) and Kislov et al. (2017) call for more research into the *consequences* of knowledge brokering, including potential harms. Clearly, one of the most significant harms that could be caused by knowledge brokering is misrepresenting research and evidence. Li defines *misinformation* as the type of information that is factually false - i.e. not consistent with the best available evidence, distinct from *disinformation* "which focuses on deceptive intent of the source and does not require the information to be either 'factual' or 'false'." (Li, 2020, p. 125). This definition of misinformation poses a clear issue for knowledge brokers in education, for whom there are deep questions around both explanatory models for evidence and the concept of "best available evidence", and I critique Li's conflation of the two ideas of "factually false" and "not consistent with the best available evidence" on this basis. Knowledge brokering operates in the space between these ideas, considering specifically how to transform knowledge for decision-making without straying into that which makes it "false". Figure 4.1 demonstrates this as a spectrum between informing and misinforming, with disinforming (also called *bullshitting*) made distinct by the boundary which represents non-attention to the truth.

*Figure 4.1 a conceptualisation of the landscape of knowledge brokering with reference to informing, misinforming and disinforming*

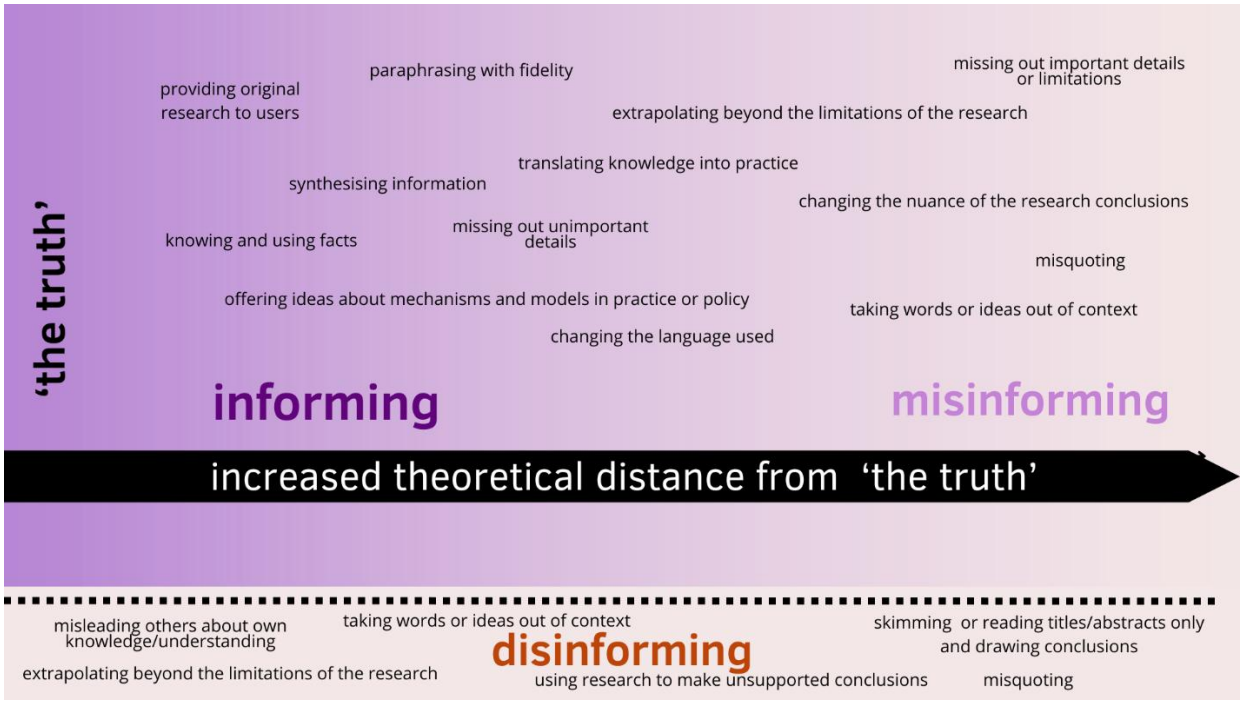


Figure 4.1 helps to clarify some of the interesting complexities of the landscape of knowledge brokering: some of the central processes straddle the blurred boundary between informing and misinforming, entirely dependent on the context, the embeddedness of the broker, and the expertise in understanding and transforming evidence that the broker possesses (or does not possess). What, then, might induce a knowledge broker to stray into misinforming or disinforming territory?

If the central question of knowledge brokering is "what does the evidence suggest about X?", then what happens if the answer is either "I don't know" or "it doesn't really suggest anything"? This is linked to ideas of knowledge brokers being embedded in commercial or academic contexts that demand that they provide "solutions" to "problems" in a "delivery" model (MacKillop et al., 2023), strongly disincentivising them from effectively coming up empty-handed in this way, and is particularly important since there is generally an absence of a strong research base with rigorous research findings on a large number of issues (Monaghan et al., 2012). There is very little literature examining this idea – and more importantly, its darker corollary: how often are knowledge brokers not being honest about their own and the research's limitations and providing misinformation or even disinformation (also known as *bullshit*) instead – and what might be the wider implications for the idea of truth in societal sense?

## Knowledge brokering and bullshitting

Frankfurt (1986) defines *bullshitting* in contrast to *lying* by referencing several features:

- Lying requires knowing (or thinking you know) the truth; bullshitting does not
- Lying is about rejecting or communicating something different to the truth; bullshitting does not need to reference the truth at all
- In lying, we can almost never accidentally tell the truth (except when we believe something to be true, tell something different, and it turns out to be true); in bullshitting, we can "accidentally" tell the truth by not knowing what the truth is or was in the first place and not caring

This is consistent with Li's (2020) definition of creating "disinformation". Frankfurt defines the act of bullshitting, then, as the bullshitter being

> neither on the side of the true nor on the side of the false. His [sic] eye is not on the facts at all, as the eyes of the honest man and of the liar are, except insofar as they may be pertinent to his interest in getting away with what he says. He does not care whether the things he says describe reality correctly. He just picks them out, or makes them up, to suit his purpose. (Frankfurt, 1986, p. 6)

In other words, a bullshitter has more freedom than someone either telling the truth or lying; they can be "panoramic rather than particular" (ibid, p.6). Further, the paradigm on which bullshitting is based is presented in contrast to both lying and truth-telling: rather than perceiving that facts exist in the world that may be determined and known, the bullshitter rejects this notion and constructs a world for themselves – and crucially, others – in which this premise is not agreed or important. Petrocelli et al. (2024, p. 1) define bullshitting as

> sharing information with little to no regard for truth, established knowledge, or genuine evidence. It involves the use of various rhetorical strategies to make one's statements sound knowledgeable, impressive, persuasive, influential, or confusing in order to aid bullshitters in explaining things in areas where their obligations to provide opinions exceed their actual knowledge in those domains.

How might this relate to knowledge brokering? The knowledge broker, then, can broadly have two different underlying paradigms which may result in four different "knowledge brokering" fields of action, as shown in Table 4.2.

*Table 4.2 four possible fields of action in terms of knowledge brokering and the truth (here seen as 'facts')*

| **Facts exist, can be determined, and can be used** | **Facts do not exist, cannot be determined, and cannot be used** |
|---|---|
| 1 - Knowledge broker tells the truth (or multiple truths) according to the facts | 3 - Knowledge broker communicates nothing |
| 2 - Knowledge broker lies according to the facts | 4 - Knowledge broker bullshits |

This fourfold way to consider knowledge brokering is immediately helpful, in that three of the actions (2, 3 and 4) are identifiable as not constituting knowledge brokering at all (provided one uses a definition for brokering knowledge which uses as a criterion telling **truth** about evidence). However, in practice these categories are not always so easily identifiable, because the act of brokering (as well as the act of research-making itself) contains layers of interpretation and storytelling (Rycroft-Smith, 2022).

Both Petrocelli and Frankfurt reference the origin of bullshit information often occurring through an imbalance: a person or organisation being asked to offer knowledge which they do not have, presumably because they have not had time to acquire it, do not have access to it, are not qualified to do so, or do not care to. It is a near-certainty that knowledge brokers will be placed in this position at some point, due to the very nature of their work and the size of the potential evidence base; what MacGregor (2024, p. 59) calls the expectation for knowledge brokers to have *manifold competencies*, well exemplified by a broker in their study telling themselves "I'm out of my depth..there's a real discomfort and I must admit.. to not fake things

here" (p.60). Harris (2024) even argues that indifference to veracity can be unintentional as well as strategic – often referred to more commonly as "never attribute to malice that which can be adequately explained by incompetence" and known as *Hanlon's razor*. What then, distinguishes a bullshitting knowledge broker from one who does not do so, and are these two categories applicable?

MacGregor (2024) discusses a spectrum of reasons for "failure" in the professional practice of knowledge brokering, drawing on the work of Edmondson (2011) which lists these categories of reasons for failure:

- **Deviance:** An individual chooses to violate a prescribed process or practice
- **Inattention:** An individual inadvertently deviates from specifications
- **Lack of ability:** An individual doesn't have the skills, conditions, or training to execute a job
- **Process inadequacy**: A competent individual adheres to a prescribed but faulty or incomplete process
- **Task challenge**: An individual faces a task too difficult to be executed reliably every time
- **Process complexity**: A process composed of many elements breaks down when it encounters novel interactions
- **Uncertainty:** A lack of clarity about future events causes people to take seemingly reasonable actions that produce undesired results
- **Hypothesis testing**: An experiment conducted to prove that an idea or a design will succeed fails
- **Exploratory testing:** An experiment conducted to expand knowledge and investigate a possibility leads to an undesired result

Of these, the most relevant to the concept of bullshit are deviance, inattention and lack of ability – interestingly, those at the beginning of the list, which is a spectrum organised by proximity to blame (the earlier items on the list are more blameworthy) and distance from praise (the later items on the list are more praiseworthy). This suggests that for knowledge brokers bullshitting is seen as harmful, preventable and therefore and something they should take accountability for.

This also accords with Frankfurt's (1986) *insidious bullshit hypothesis*, which states that bullshitting is evaluated less negatively than lying but bullshit can be more harmful than lies, or even misinformation. This is because bullshit-based content may be easily perceived as something profound. An example is given by Pennycook et al. (2015) who explored people's reception to randomly constructed and vague but plausible statements that they called

*pseudo-profound*, such as "Imagination is inside exponential space time events" (p.552). This matters in knowledge brokering for two reasons: these sorts of statements are almost impossible to disprove, and for those that this is possible, doing so takes much, much longer than constructing the bullshit – a principle known as Brandolini's law. There is, therefore, incentive for knowledge brokers to bullshit, and yet the consequences for the field in terms of credibility and trust, as well as the amount of time it may take to chase and refute disinformation and misinformation, could be extremely significant.

In the next section, I consider the literature regarding the reasons why bullshitting as wilful ignorance of the truth has far-reaching consequences for society, and hence the particular danger of doing so when brokering research.

## Knowledge brokering and the political

Snyder (2017) links truth to democracy, and hence the death of truth to facilitating tyranny. He describes the death of truth in four stages:

- ***Open hostility to verifiable reality****: presenting lies as "facts"*
- ***Shamanistic incantation****: the repetition of phrases until they become ingrained and transformed*
- ***Magical thinking:*** *accepting and repeating contradiction without question*
- ***Misplaced faith:*** *ignoring individual discernment and experience, trusting untrustworthy figures of authority uncritically, and fully accepting propaganda*

Knowledge can be and is used to increase social divisions and inequality, posing a threat to democracy (Dawson, 2023). This suggests that knowledge brokering that attends to truth, and hence understands its own political responsibility, is particularly important - and yet rarely discussed in the literature at present.

The practice of science, defined as "the pursuit and application of knowledge and understanding of the natural and social world following a systematic methodology based on evidence" – including the dissemination of knowledge – is considered to be political (Fuentes, 2024). Fuentes argues not just that science is political, but that scientists require an active political approach: "it is time for scientists to be more effective, forceful, and vociferous as their own political advocates…[they must] must recognize and lean into their role as political actors." Thorp (2020) argues that science has always been political, suggesting that "that science thrives when its advocates are shrewd politicians but suffers when its opponents are better at politics."

Politics has been defined as the distribution of resources, the framing of problems, and/or a battle of ideas (Boswell, 2020). Knowledge brokers are "active, involved agents that shape complex, messy and political processes of knowledge transfer", co-constructing and co-managing fuzzy, changeable boundaries between both communities and knowledge domains as well as the standards and expectations of credibility, legitimacy and relevance of research (Karaulova & Edler, 2024, p. 5). Duncan et al. (2020) found that science and policy were interlinked, mutually constitutive and co-produced at multiple levels in their study of knowledge brokers, who bridged, blurred and built science-policy boundaries to integrate knowledges and to foster credibility and legitimacy for themselves as scientists and the knowledge they were brokering; what they called "active and precarious" (p.9) work. There is clearly a vicious cycle here: if knowledge brokers shape views of the very ideas of credibility and legitimacy of research as part of their activity, they are disincentivised to present both themselves and evidence as complex, unresolved, limited, irrelevant, and constrained to use specific contexts; and conversely, incentivised to present both themselves and evidence as straightforward, clear, applicable, relevant and transferable/generalisable.

Knowledge brokering is not neutral nor impartial, although sometimes it claims to be (Karaulova & Edler, 2024). In particular, some knowledge brokers employ the "god trick'"(Haraway, 2016) of using data or "facts" to claim that their viewpoint is not only neutral, but universal and omniscient, where in fact it is interpretative, situated and limited. Knowledge brokering, therefore, is political in at least three ways:

- **The distribution of resources**: Brokers choose which knowledge, or knowledge types to *exclude* from consideration/presentation (Duncan et al., 2020), as part of controlling *what* knowledge and *when* it is introduced
- **The framing of problems**: Brokers negotiate relationships between decision-makers, themselves and knowledge, especially as part of what constitute "problems" and "solutions", as an integral part of brokering (MacKillop & Downe, 2022; e.g. Rycroft-Smith, 2022, p.)
- **A battle of ideas**: Brokers navigate tensions and boundaries in whose knowledge is privileged and considered relevant and valuable, constrained by the limits of their (and others') knowledge, biases and paradigms (e.g. MacKillop et al., 2023; J. Malin & Brown, 2020b)

Knowledge created in the academy has always had a complex relationship with the political; Vann and Bowker (2001, p. 247) speak of research as the "practical ambivalence of objects created as knowledge" as part of "the commodification of knowledge about knowledge";

knowledge is created in the landscape of commercial, political and economic interest, and is shaped by it. Some, such as Cooper (2014) suggest that *policy influence* is a key activity of knowledge brokers. Rodway (2015, p. 4) describes knowledge brokering as "inherently relational". Despite this, analysis of knowledge brokering as political is absent from the literature - a notable omission (MacKillop et al., 2020). Here, I concur with Fuentes that knowledge brokers, like scientists, should consider political work – and making their work political - an active part of their role:

> Scientists need to recognize that bold presentation, dissemination, and support of scientific knowledge has become both a basic commitment and a political act. Being purely reactive to political attacks (only playing defense) or assuming an artificial air of neutrality and seeking to "stay on the sidelines" are both ethically problematic and practically detrimental. (Fuentes, 2024).

This includes a thorough understanding of the hidden ethics fallacy: the idea there is no such thing as not taking an ethical position and hence that claiming neutrality is still a position, and one which actively supports the status quo (Rycroft-Smith et al., 2024).

Knowledge brokering and research are inherently truth-seeking activities that involve investigating, describing, and explaining knowledge while navigating complex systems of evidence, value, and political ideology in which that knowledge may be situated. However, truth-telling in knowledge brokering is fraught with challenges, including potential mis- and dis-information, political entanglements, and ethical dilemmas, as knowledge brokers attempt to reconcile diverse knowledge systems, manage biases, and address pressures to present clear solutions even when evidence is inconclusive, missing, or unclear.

In the next section I consider the advantages and drawbacks of art-based research, and its relationship to knowledge, knowledge brokering, and the truth.

## Art-based research

Art-based research has been conceptualised as a subset of creative research methods, which also includes research using technology, mixed methods research, and transformative research frameworks including participatory feminist and decolonising methodologies, with the important caveat that they are not mutually exclusive (Kara, 2015). Kara also notes that social science and art-based methods often go well together, but that there are important tensions, such as the notion of "truth", which can be contested.

Incorporating the arts in to the research, and in particular "the place of the artistic and the aesthetic in the process and product of..research" (Barone & Eisner, 2011, p. x) has begun to attract more interest from researchers interested in exploring different ways to connect with

knowledges and, in turn, create connections for others. Barone and Eisner also make the point that using art in and for research is not new; in many ways its renaissance is a resistance to the positivist insistence that science and art be distinct and dichotomous, especially the particular viewpoint that "scientific" methods overpower "artistic" ones when it comes to research because art constitutes a source of "bias and contamination" (ibid, p.xi).

Springborg (2012, p. 116) suggests that "the unique contribution of art-based methods is to foreground and facilitate the process of making and expressing more refined perceptual distinctions, not to get accurate data, but as a meta-level learning process in itself." This is in contrast to art-based methods being defined simply by the techniques used. It also calls into question what data itself comprises, and the question of "accuracy" as applied to complex and powerful processes.

Friberg (2010) is clear that art-based research is in fact more honest and transparent than other forms, because, they argue, it is simply not possible to remain at a distance as a researcher, although it is possible (and common) to create the illusion of being so. This is reflected in Haraway's (2016) idea that all research comes from somewhere and it is a god trick to pretend otherwise, lending research an air of not only neutrality but credibility that is both illegitimate and downright deceitful.

## Art and the 'truth'

There is a long history of theorising complex relationships between art and truth. One line of reasoning can be encapsulated by Picasso's famous quote: "We all know that Art is not truth. Art is a lie that makes us realize truth, at least the truth that is given us to understand. The artist must know the manner whereby to convince others of the truthfulness of his lies." (Picasso, 1923, p. 316). Similarly, Matisse's suggestion that art should exaggerate in the direction of reality seems to suggest that there is a spectrum of truth and falsehood to which art attends. Matisse was clear that art should not just represent form, but also the artist's feelings about and coherent story of the form – similar perhaps to the way that researchers do not just list ideas, but critically judge them to form a coherent narrative, what Matisse termed "the essential". (Elsen, 1968). Art has been suggested as important and useful in conveying truth – but specifically not by replicating. Instead, the artist's primary concern may be seen as to communicate information about what they see in a very particular way. Aristotle said, **"**The aim of art is not to represent the outward appearance of things, but their inward significance." (This quote is claimed to be attributed to Aristotle by Seneca in On Tranquillity of Mind in Flynn, 2024). Allen (2013) speaks of this as "soul truth", echoing a quote attributed to director Stanley Kubrick: "the truth of a thing is the feel of it, not the think of it."

Art, it is often suggested, captures a *transient* truth, and sometimes addresses the tensions between contextual truths and the very concept of universal truth. Others have contested these ideas on the basis of the idea of truth itself, suggesting that **"**There are no hard distinctions between what is real and what is unreal, nor between what is true and what is false. A thing is not necessarily either true or false; it can be both true and false" (Pinter, 2006, p. 811). Pinter goes on to explain, however, that this applies to art only: as a citizen, truth and false are distinguishable and crucial to society. The use of art in therapy takes this one stage further, considering that truth can be mutable over time and therefore that using art in this way to "see'" changing truths can be powerful and important (Herrmann, 2022).

An artist draws attention to something they find interesting (Judkins, 2024); it can be argued that knowledge brokers have the same purpose. Art has been used to enhance understanding and meaningful knowledge as part of moving ideas from research to practice (e.g. Mitchell & Cody, 2002).

## Art and the nature of knowledge and knowing

This study employs art-based methods and qualitative methods. Choosing to use big Q qualitative methods and feminist critical epistemologies already suggests a certain view of knowledge: as plural, complex, layered, situated/contextualised, and never final. I draw on D'Ignazio and Klein's (2020) ideas about the importance of "subjugated knowledge": forms of knowledge that have been devalued and kept from the academy as a form of patriarchal control, such as music, literature, and dialogue (Hill Collins, 2009), insisting that process of making art in its many forms *is* research, and examining these processes *is* knowledge.

Critical feminist epistemologies also place responsibility alongside knowledge creation: those of ethics and accountability, not cutting off the flower-heads of "data" for mounting in a glass case; but studying the whole meadow in situ. In particular, those acting as knowledge evaluators, intermediaries or brokers have a particular responsibility to resist decontextualising knowledge, especially in pursuit of power and status as knowledge-wielders – very similar to that which, in the realm of big data, D'Igazio and Klein (2020) term "Big Dick Data". In fact, the construction of fields of knowledge themselves have been driven by war, colonisation, capitalism and conquest (Arvanitis et al., 2023 in Keim and Rodriguez Medina - 2023 - Routledge handbook of academic knowledge circulation), of which artificial intelligence is the latest in a long line of "Big Dick Data" projects - characterized by "patriarchial, cis-masculinist, totalizing fantasies of world domination as enacted through data capture and analysis. Big Dick Data projects ignore context, fetishize size, and inflate their technical and scientific capabilities." I extend this idea of Big Dick Data to suggest the concept of *Big Dick Research* – that which seeks

to compare, impress, overpower, penetrate or demand attention, rather than to enrich, dialogue, collaborate, offer and receive consent, and/or pay attention. I subscribe instead to research that attends to its own situated context, is creative and caring, and most of all dialogic and never final:

> Knowledge is reliable, safe and certain as long as it is held in mono-logical isolation and synchronic arrest. As soon as it becomes mobilized and communicable, this certainty slips away and truth is negotiated in the gap between self and other, through an unfolding, dialogical exchange. (Kester, 2011, p. 19).

Kester sees the purpose of art, therefore, to transgress boundaries and identities to provide critical insight, a view which I share and which informs this study.

## Art-based knowledge brokering

There is very little in terms of either theoretical or empirical work in the emerging field of *art-based knowledge brokering*, which I define as using the arts to transform ideas from research into practice, policy or other contexts in which they can be used and usable. The "can" is important: it refers to two important facets: one, that the knowledge created *is able to be used* by agents making decisions for which the research may be pertinent and two, it *may be* used, offering agency to the agents to debate, critique, question and ultimately reject the ideas in context. It is, of course, true that all knowledge brokering is in some way art-based, in the sense that writing, graphic design, interpretation, creating resources, problem-solving, and presenting ideas have all been conceptualised as part of knowledge brokering practice (Malin & Brown, 2020b) and are all therefore likely to draw on what might be conceived as artistic or creative processes, defined somewhat problematically as either attending to form as well as/over function (artistic) or somehow new or original, different from what has been done before (creative) (e.g. Koppman, 2014). The distinction I am making here is that art-based knowledge brokering intentionally uses techniques such as (but not limited to) poetry; illustration; cartoon; stand-up comedy; singing, rap and/or music; painting and drawing; animation; making; theatre or dramatic arts; textiles; or sculpture to better connect target audiences with ideas from research. This could be as a process or analogy, or as an outcome or product. The second facet of a definition of *art-based knowledge brokering* is that the brokering acknowledges the false dichotomy of science versus art, transforming knowledge in a way that attends to ways that art can deepen and enrich understandings of what knowledge is, how it is produced and used, and who gets to access it.

Various models and metaphors have been proposed to conceptualise knowledge brokering, such as knowledge brokering as mediating, straddling, Janusian integration,

boundary blurring, boundary spanning, translation and matchmaking, all with various connotations about the type of work involved (Rycroft-Smith, 2022); these so far have a distinctly instrumental or social focus. I am particularly interested in exploring, through this study, the more creative and artistic practice that could take place or may already be taking place as part of knowledge brokering activity – in other words *research art*.

# Methods

## Data collection

The process of data gathering involved:

- Collating the multiple drafts, sketches, notes and versions of art created as part of, around, and about brokering ideas from a total of 9 mathematics education research papers
- Recorded video conversation between myself and a collaborator while composing songs
- Recorded video of a mathematical communication composition workshop
- Writing in the reflexive researcher journal at least once a week

The reflexive researcher journal was collected electronically (to facilitate ease of searching, collating and analysis), and was written in an open-ended, unstructured diary format; this decision was made after piloting various structured question formats and finding them too restrictive.

The data collected comprise:

1. Three pieces of art, with associated notes, sketches, and photographs. These were completed by me over a period of five months, between March and July 2023, and are summarised in Table 4.3.

*Table 4.3 artworks produced in the study*

| Title | Medium | Processes |
|---|---|---|
| *A bunch of research papers (2023)* | Paper, glue, elastic bands | Cutting paper, folding paper, manipulating paper, bunching paper, gluing paper |
| *Synthesis (2023)* | Paper, glue, copper leaf paint | Making paper, painting, assembling, constructing |
| *Western hemisphere (2023)* | Paper, napkins, copper leaf, glue, lamp | Tearing paper, papier mâché, building up, making layers |

All three of these pieces used the same set of six research papers, on the theme of creativity in mathematics, as their starting point:

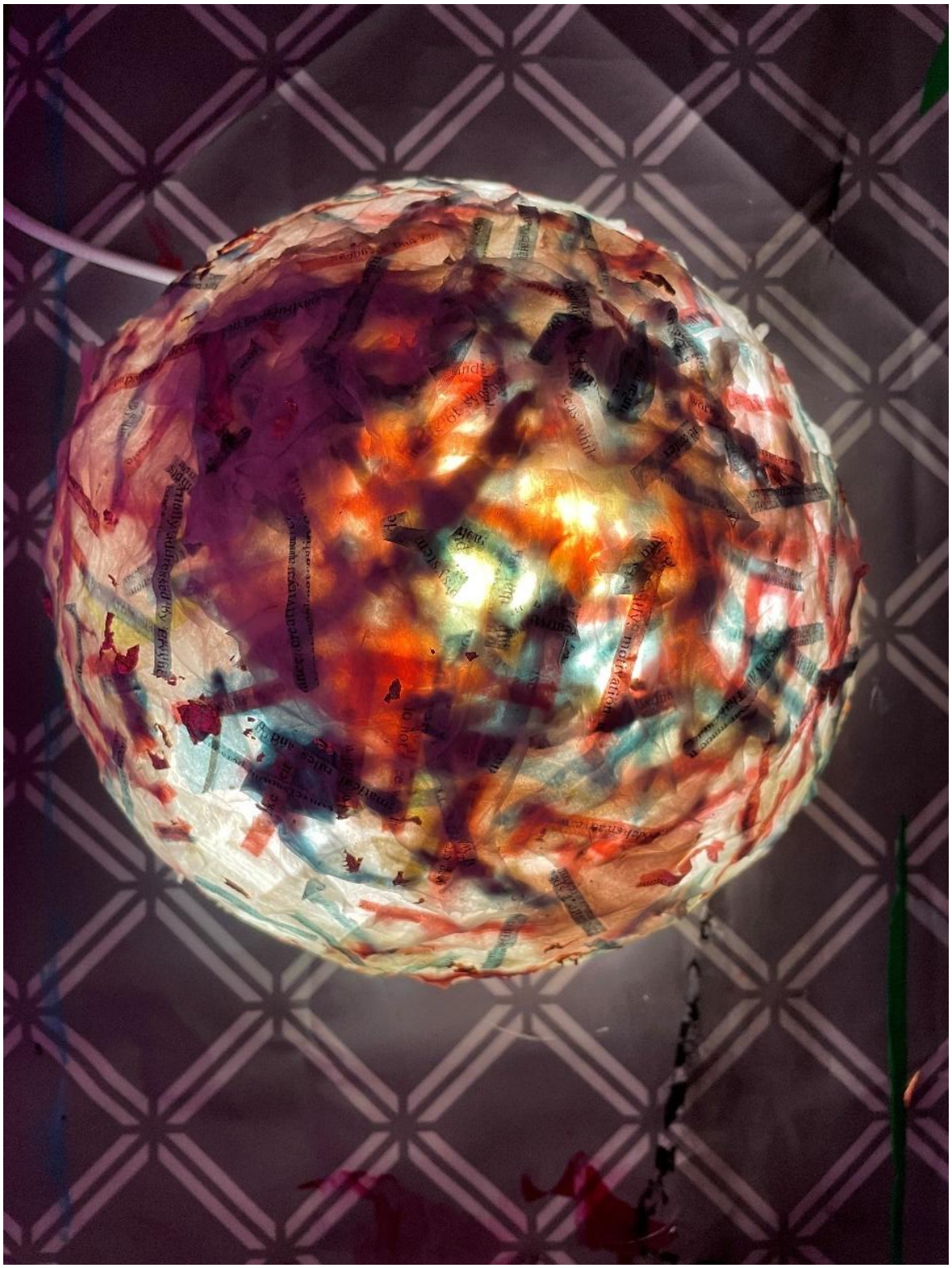
- *Chamberlin, S. A., Liljedahl, P., & Savić, M. (Eds.). (2022). Mathematical Creativity: A Developmental Perspective. Springer International Publishing.* https://doi.org/10.1007/978-3-031-14474-5
- *Hansen, E. K. S. (2022). Students' agency, creative reasoning, and collaboration in mathematical problem solving. Mathematics Education Research Journal, 34(4), 813–834.* https://doi.org/10.1007/s13394-021-00365-y
- *Joklitschke, J., Rott, B., & Schindler, M. (2022). Notions of Creativity in Mathematics Education Research: A Systematic Literature Review. International Journal of Science and Mathematics Education, 20(6), 1161–1181.* https://doi.org/10.1007/s10763-021-10192-z
- *Kattou, M., Kontoyianni, K., Pitta-Pantazi, D., & Christou, C. (2013). Connecting mathematical creativity to mathematical ability. ZDM, 45(2), 167–181.* https://doi.org/10.1007/s11858-012-0467-1
- *Kroesbergen, E., & Schoevers, E. (2017). Creativity as Predictor of Mathematical Abilities in Fourth Graders in Addition to Number Sense and Working Memory. Journal of Numerical Cognition, 3, 417–440.* https://doi.org/10.5964/jnc.v3i2.63
- *Sriraman, B. (2004). The Characteristics of Mathematical Creativity. The Mathematics Educator, 14(1), 1.* https://ojs01.galib.uga.edu/tme/article/view/1868


Images of these pieces are shown in Figures 4.2, 4.3 and 4.4.

*Figure 4.2 A bunch of research papers, an artwork produced during the study*

*Figure 4.3 Synthesis, an artwork produced during the study*

*Figure 4.4 Western hemisphere, an artwork produced during the study*



2. Three pieces of music, in sheet music and various recorded forms, which are summarised in Table 4.4.

*Table 4.4 Music written in the study*

| Piece | Genre | Source paper |
|---|---|---|
| *Five Little Slugs* | Nursery rhyme/children's song | Meng, R., Yeo, A., Ding, M., & Alibali, M. W. (2023). Linking representations of equality in first-grade mathematics lessons in China. *Educational Research for Policy and Practice*. https://doi.org/10.1007/s10671-023-09334-7 |
| *Ostinato (The Rules of the Game)* | Choral piece written for four voices | Guerra, P. L., & Wubbena, Z. C. (2017). *Teacher Beliefs and Classroom Practices*. *26*(1). |
| *Time to Learn* | Dramatic folk/musical theatre song | Kopparla, M., & Saini, A. K. (2022). "Science Is My True Villain": Exploring STEM Classroom Dynamics through Student Drawings. *European Journal of STEM Education*, *7*(1). https://eric.ed.gov/?id=EJ1341163 |

Sheet music and demos for these songs can be found here:

https://lucyrycroftsmith.com/music/

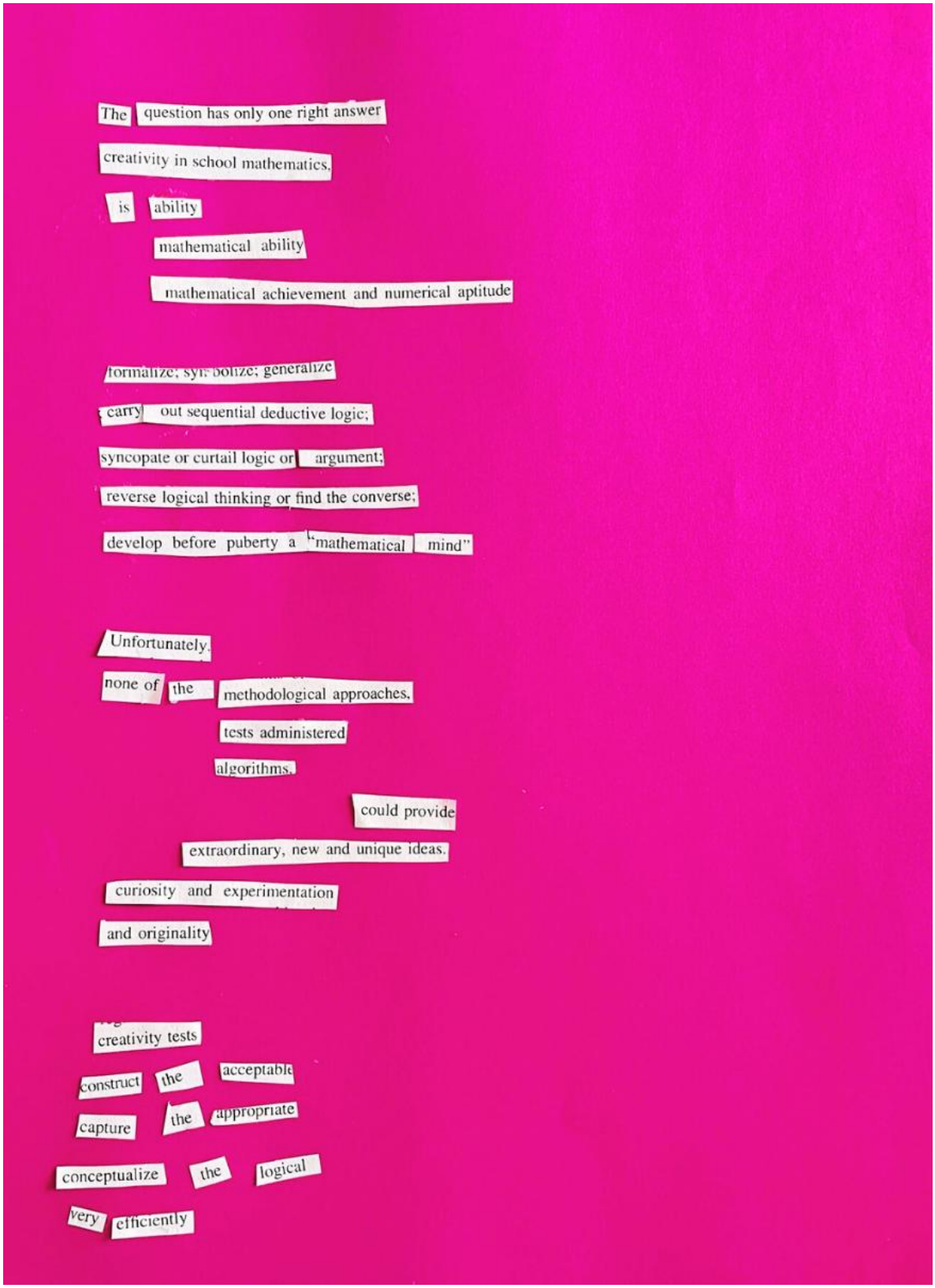
3. Ten videos and associated transcripts from art-making collaboration meetings, held between February 2023 and December 2023.

The collaborators were:

- A professional composer and teacher who was also a friend. Nine meetings were recorded between me and this collaborator.
- A group of peers who were engaged in art-based methods of communicating mathematics and science. One meeting/workshop was recorded between me and these collaborators. The participants were self-selected – they were asked on the basis of me knowing them, their interest in using art to communicate mathematical ideas, and their willingness to participate in the project.

5. A poem, written by the process of cutting and collating a research paper, entitled *Mathematical creativity* (a cut and collated poem adapted from Kattou et al, 2012). The poem is shown in Figure 4.5.

*Figure 4.5 Mathematical creativity , a poem adapted from Kattou, M., Kontoyianni, K., Pitta-Pantazi, D., & Christou, C. (2013)*



Finally, a reflexive researcher journal (comprising digital text, video and images) was written between January 2022 and September 2023, alongside and reflecting on creation of the artworks.

## Ethics

This research was approved by the University of Cambridge ethics process. Participants gave their consent for the data to be collected and used for research purposes when they agreed to collaborate with me, using – and explicitly naming - the principle of informed consent. Participants were anonymised and, since the focus is on themes and discourses, it was not necessary to use identifying information in the study.

One of the ways in which I attended to ethics in this work, consistent with my theoretical approach as a critical feminist post-structuralist researcher, is to locate myself clearly and transparently within the research – in other words, to use positionality and reflexivity with intention (Kara, 2018). This was expressed in a variety of important ways:

- setting out my viewpoints, research paradigms and epistemological stances in my writing (for example in my registration report, published papers, and here)
- making a commitment not to be anonymous or hide behind institutional identity in my knowledge brokering work
- being transparent about my own specific biases and interpretations, as well as the meta-level general critique of research as a process which contains and creates biases and interpretations at every stage (for example I had a highlighter colour which signified "biases", which I used on my data)
- reflexively analysing the gaps, silences, blind spots and invisibilities that are likely to occur in my work due to my cultural, societal, geographical and linguistic anchors

I have made freely available wherever possible all products generated during this study on my website, appropriately credited where consent is given to do so (which, in the case of the composer I collaborated with, means they are not anonymous, which has been agreed).

## Data analysis

This study responds to the need for deeper and richer understanding in the field of knowledge brokering in education (Bannister & Hardill, 2017a; J. Malin & Brown, 2020b; Rycroft-Smith, 2022). The findings are intended to develop the field of educational knowledge brokering, as well as knowledge brokering more widely, by examining themes that are elicited from techniques and practices, especially as related to types of knowledges, and developing

understandings of discourses related to processes of knowledge brokering, especially that of the place of truth-telling in knowledge brokering. Creative methods including art-based research was therefore used, which is ideally suited to deepening and enriching understandings (e.g. Barone & Eisner, 2011; Wang et al., 2017) as well as reflexive critical thematic analysis, which is designed to explore richness, complexity and nuance, utilising researcher positionality as a strength (Braun & Clarke, 2021) in pursuit of such focus on "thick" analysis. Whereas some education research exists that uses the arts to disseminate findings - for example Hill's (2018) "troubling" the hegemony of research dissemination by using *cabaret for research* – the use of arts-based methods as I have here to explore educational knowledge brokering is entirely innovative. In this study I used mixed methods, including thematic analysis, to consider the question: What themes, discourses, and boundaries related to truth and truth-telling emerged for me through the process of creating art as a form of knowledge brokering in mathematics education?

Research based on deep and critical thematic analysis aligns well with art-based methods and the reflexive focus here - a type of qualitative organization, which helps to harness meaning (Rappaport 2013). Thematic analysis, described as a method for identifying, analysing, and reporting patterns (Water et al. 2017), is often "poorly demarcated, rarely acknowledged, yet widely used" (Braun and Clarke 2006, 77). This method is consistent with my feminist post-structuralist constructionist approach, which examines how events, realities, meanings, and experiences are shaped by societal discourses (Braun and Clarke 2006, 80). The method is specifically a way to reflect reality and unravel its surface (ibid). In this study, an inductive approach was used to identify themes, representing patterned responses or meanings within the data set, interpreted flexibly but documented explicitly and in detail (Braun and Clarke 2006).

I specifically chose reflexive thematic analysis, defined by Braun and Clarke (2021, p.7) as a type of thematic analysis characterized by:

- A fully qualitative sensibility, focusing on process and meaning over cause and effect.
- A critical and questioning approach to life and knowledge.
- The ability to reflect on dominant cultural assumptions.
- Emphasis on nuance, complexity, and contradiction over tidiness or certainty.
- Disinterest in discovering a singular universal truth.
- Viewing the researcher's subjectivity as a resource for analysis, not a problem to be managed.
- Treating data analysis as an art, with creativity within a framework of rigor.

Braun and Clarke's reflexive thematic analysis was employed alongside a fully qualitative approach, termed "big Q" by Kidder & Fine (1987). This approach uses qualitative data generation and analysis techniques within a non-positivist framework, informed by qualitative research values and paradigms. Big Q research combines qualitative methods and paradigms, focusing on meaning-making practices, recognising elements as only partially knowable, and valuing the researcher's subjectivity as a storyteller. It aims for rich, in-depth understanding, often with smaller samples (Braun and Clarke 2021).

This study utilised both experiential and critical elements of the big Q approach, integrating ideas of meaning, experience, and knowledge brokering practices (such as art-making, discussion, and collaboration) and analysing the construction, negotiation, and unpacking of that meaning. Braun and Clarke's reflexive thematic analysis represents an interpretive view, explicitly rejecting the notion that coding can ever be accurate—as it is an inherently interpretative practice, and meaning is not fixed within data.

## Analysis

The focus of this study was the question: What themes, discourses, and boundaries related to truth and truth-telling emerged for me through the process of creating art as a form of knowledge brokering in mathematics education? I used thematic analysis on the dataset to develop four main themes and two further themes explicitly related to boundaries, which were elicited for me from the process of creating art as knowledge brokering in mathematics education; these are shown in Table 4.5, with examples of each theme.

### Summary of themes

*Table 4.5 Summary of themes that were analysed from the data*

| Theme | Characteristics | Examples |
|---|---|---|
| **Storytelling in knowledge brokering** | • the multifaceted elements that contribute to narrative richness, especially including structure and narrative techniques, transcending the confines of language/words alone<br>• visual and perspective elements—such as framing, texture,, shape, colour, and harmony—used to paint vivid scenes and add depth to the narrative canvas<br>• the interplay between base, bass, frame, grid, canvas, background and form; and tune, melody, shape, image, story, foreground and focus – can be aligned or contradictory, coherent or conflicting<br>• fidelity to the original ideas in the research in tension with crafting a narrative which is by necessity simpler and leaves things out | 'there is a hero'<br>'The message versus the music – should it be a poem, or a book, instead?'<br>'we should show not tell'<br>'it might veer too far from the original research - how do we decide?'<br>'the colour/texture of the background means the research 'emerges' from the background'<br>'it's not the story I want to tell but it's the truth' |

| | | |
|---|---|---|
| **Rule-abiding and rule-breaking as part of knowledge brokering and making art** | • Rules and conventions as both guidelines and constraints; adhering to them provides structure, while breaking them fosters innovation<br>• The act of seeing rules—truly understanding their reason for existence—allows us to navigate their nuances effectively, also perhaps giving us permission to break them<br>• Drawing inspiration from existing works, generating ideas in the image of what came before, can yield fresh perspectives, but also raises questions about authenticity, citation, ownership and credit.<br>• Artistry thrives on intuition, emotion, and subjectivity, embracing the derivative, weaving threads of influence into a unique tapestry; so does research (and mathematics?) but do we acknowledge this differently? | 'it's a whole new genre!'<br>'constituting and reconstituting research'<br>'you can make any noise you wish – the stupider the better (blows raspberry)'<br>'don't be constrained by rules!'<br>'the rules of harmony…doubling thirds…moving in parallel octaves'<br>'I went back and read the original paper, which helped'<br>'I made a little references to the Deis Irae'<br>'There's a part that's Rachmaninoff in there' |
| **The difficulty of separating processes and products in knowledge brokering** | • The process is the creative journey, the activity of experimenting and exploring, feeling free to make mistakes and enjoy serendipitous collisions when challenges occur, and we want to focus on this, not the outcome<br>• However, when making or creating, the product is the endpoint; it's how we know we have 'finished', and what we primarily use to communicate with others | 'I don't care if I don't perform it as written'<br>'the formality of sheet music'<br>'I don't need to reach a conclusion, just ask questions'<br>'it's more about process than product'<br>'the songwriting process tells us something about the research in the process of brokering'<br>'the aim is not to put on a show where everyone comes along and immediately understands research'<br>'what is my art for? Valued; valuable; to sell, display or exhibit' |
| **The interplay between accessibility and gatekeeping in knowledge brokering** | • how information flows, who holds the keys, and the delicate balance between empowerment and misuse<br>• since knowledge brokers wield influence over what evidence reaches decision-makers and in what form, their decisions matter<br>• the choice of language, what to define and what to translate into different words, as well as the choice of form and format, all tell stories about the seriousness and credibility of the content as well as contributing to increased accessibility<br>• knowledge brokers have a duty to make their work as accessible as possible – where does this collide with transforming the knowledge itself as well as the modes it flows in? | Should we translate 'adagio'?<br>'Is the word refrain or chorus more appropriate?'<br>'I can't think of a time when I have seen both together'<br>'is it okay to laugh?'<br>'there is gatekeeping in the language we use'<br>'too wordy versus too pared-down'<br>'refrain might mean don't do it'<br>'tension between wanting scores to be accessible and also as clean and clear as possible, not too busy' |
| **Boundary-eliciting work as part of knowledge brokering** | • To discern the boundaries of knowledge brokering work, knowledge brokers may engage in unconventional practices or venture beyond the familiar, which may also cross boundaries into unsuccessful, unacceptable, or unhelpful<br>• Knowledge brokers gain insights into the limits of their field by using processes that are new and unorthodox<br>• It may be only by crossing boundaries that we find them – what might this mean in knowledge brokering work and how can we do this without causing harm? | 'we are using art to explore and find limitations'<br>'in many ways this is the opposite of a research summary'<br>'the interplay between the literal and metaphorical'<br>'does the work stand up on its own, or does it need introduction, context or explanation?'<br>'what constitutes successful here?' |
| **Boundary-blurring work** | • Challenging established boundaries by trialling new ideas, forms and methods | 'I don't want to put words in anyone's mouth' |

| | | |
|---|---|---|
| | • The importance of problematizing dichotomies and exposing false binaries<br>• Pushing the limits of conventional thinking through critical examination of assumptions | 'knowledge brokering as high quality expert accountable and transparent - the person is the product'<br>'it is not comfortable, but I don't just want to write things I agree with'<br>'we're in the experimental phase you're allowed to play and do weird stuff'<br>'writing music with and about research is a brand-new field'<br>'pushing boundaries in all directions' |

In this study I focus on the themes of boundary-eliciting and boundary-blurring, with some discussion of storytelling, in response to the specific focus here on navigating boundaries and truth-telling. For a broader view, including more on the other themes found as part of the reflexive critical analysis, see Rycroft-Smith, 2024: "Using art-based methods to explore processes of knowledge brokering in mathematics education."

## The importance of storytelling in knowledge brokering

The first theme and discourse that this study focuses on is the idea of storytelling in knowledge brokering. This encompasses ideas of narrative richness, truth-telling, and the interplay between fidelity to the original ideas and interpreting them for an audience. While in the past models of knowledge brokering have often concentrated on ideas of translation, bridging, mediation, or conversion, the analysis of this data suggests that viewing knowledge brokering as storytelling can be very powerful. In particular, there were many data sources which attended to the concept of "truth", or fidelity to the original ideas in the research - which were sometimes in tension with crafting a simpler narrative which is by necessity shorter and therefore omits some information, as well as being reorganised or transformed to make that narrative compelling. One of the comments that encapsulates this theme is "it might veer too far from the original research - how do we decide?". This aligns exactly to the notions of informing, disinforming and misinforming discussed in the literature, suggesting that these may not be discretely bounded from one another, but form more of a spectrum, which I discuss further in the Implications section.

Embedded in this discourse is the assumption that to facilitate understanding of research ideas, there must be a coherent narrative that is focused, clear, interpretive, and persuasive. The idea of storytelling was sometimes aligned with and sometimes at odds with concepts of accuracy or fidelity. For example we discussed that we should be both musically and biologically accurate when writing *Five Little Slugs*, commenting that the facts should be correct: ie that frogs ate slugs, the noises they made, and even the speed they ate them should not be misleadingly represented in the song (even though this was not information that directly

came from the research itself). This example shows the need to read further and provide context, as this information came not from the original research paper but from further contextual research. In a contrasting example, concerns about portraying mathematics in a negative light - in particular contributing to the reputation of mathematics as a difficult, frightening, or monstrous - were evident in the writing of the song *Time to Learn,* where the original research in many ways presented mathematics as a monster in the eyes of students, yet in the interpretation of the storytelling process we worried about the potential repercussions of presenting mathematics this way. This represents a tension between fidelity to the original research - in this case the choices of the students represented there - and concerns about consequences, ethics, or potential interpretations that might be perceived as unhelpful, discriminatory or contributing to stereotypical narratives, for example: "We don't want to do it [represent mathematics as a monster]...but also it gives students a voice" and, most powerfully: "it's not the story I want to tell but it's the truth". In many ways this represents the central process of storytelling: selecting, organizing and ordering information in order to tell a story that is intentional and - it could be argued - fulfils a purpose that is not harmful. This is also reflected in the comment that "Songs may provide a question, an answer, or both", with the suggestion that the "story" may be question-posing or open-ended as well as neat and/or question-answering.

This interest in portraying the central ideas but also the context and "texture" (Rycroft-Smith & Stylianides, 2022) of the research being brokered was present throughout the data. The "intention" of the research was also important, not only in terms of ideas and concepts, but also affect and "feel", which is well exemplified in the quote regarding the song *Ostinato*: "it was starting to feel boring structurally so I added more layers...it *feels like* the messiness of being a teacher". There were several points during the study when I or others reported that we felt "good" about the storytelling feeling "true", for example "it absolutely conveys the thing is supposed to" - despite not being able to, in the moment, convey that "thing" in words! This again underlines the subjectivity, messiness and interpretation involved in knowledge brokering as storytelling – here defined as the art of conveying truths through compelling narratives that resonate with the audience and help to reveal deeper messages or insights than a surface reading.

## Boundaries and knowledge brokering

In this study, I found two different significant discourses around boundaries in the process of making art as knowledge brokering: knowledge brokering as boundary-eliciting and knowledge brokering as boundary-blurring, both significant in the exploration of truth-telling.

**Boundary-eliciting work**

Creativity can be a powerful compass. Creative processes, particularly those rooted in art-based research, often play a crucial role in identifying boundaries. This is because artistic practice emphasises exploration and discovery, operating beyond the constraints of convention, acceptability or norms. Boundaries themselves are often intangible, difficult to define, or subject to change; it is frequently through acts of transgression that their presence becomes apparent. In this study, as part of my work as a knowledge broker and in seeking to understand the limits of this work I ventured beyond the familiar, engaging in practices that risked being ineffective, inappropriate, or counterproductive – in other words mapping the terrain of informing, misinforming and disinforming in brokering mathematics education research. Boundary-crossing work here was boundary-eliciting work, prompting important considerations about how such actions in knowledge brokering can be pursued thoughtfully and responsibly to avoid causing harm.

In writing the nursery rhyme *Five Little Slugs*, we were intentional about finding the boundary of what might constitute knowledge brokering with research – engaging purposefully with the absurd, the childlike, the whimsical, and the seemingly silly in an attempt to illuminate the contours of what knowledge brokering might be (and might not be). We noted that "we are using art to explore and find limitations", choosing which art forms to create with the intention of seeing what was possible and straddling the boundary of what could be successful knowledge brokering. The obvious issue with this boundary-eliciting is the lack of clear criteria as to what constituted "success" in knowledge brokering activity; and conversely, what might cross and therefore elicit a boundary which separates informing from misinforming (or indeed disinforming).

In the study, it was clear that knowledge brokers question assumptions, especially those around what constitutes valid knowledge, and what lies beyond accepted norms – we asked 'what constitutes success here' more than once. The biggest question that emerged from the boundary-eliciting theme was simply: "is this knowledge brokering, or not?", referring back to the problem of "evidence-based everything" that was described in the literature review. In particular I reflected in my reflexive diary on the question that by virtue of being a researcher, and starting with the research, was all the activity I worked on/collaborated on during the study automatically "knowledge brokering"?

I explicitly investigated this question when making the pieces *Synthesis* and *A Bunch of research papers*; rather than selecting, curating and narrative-constructing, I deliberately used randomness and chaos to create artworks from words and phrases in research papers that did

**not** draw on my knowledge brokering expertise. Despite the fact that the papers were all carefully chosen to constitute a single area/field of mathematics education research, I felt strongly that the actual processes involved – while excellent metaphors for knowledge brokering, especially sifting, scooping, interweaving and folding – did not themselves constitute knowledge brokering. I wrote "in many ways this is the opposite of a research summary". The resulting artwork does not have a narrative; it does not draw on the storytelling expertise of the broker.

Another interesting example of boundary-eliciting work was surfaced through the creation of the poem *Mathematical Creativity,* in which I used only selected words from the research paper in question to express something somewhat different from the original. In the paper, Kattou et al. (2013) define mathematical creativity as a domain-specific characteristic that allows students to exhibit fluency, flexibility, and originality in mathematics. They consider mathematical ability as a multidimensional construct, including quantitative, causal, spatial, qualitative, and inductive/deductive abilities, and tested students to find a correlation between mathematical creativity and mathematical "ability", exploring ideas such as "maximum creativity". In the poem *Mathematical Creativity* I do not so much communicate these ideas as critique them. For example, the opening line "The question has only one right answer" expresses my frustration and criticism that such a rich and interesting topic has been reduced to instrumental constructs; similarly, the line "develop before puberty a mathematical mind" explicitly addresses the "genius myth" in mathematics, whereby people mistakenly believe that you are either "born with" mathematical "ability" or you are not. This example can also be considered a non-example of knowledge brokering: it does not represent the ideas in the original research with fidelity, despite using only the words used therein. It is, instead, a critique and response to the paper. While knowledge brokering activity can and should critique, in this case the boundary between *the research findings* and *my critical weighing of them in context* has been blurred to an extent where much more explanation and exploration would be needed to separate them usefully for a practitioner or policymaker. That is; it is not that the poem is not useful, but that it *alone* does not constitute knowledge brokering.

In this way, through the technique of creating examples and non-examples, I elicited boundaries regarding what does and does not constitute knowledge brokering for me. I return to this idea in the section on implications.

**Boundary-blurring work**

In the context of boundaries, the analysis of the data gathered during this study uncovered another cluster of themes centred on the idea of boundary-blurring. This involved challenging

existing boundaries by experimenting with innovative ideas, forms, and methods; questioning dichotomies and exposing misleading binaries; and critically examining assumptions to test the limits of traditional thinking and established conventions surrounding research use. Boundaries were specifically mentioned in terms of being "pushed" in "all directions", and the selection of artistic forms and formats was closely tied to this process of exploring and blurring boundaries, where both aspects may have played a role.

For example, when writing *Five Little Slugs* we discussed the excitement of trying to incorporate algebraic structure in some way as part of the central theme of equivalence. When thinking of ways to represent a variable in song (without using the rather more traditional 'X') I said excitedly "you can make any noise you wish – the stupider the better (blows raspberry)" and mentioned that this would be hard to notate, but that this challenge was one I saw as exciting and interesting. However, as part of the process by which the song was written into musical notation this boundary re-emerged, resisting our efforts to blur it; the composer was unsure and therefore in some way "opted out" of notating this idea by writing on the score "[blank] little slugs and [blank] big frogs".

The boundary of what constitutes "acceptable" and "normal" ways to communicate ideas from research was the most clearly visible target, with many references to making new rules, norms, and experimentation: for example, "writing music with and about research is a brand-new field". I felt the tangible effect of boundary blurring as I created the artwork *A Bunch of Research Papers;* through the process of folding the research papers into organic, flower-like forms, I watched as ideas literally "came together" in new ways, suggesting that using art-based methods to explore knowledge brokering processes was helpful in considering the idea of transformation in particular. Here, ideas had been smoothed, cut, concertinaed and shaped together and then collated into a bundle of forms we might traditionally associate not with beautiful concepts and the academy but with beautiful objects and the domestic. This accorded with other ideas that emerged as part of boundary-blurring work: making research fun and enjoyable by incongruously associating it with unusual forms and modes that might more usually be seen as *entertainment* or *art*.

Other boundary-blurring work happened too, which might be called "queering": we also troubled many dichotomies, such as highbrow/lowbrow and trivial/significant. By this we meant the contrasts and comparisons between the knowledge that we were working with, which was seen as academic scholarly, dense, and serious, and the musical styles we were using to compose which, in the case of the nursery rhyme, was in stark contrast to the idea of research itself, being childlike, simple, and at times explicitly silly. This discourse brought up many ideas

of hierarchy, in which mathematics and music was seen to be similar; for example ideas about mathematics being difficult, serious, and discipline with a hierarchical structure in which you "attained" the highest levels. Another parallel was in the idea of recreation and fun as a false dichotomy to professionalism, expertise, and seriousness. We found and troubled many such false dichotomies, some of which are shown with examples in Table 4.6.

*Table 4.6 some false dichotomies that were surfaced during data analysis*

| **False dichotomy** | **Example of dialogue** |
|---|---|
| *Highbrow/lowbrow (in both mathematics and music)* | 'Is it too melodramatic?' 'what kinds of genre of music would be most congruous and incongruous with research?' 'this is quite churchy…that seems a bit transgressive' |
| *Trivial/significant* | 'it's a stupid problem for a nursery rhyme'; 'it's important!'; 'getting people to care about abstract concepts' |
| *Maths is good/maths is bad* | 'they don't see maths– rather the lesson – as monstrous and something to be overcome' 'sometimes I hate maths..sometimes I want to rip its head off and flush it down the toilet'; 'people seem ok to say they are 'bad at maths' |
| *Faithful to the research/interpretative of the research* | 'This is not a 'product' that communicated straightforwardly the research – it is influenced by, inspired by, adapted; if we end up quite far from the original research, then so be it'<br>'the aim was to write a piece of music that felt how that research felt' |
| *The story/the maths* | 'There is a tension and balance between storytelling and maths' |

The importance of seeing (art-based) knowledge brokering processes as storytelling, and both eliciting and blurring boundaries is suggested. In particular, the ways in which these themes interact with ideas of truth, informing, misinforming and disinforming has consequences for the way that knowledge brokering is considered, both in theory and in practice. In the next section, I draw out these implications in more detail.

## Implications

In my literature review, I concluded that:

- knowledge brokering is a new, contested field focused on the intentional, relational, and creative access, transformation and negotiation between those who make and those who use research
- Knowledge brokers must address challenges such as gaps in understanding, priorities, and processes of different communities; inaccessible language, and limited access to research, while grappling with tensions around evaluating effectiveness, defining "good" practice, and navigating complex notions of evidence validity in context
- The concept of "evidence-based" in education has been co-opted to the point where it may no longer be meaningful

- Knowledge brokering is truth-seeking: it involves investigating, describing, and explaining knowledge while navigating complex systems of evidence, value, and political ideology in which that knowledge may be situated
- This activity of truth-telling in knowledge brokering is challenging and under-theorised, including the potential to stray into mis- and dis-information
- Knowledge brokering activity contains unavoidable political entanglements and ethical dilemmas, as knowledge brokers attempt to navigate and connect knowledge systems, manage biases, and address pressures to misrepresent research to make it relevant or usable

I then collected and analysed data using art-based methods to explore the processes of knowledge brokering in the context of mathematics education. Below, I consider the implications of my analysis for knowledge brokering both within education and beyond.

## Storytelling in knowledge brokering

Earlier, I underlined the importance of storytelling in knowledge brokering - the art of conveying truths through compelling narratives that resonate with the audience and help to reveal deeper messages or insights than a surface reading. In particular, what was revealed through the art-based methods of this study was the tension between creating these narratives and straying into misinforming (or even disinforming) the audience. This area is suggested as a fruitful one for future research on knowledge brokering, both in education and other fields, especially where there is a significant amount of interpretation in the original research as well as the knowledge brokering work.

It has been said that Harry Truman often yearned for a “one-handed economist” because he tired of them presenting balanced arguments ‘on the one hand…and on the other’ without a clear recommendation for action (Smith, 2003). The same could be said of knowledge brokers: there is a distinction between the ability to carefully weigh and analyse evidence from all perspectives, and the skill of interpreting such evidence into a compelling and useful narrative that supports (but does not force) conclusions and implications. Knowledge brokers thus are continually asked to operate not only on the margins of communities and value systems, but on the margin between informing and misinforming; they must construct compelling narratives without losing truth.

## Boundary-eliciting work

In this study, it was particularly useful to employ art-based methods in creating examples and non-examples to elicit boundaries, in this case regarding what may and may not constitute (truthful, effective, purposeful and useful) knowledge brokering.

Knowledge brokers (and indeed researchers) should engage in creative processes to explore and identify the boundaries of their work. This involves venturing beyond conventional practices and embracing art-based methods to understand the limits of informing, misinforming, and disinforming in knowledge brokering. Such boundary-crossing work can help in defining what constitutes "successful" and/or "good" knowledge brokering and in avoiding potential harm. Knowledge brokers should also critically question assumptions about what constitutes valid knowledge and success in their activities, both at the beginning of the work and throughout, as their knowledges develop. This includes reflecting on whether all activities related to research automatically qualify as knowledge brokering, and if so, what boundaries can be drawn that relate to both their professional practice/priorities and their personal ethical standards.

While knowledge brokering activities can and should involve critique, it is important to maintain a balance between representing research findings with fidelity and providing critical judgement of them, and consider the boundaries of when judgement is based on deep embedding in communities as well as knowledge of research itself - and when it is more reactive or opinion-based. The section below on boundary blurring also addresses this by considering the spectrum of knowledge brokering work and how boundaries might be usefully perceived.

## Boundary-blurring work

In this study I explored the concept of boundary-blurring in knowledge brokering, which involves finding an/or challenging existing boundaries by experimenting, questioning dichotomies, and critically examining assumptions to test the limits of traditional thinking and established conventions. This process was evident in various parts of the data, such as incorporating algebraic structures into songs and creating artwork from research papers, where boundaries were explicitly discussed, rejected and blurred. Additionally, this study highlights the usefulness of art-based methods in the pursuit of understandings about informing, misinforming and disinforming in the processes of knowledge brokering – a way of both acknowledging blurred boundaries (most dichotomies are false) and encouraging brokers to draw their own (what might constitute poor practice for me as a broker and why?). This study makes clear that knowledge brokering as currently constituted is messy and complex, and further work on which boundaries are unhelpful and which might add clarity to this work is urgently called for. In the section below

I explore this in more detail with respect to the concepts of informing, misinforming and disinforming.

## Knowledge brokering and informing, misinforming and disinforming

In Table 4.7 I consider the aspects of knowledge brokering that were found in the motivating literature and use ideas surfaced in the study to theorise the way that these aspects might present as informing, misinforming and disinforming.

*Table 4.7 some possible ways to understand the activity of knowledge brokers through the boundaries created by informing, misinforming and disinforming*

| **Aspect of knowledge brokering (from Table 4.1)** | **Informing** | **Misinforming** | **Disinforming** |
|---|---|---|---|
| Knowledge brokers **mediate** between research producers and research users, facilitating relationships, connections and sharing information | Mediation contains minimal amount of interpretation; brokers connect people with other people and/or information and minimise themselves, focusing on the truth and the needs of the user | Mediation contains too much interpretation; brokers connect people with other people and/or information in ways that extends or overextrapolates the truth | Mediation is all interpretation; brokers connect people with other people and/or information without regard for truth and/or the needs of the user |
| Knowledge brokers **embed** themselves into practice, or connect more deeply with decision-makers, supporting them to contextualise and question findings as well as 'use' them | Embedding involves learning and understanding contexts for use, including possible models and mechanisms, and limitations | Embedding involves minimising or ignoring contexts for use, including failing to pay attention to possible models and mechanisms, and limitations | Embedding is not seen as a goal; contexts for use, including possible models and mechanisms, and limitations, are not referred to or considered important, and recommendations are too general/vague |
| Knowledge brokers **translate,** define and use analogy and metaphor to explain concepts from research more clearly | Translation involves thoughtfully moving research ideas into contexts or focus without losing the original intent or losing fidelity; ideas are not moved too far, and limitations discussed | Translation involves moving research ideas into contexts or spaces which loses the original intent or loses fidelity; ideas are moved too far, or the meaning is changed too much, and limitations not addressed | Translation involves a lack of regard for or understanding of original ideas, such that they are misrepresented |
| Knowledge brokers **transform** research ideas into differently structured or focused forms and formats, interpreting for decision-making and crafting narratives | Transforming involves restructuring, focusing or retelling ideas in forms that make them clearer or more compelling without losing fidelity; the transformation is of the telling, not the truth | Transforming involves restructuring, focusing or retelling ideas in forms that make them more difficult to understand or involve them in narratives that transform the truth, not the way of telling it | Transforming involves little or no engagement with the original ideas or their contexts; transformation makes knowledge unrecognisable or unrelatable and loses any meaning |

Knowledge brokers are particularly likely to perform the activity of disinforming or *bullshitting*, especially if (and this is currently suggested to be the case by the lack of reported supports and guidelines for brokers) their position does not disincentivise them from doing so. Frankfurt (1986) defines bullshitting as the act of communicating without regard for the truth, unlike lying which involves knowing and rejecting the truth. This concept is further supported by Petrocelli et

al. (2024), who describe bullshitting as sharing information with little to no regard for truth or evidence, often using rhetorical strategies to appear knowledgeable or persuasive, and accords with Li's (2020) definition of "disinformation". Knowledge brokers, therefore, must be vigilant to avoid bullshitting, as it can undermine the integrity of their work (and the field as a whole), lead to the dissemination of false or misleading information, and result in no way to trace or evaluate the veracity of this information. They must develop methods of tracking the truth and evaluating their own practices of informing with reference to straying into misinforming and disinforming. The expectation for knowledge brokers to have extensive competencies as well as multiple embedded identities can create situations where they might resort to bullshitting due to a lack of knowledge or resources, highlighting the need for continuous learning and support in their roles and the need for realistic expectations about what knowledges knowledge brokers are expected to have and what they are able to do with them.

## References

Allen, P. B. (2013). Art as enquiry: Towards a research method that holds soul truth. In S. McNiff (Ed.), *Art as research: Opportunities and challenges* (1. publ, pp. 11–18). Intellect.

Allo, P. (2018). *Mathematical Values in Data Science: Three Conjectures to Explain Mathwashing*. Data, Security, Values: Vocations and Visions of Data Analysis. https://www.researchgate.net/publication/330244580_Mathematical_Values_in_Data_Science_Three_Conjectures_to_Explain_Mathwashing

Bannister, J., & Hardill, I. (2017). Knowledge mobilisation and the social sciences: Dancng with new partners in an age of austerity. In *Knowledge Mobilisation and the Social Sciences* (p. 206). Academy Social Sciences.

Barone, T., & Eisner, E. W. (2011). *Arts Based Research*. SAGE Publications.

Boaz, A., & Gough, D. (2012). *Complexity and clarity in evidence use*. https://doi.org/10.1332/174426412X620092

Boswell, C. (2020). What is politics? *The British Academy*. https://www.thebritishacademy.ac.uk/blog/what-is-politics/

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide to understanding and doing* (1st ed.). SAGE Publications.

Chew, S., Armstrong, N., & Martin, G. P. (2022). Understanding knowledge brokerage and its transformative potential: A Bourdieusian perspective. *Evidence & Policy*, *18*(1), 25–42. https://doi.org/10.1332/174426421X16149632470114

Collins, M. (2004). Critical approaches to research in practice. In J. Swann & J. Pratt (Eds.), *Educational research in practice: Making sense of methodology* (pp. 67–83). Continuum.

Cooper, A. (2014). Knowledge mobilisation in education across Canada: A cross-case analysis of 44 research brokering organisations. *Evidence & Policy: A Journal of Research, Debate and Practice*, *10*(1), 29–59. https://doi.org/10.1332/174426413X662806

Cooper, A., Rodway, J., MacGregor, S., Shewchuk, S., & Searle, M. (2020). Knowledge brokering: "not a place for novices or new conscripts." In J. L. Malin & C. Brown (Eds.), *The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice* (pp. 90–107). Routledge.

Coryn, C. L. S. (2007). *The Fundamental Characteristics of Research*. *5*.

Cvitanovic, C., Cunningham, R., Dowd, A.-M., Howden, S. m., & van Putten, E. i. (2017). Using Social Network Analysis to Monitor and Assess the Effectiveness of Knowledge Brokers at Connecting Scientists and Decision-Makers: An Australian case study. *Environmental Policy and Governance*, *27*(3), 256–269. https://doi.org/10.1002/eet.1752

Davies, H. T. O., & Powell, A. E. (2012). *Communicating social research findings more effectively: What can we learn from other fields?* https://doi.org/10.1332/174426412X640090

Dawson, J. (2023). Who Controls the Code, Controls the System: Algorithmically Amplified Bullshit, Social Inequality, and the Ubiquitous Surveillance of Everyday Life. *Sociological Forum*, *38*, 1082–1105. https://doi.org/10.1111/socf.12907

D'Ignazio, C., & Klein, L. F. (2020). *Data feminism*. The MIT Press.

Duncan, R., Robson-Williams, M., & Edwards, S. (2020). A close examination of the role and needed expertise of brokers in bridging and building science policy boundaries in environmental decision making. *Palgrave Communications*, *6*(1), 1–12. https://doi.org/10.1057/s41599-020-0448-x

Edmondson, A. (2011). Strategies for learning from failure. *Harvard Business Review*, *89*(4), 48–55.

Elsen, A. (1968). THE SCULPTURE OF MATISSE, PART I. *Artforum*. https://www.artforum.com/features/the-sculpture-of-matisse-part-i-211035/

Farley-Ripple, E., & Grajeda, S. (2020). Avenues of influence: An exploration of school-based practitioners as knowledge-brokers amd mobilizers. In J. Malin & C. Brown (Eds.), *The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice* (p. 193). Routledge.

Farley-Ripple, E., May, H., Karpyn, A., Tilley, K., & McDonough, K. (2018). Rethinking Connections Between Research and Practice in Education: A Conceptual Framework: *Educational Researcher*, *47*, 235–245. https://doi.org/10.3102/0013189X18761042

Ferrero, D. J. (2005). Does 'Research Based' Mean 'Value Neutral'? *Phi Delta Kappan*, *86*(6), 424–432. https://doi.org/10.1177/003172170508600604

Flynn, J. (2024). THAT'S NOT TRUE: Thoughts, Novel or Not, On Truth, Context, & Defamation. *JD Supra*. https://www.jdsupra.com/legalnews/that-s-not-true-thoughts-novel-or-not-5275422/

Frankfurt, H. G. (1986). *On Bullshit*. Princeton University Press. https://doi.org/10.1515/9781400826537

Friberg, C. (2010). Moving Into The Field of The Unknown: A Reflection on The Difference Between Theory and Practice. In *At the intersection between art and research: Practice-based research in the performing arts* (pp. 19–38). NSU Press.

Fuentes, A. (2024). Scientists as political advocates. *Science*. https://www.science.org/doi/10.1126/science.adt7194

Haraway, D. J. (2016). *Staying with the trouble: Making kin in the Chthulucene*. Duke University Press.

Harris, T. R. (2024). The Wrong of Bullshit. *Social Epistemology*. https://www.tandfonline.com/doi/abs/10.1080/02691728.2023.2267501

Hering, J. G. (2016). Do we need "more research" or better implementation through knowledge brokering? *Sustainability Science*, *11*(2), 363–369. https://doi.org/10.1007/s11625-015-0314-8

Herrmann, U. (2022). Changing truths: Deconstructing and reconstructing the elusive in art therapy. In *Imagining Windmills: Trust, Truth, and the Unknown in the Arts Therapies, 2022, ISBN 9780367626730, págs. 29-53* (pp. 29–53). Routledge/Taylor & Francis Group. https://dialnet.unirioja.es/servlet/articulo?codigo=9125665

Hill Collins, P. (2009). *Black Feminist Thought: Knowledge, Consciousness, and the Politics of*. https://www.routledge.com/Black-Feminist-Thought-Knowledge-Consciousness-and-the-Politics-of-Empowerment/Collins/p/book/9780415964722

Hill, G. (2018). *Cabaret for research and as research dissemination*. [Monograph]. HEA. https://www.open-access.bcu.ac.uk/5686/

Ion, G., & Iucu, R. (2014). Professionals' perceptions about the use of research in educational practice. *European Journal of Higher Education*, *4*(4), 334–347. https://doi.org/10.1080/21568235.2014.899154

Jackson, N. (2003). Introduction to Brokering in Higher Education. In *Engaging and Changing Higher Education through Brokerage*. Routledge.

Joyce, K. E., & Cartwright, N. (2020). Bridging the Gap Between Research and Practice: Predicting What Will Work Locally. *American Educational Research Journal*, *57*(3), 1045–1082. https://doi.org/10.3102/0002831219866687

Judkins, R. (2024). *Lie Like An Artist*. BIS Publishers.

Kara, H. (2015). *Creative research methods in the social sciences: A practical guide*. Policy press.

Kara, H. (2018). *Research ethics in the real world: Euro-Western and indigenous perspectives*. Policy Press.

Karaulova, M., & Edler, J. (2024). *Bringing research into policy: Understanding context-specific requirements for productive knowledge brokering in legislatures*. https://doi.org/10.1332/17442648Y2024D000000027

Kattou, M., Kontoyianni, K., Pitta-Pantazi, D., & Christou, C. (2013). Connecting mathematical creativity to mathematical ability. *ZDM*, *45*(2), 167–181. https://doi.org/10.1007/s11858-012-0467-1

Kester, G. H. (2011). *The One and the Many: Contemporary Collaborative Art in a Global Context*. Duke University Press. https://doi.org/10.2307/j.ctv11smfch

Koppman, S. (2014). Making art work: Creative assessment as boundary work. *Poetics*, *46*, 1–21. https://doi.org/10.1016/j.poetic.2014.09.001

Li, J. (2020). Toward a Research Agenda on Political Misinformation and Corrective Information. *Political Communication*, *37*(1), 125–135. https://doi.org/10.1080/10584609.2020.1716499

Lubienski, C. (2020). Conclusion: The future of research use? In J. Malin & C. Brown (Eds.), *The role of knowledge brokers in education: Connecting the dots between research and practice* (pp. 182–188). Routledge.

MacGregor, S. (2024). Theorising a spectrum of reasons for failure in knowledge brokering: A developmental evaluation. *Evidence & Policy*, *20*(1), 51–69. https://doi.org/10.1332/17442648Y2023D000000004

MacKillop, E., Connell, A., Downe, J., & Durrant, H. (2023). Making sense of knowledge-brokering organisations: Boundary organisations or policy entrepreneurs? *Science and Public Policy*, *50*(6), 950–960. https://doi.org/10.1093/scipol/scad029

MacKillop, E., & Downe, J. (2022). Knowledge brokering organisations: A new way of governing evidence. *Evidence & Policy*, *1*(aop), 1–20. https://doi.org/10.1332/174426421X16445093010411

MacKillop, E., Quarmby, S., & Downe, J. (2020). Does knowledge brokering facilitate evidence-based policy? A review of existing knowledge and an agenda for future research. *Policy & Politics*, *48*(2), 335–353. https://doi.org/10.1332/030557319X15740848311069

Malin, J., & Brown, C. (Eds.). (2020). *The role of knowledge brokers in education: Connecting the dots between research and practice*. Routledge.

Mitchell, G. J., & Cody, W. K. (2002). Ambiguous Opportunity: Toiling for Truth of Nursing Art and Science. *Nursing Science Quarterly*, *15*(1), 71–79. https://doi.org/10.1177/08943180222108660

Monaghan, M., Pawson, R., & Wicker, K. (2012). *The precautionary principle and evidence-based policy*. https://doi.org/10.1332/174426412X640072

Morris, R., Perry, T., & Asquith, S. (2020). The opportunities and challenges of leaders using evidence in education. In *Getting Evidence into Education*. Routledge.

Oakley, A. (2002). Social Science and Evidence-based Everything: The case of education. *Educational Review*, *54*(3), 277–286. https://doi.org/10.1080/0013191022000016329

Parkhurst, J. O. (2012). *Framing, ideology and evidence: Uganda's HIV success and the development of PEPFAR's 'ABC' policy for HIV prevention*. https://doi.org/10.1332/174426412X620119

Pennycook, G., Cheyne, J. A., Barr, N., Koehler, D. J., & Fugelsang, J. A. (2015). On the reception and detection of pseudo-profound bullshit. *Judgment and Decision Making*, *10*(6), 549–563. https://doi.org/10.1017/S1930297500006999

Perry, T., & Morris, R. (2023). *A critical guide to evidence-informed education* (First edition). Open University Press, McGraw Hill.

Petrocelli, J. V., Curran, J. M., & Stall, L. M. (2024). Bullshit can be harmful to your health: Bullibility as a precursor to poor decision--making. *Current Opinion in Psychology*, *55*, 101769. https://doi.org/10.1016/j.copsyc.2023.101769

Picasso, P. (1923). "Picasso Speaks,." *The Arts*, 315–326.

Pinter, H. (2006). Art, Truth & Politics. *PMLA*, *121*(3), 811–818. https://doi.org/10.1632/003081206X142904

Rodway, J. (2015). Connecting the dots: Understanding the flow of research knowledge within a research brokering network. *education policy analysis archives*, *23*(0), 123. https://doi.org/10.14507/epaa.v23.2180

Roush, S. (2005). *Tracking Truth: Knowledge, Evidence, and Science*. Clarendon Press.

Rycroft-Smith, L. (2022). Knowledge brokering to bridge the research-practice gap in education: Where are we now? *Review of Education*, *10*(1), e3341. https://doi.org/10.1002/rev3.3341

Rycroft-Smith, L., & Macey, D. (2021). Deep questions of evidence and agency: How might we find ways to resolve tensions between teacher agency and the use of research evidence in mathematics education professional development? *Proceedings of the British Society for Research into Learning Mathematics*, *41*. https://bsrlm.org.uk/wp-content/uploads/2021/08/BSRLM-CP-41-2-18.pdf

Rycroft-Smith, L., Müller, D., Chiodo, M., & Macey, D. (2024). A Useful Ethics Framework for Mathematics Teachers. In P. Ernest (Ed.), *Ethics and Mathematics Education: The Good, the Bad and the Ugly* (pp. 359–394). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-58683-5_18

Rycroft-Smith, L., & Stylianides, A. J. (2022). What makes a good educational research summary? A comparative judgement study of mathematics teachers' and mathematics

education researchers' views. *Review of Education*, *10*(1), e3338. https://doi.org/10.1002/rev3.3338

See, B. H., Gorard, S., & Siddiqui, N. (2016). Teachers' use of research evidence in practice: A pilot study of feedback to enhance learning. *Educational Research.*, *58*(1), 56–72.

Sharples, J., & Sheard, M. (2015). Developing an evidence-informed support service for schools – reflections on a UK model. *Evidence & Policy: A Journal of Research, Debate and Practice*, *11*(4), 577–587. https://doi.org/10.1332/174426415X14222958889404

Smith, D. (2003). *Free lunch: Easily digestible economics, served on a plate*. Profile Books.

Smith, K. E., & Joyce, K. E. (2012). *Capturing complex realities: Understanding efforts to achieve evidence-based policy and practice in public health*. https://doi.org/10.1332/174426412X6201371

Snyder, T. (2017). *On tyranny: Twenty lessons from the twentieth century*. The Bodley Head.

Springborg, C. (2012). Perceptual Refinement: Art-based Methods in Managerial Education. *Organizational Aesthetics*, *1*(1), 1.

Sullivan, H. (2011). *'Truth' junkies: Using evaluation in UK public policy*. https://doi.org/10.1332/030557311X574216

Swann, J., & Pratt, J. (Eds.). (2004). *Educational research in practice: Making sense of methodology*. Continuum.

Thorp, H. H. (2020). Science has always been political. *Science*, *369*(6501), 227–227. https://doi.org/10.1126/science.abd7628

Vann, K., & Bowker, G. C. (2001). Instrumentalizing the truth of practice. *Social Epistemology*, *15*(3), 247–262. https://doi.org/10.1080/02691720110076567

Wang, Q., Coemans, S., Siegesmund, R., & Hannes, K. (2017). Arts-based Methods in Socially Engaged Research Practice: A Classification Framework. *Art/Research International: A Transdisciplinary Journal*, *2*(2), 2. https://doi.org/10.18432/R26G8P

# 5. PAPER 4 - 'IT'S NICE TO JUST HAVE REASSURANCE THAT I'M NOT CRAZY AND THAT THERE ISN'T AN EASY ANSWER': KNOWLEDGE BROKERING IN MATHEMATICS EDUCATION THROUGH A *RESEARCH CLINIC* MODEL

## Visual abstract

*Figure 5.1 Visual abstract for Paper 4 of this thesis*


## Abstract

This study used a mixed-methods design including reflexive critical thematic analysis to consider what happens in a *research clinic* – that is, an open online clinic set up for participants to book and attend in which they discuss issues of their choice with a knowledge broker with mathematics education specialism. The main themes that emerged were: making decisions using research; making use of professional knowledges of participants; relationship-building; critique of research ideas, organisations or people; exploring research methodologies and what

they mean; conflict and tensions in the use of research in education; and finally systems thinking, identity shifting, and boundary blurring. Teachers in the study tended to want to discuss deep questions: of conflict between research and practice, and about the mathematical subject matter content. Professional development facilitators in the study tended to ask for support making their work more evidence-based. Responses to these issues by the knowledge broker-researcher frequently included asking questions; stating a principle or making an analysis; making recommendations for next steps; wearing identities; stating the limitations of my own knowledge; outlining assumptions; and using metaphors or analogies. The findings were placed in the context of four conceptualisations of knowledge brokering: knowledge implementation, capacity enhancement, collaborative entanglement, and systemic action research, and implications for the field of knowledge brokering (in education, and more widely) are explored.

# Introduction

The study is grounded in mathematics education as a context, as I am a knowledge broker with particular expertise in mathematics education research and practice. Since this study draws on a novel method of knowledge brokering (the *research clinic*), with elements transported from healthcare, the literature used to inform the study draws on knowledge brokering not only in education but also ideas, models and data from healthcare and other fields.

# Background

## Knowledge brokering in education

Knowledge brokering, although not yet well-defined, is work that seeks to connect research and practice or policy in useful ways. Rycroft-Smith (2022) found that knowledge brokering in education seeks to address several issues:

- Users and producers of research inhabit different worlds, with different perspectives and priorities, and knowledge brokering seeks to **bring these worlds together** in some way
- Research is produced which in theory could be useful, relevant and applicable to policy and practice, but those who could make decisions using this research do not know about it; knowledge brokering seeks to **communicate** these research findings effectively

- Accessing, selecting, reading, summarising and actioning research is difficult and time-consuming; knowledge brokering seeks to **do this labour** (in some cases with the explicit goal of also not reducing the agency of research users)
- Ideas in research may be hard to understand, written in inaccessible language, or conceived too far from practice; knowledge brokering seeks to **interpret** research into implications that are actionable in context
- Political, ideological, commercial or adversarial interests may become involved in research utilisation; knowledge brokering seeks to **illuminate** these and support users to use research ethically and for good
- Oversimplified conceptions of "research-into-use" may confer undue power and status, and skew relationships; knowledge brokering seeks to **build equitable relationships** as part of an ecosystem, not a pipeline, which supports improvements not only in the way research is used but equally how it is conceived, funded, produced, and evaluated.

Ward et al. (2009, p. 2) suggests that knowledge brokers, "positioned at the interface between the worlds of researchers and decision makers", are best placed to support the use of evidence to make decisions in a timely, thoughtful and useful manner. They suggest three main functions of knowledge brokers: as knowledge managers (facilitating the creation, diffusion and use of knowledge), linkage agents (fostering links between creators and users of knowledge), and/or as capacity builders (training knowledge users). Kislov et al. (2017) similarly see brokers as fulfilling a complex, diverse and contextual role: there to "bridge a gap in social structure and help knowledge flow across that gap by enabling translation, coordination and alignment between different perspectives and facilitating transaction between previously separated practices". They take Ward et al.'s work further, suggesting that different elements of these three activities are often used together in practice, but that crucially there can be tensions between them – in particular knowledge brokers may feel incentivised to find and translate information for users, instead of linking them with others or building their capacity to do so for themselves. Conklin et al. (2013) suggest that building trust is one of the most important functions of knowledge brokers, because all other knowledge brokering activity relies on it, to which many researchers since have added their agreement (e.g. Lockton et al., 2022). The social and relational role of knowledge brokers is further emphasised by other research (e.g. Malin & Brown, 2020a).

Meyer (2010, p. 122) suggests knowledge brokers should have *double peripherality* - the ability to bridge worlds, transforming into "intentional hybrids" Lam (2018, p. 1716), and thus

inhabiting an overlapping third space where difference is negotiated and ideas are deliberately tested and contested. In this space, tension is the norm and the focus; while some problems may be easily "solved", it is more likely that issues discussed are complex and multi-layered, leading to a need to examine and co-dissect in detail, with references to context, rather than a straightforward "question-and-answer" session. This is what led me to decide to offer a clinic(al) model for this study, which I explore further in the next section.

## Tensions and complexities in educational knowledge brokering

In this study I examine the ways that I approached the "problems" brought to me as part of knowledge brokering activity in mathematics education, acknowledging that defining these "problems" in the first place is contested and complex, and should be part of an equitable co-construction process (Bacchi, 2012).

The socio-political perspective is an important basis for decisions in knowledge brokering (Rycroft-Smith, 2022) as well as mathematics education (de Freitas, 2008; Gutierrez, 2013) , and intersectionally across both, as both research and mathematics are gatekept, co-opted and politicised (Rycroft-Smith & Macey, 2021). In this I agree with Lawler that "As researchers and educators, we are compelled to recognise that power is everywhere, to engage in dialogue that seeks to notice and disrupt, and to admit our own implication in power dynamics." (2017, p. 200).

Adler and Sfard (2018, p. 2) advocate for an exploration of the complexities of disempowerment of identities and constraints of power in the contexts of mathematics education research and practice, shifting the discourse from one of deficit to one of possibility. Sfard (2005, p. 412) refers to the "emancipatory power of research", suggesting that research specifically helps us to question discourses and narratives. Thus knowledge brokers have a responsibility not just to retrieve and report research, but also to engage those they dialogue with in *metaevidential awareness* (Rycroft-Smith & Macey, 2021) - to invite criticism, questioning, and examination of methods; to explore collisions with context; and to undermine the authority of research as a single source of "truth". A knowledge broker who does not engage with these issues and/or make explicit their position on them has the potential to do harm (Rycroft-Smith, 2022).

Malin, Rycroft-Smith and Ward (in press) define knowledge brokering activity in education in terms of teacher agency, arguing that there are two contradictory models at play. The first involves engineering or mandating the use of research evidence by, for instance, building it into curricula, or making it the subject of legislation (e.g. Gorard et al., 2020), categorised as a *low teacher agency approach*: teachers' capacity to act (i.e. to use their own

judgement) is limited in order to increase the likelihood that the implementation of research evidence is faithful and straightforward. This creates issues because teachers are likely to be left in positions of conflict, and lose the expectation or incentive to engage critically with the research themselves. A *high teacher agency approach*, by contrast, is based on the principle that teachers *can* make use of research as part of professional judgement and weighing different knowledges; this approach is suggested as both **dependent on** and **leading to** greater dialogue and collaboration between researchers, policymakers and teachers, which might also encourage more research to be produced that is useful to practitioners.

An important focus on this research was not just to consider *what knowledge brokers do* but also what they *should* do – in other words, to make progress towards a more ethically-informed framework of not just describing but also prescribing brokerage work. The main issues with knowledge brokering and hence my intentions and therefore the types of activity which I expect and hope to use are therefore summarised in Table 5.1.

*Table 5.0.1 a summary of the issues from the literature on knowledge brokering, my intentions in response to them, and the expected activity that may emerge*

| **Issue** | **Intention** | **Knowledge brokering activity type** |
|---|---|---|
| Knowledge brokering can reduce or increase teacher (and other actor) agency (Malin et a.l, in press) | Increasing agency is the preferred approach if capacity building is considered important | **Conferring agency** |
| There exist different types of knowledges, of which research evidence can be privileged by brokers in terms of a hierarchy over other types, affecting access, (de)professionalisation, and power (im)balances (Farley-Ripple & Grajeda, 2020; Rycroft-Smith & Macey, 2021) | It is important to be careful and intentional about highlighting practitioner, embedded and contextual knowledges as important and not displaced by research | **Highlighting and integrating existing knowledges** |
| Defining 'the problem' can be one way in which knowledge brokers impose their views and enact power upon others; constructing what the problem is significant and reflects/enacts power dynamics and structures (Bacchi, 2012) | My perception of the 'problems' may not be useful; it is important that participants define the problems themselves | **Supporting an equitable co-definition of the problem** |
| Research is not infallible; it is contested (Aldridge et al., 2018), sometimes irrelevant and unhelpful (Burkhardt & Schoenfeld, 2003), and can conflict with other types of knowledges (Collins, 2004; G. Thomas & Pring, 2010); | Maintaining orthodoxy does not support meaningful knowledge brokering; critique of research (both generally and specifically) is to be encouraged, as well as critique of accepted or received views and opportunities for 'transgressive' talk | **Inviting critique and transgression** |
| Knowledge brokering can be represented as a linear, unidirectional, uncontested 'problem-solving' activity which | Aiming to uncover and illuminate interesting tensions is valuable in itself, and better than oversimplification or | **Naming tensions** |

| | | |
|---|---|---|
| may obscure the contested nature of research and oversimplify the problems practitioners face (Farley-Ripple et al., 2018; Michaels, 2009) | misrepresenting the capabilities of research | |
| Knowledge brokers cannot have expertise in everything, and they are likely to be asked about concepts and topics to which they have limited (current) knowledges or the research is unclear (Chew et al., 2022) | Admitting lack of knowledge is a transparent way to operate, builds trust, and allows the broker to model ways to interact with research | **Admitting limitations** |
| Supporting users to access, read and critique original sources of knowledges may be in tension with summarising or interpreting knowledges 'for' them (Kislov et al., 2017) | Giving users information about original sources is better in terms of agency, empowerment and development of metaevidential thinking than obfuscating them | **Making recommendations** |
| Suggesting courses of action, solutions and ways to analyse issues derived from research is part of (although not the whole of) knowledge brokering activity; this is interpretative and requires understanding of context as well as multiple identities (J. Malin & Brown, 2020b) | Making research useful can happen in a myriad of different ways, but should involve interpretation and translation grounded in multiple identities on the part of the broker | **Making use of research** |

I return to these issues in the analysis section, where I contrast them with the themes that were actually found through reflexive critical thematic analysis.

## Making space for knowledge brokering

There is a further important focus to this research, which is the *environment* in which knowledge brokering processes – especially those with a social, political and relational focus– take place. There is little currently known about the spaces (conceived in several senses) in which knowledge brokering takes place, and how these spaces might contribute to the success of knowledge brokering functions such as relationship-building and equity. Research on knowledge brokering frequently using language of space, such as "spanning the boundaries between the two realms" (Karcher et al, 2025, p.118), and words such as 'interface' and 'boundary' occur very frequently in the literature. Hargadon (2002, p.41) presents a model of knowledge brokering as a kind of material innovation: recombining knowledges in social contexts, "dissembling and reassembling of extant ideas, artifacts, and people". Lyotard (2005) suggests that in circuits of communication, we occupy nodal points where we re-transmit knowledges with interferences which have capacity to alter power relations, which seems especially important for knowledge brokers. I aim to therefore *create space* for the type of collisions and interplay that Mosher et al. (2014) describe at deeper levels of their framework,

examining in more detail what types of problems, solutions, models and mechanism might emerge when I invite those in education to come to me in as open a way as I can create: an virtually-situated *research clinic* model. As far as I know, this is a new type of methodology (and certainly in educational contexts). At its heart, the model is focused on social understandings, relationships and dialogue – connection-building – the elements that strongly emerged from my literature review as important to knowledge brokering. Holding the research clinics online will also support video capture of the sessions. Video is often a rich source of different types of data but can therefore require and prompt creativity in decisions about what to analyse (Kara, 2015). My analysis will therefore be able to take into account the social and relational aspects of knowledge brokering; as Kara (2015, p.108) suggests: "The analysis of video data allows researchers to examine aspects of social practice that it would be difficult or impossible to study in any other way." I will be using the type of video analysis suggested by Knoblauch (2014) as *videography*: that is, interpretive video analysis of a broadly 'natural' situation, part of more broadly the kind of field research called 'focused ethnography'. "Videography is characterized by the fact that the researchers themselves are recording the video 'in the field' and then using these audiovisual tapes for their analyses." (ibid, p.438). Therefore, the use of video-recorded virtual *research clinics* supports further examination of knowledge brokering processes, and contributes to the field by establishing a suggested method of creating space for knowledge brokering that is equitable and attends to social and relational aspects. I explore this method further in the following section on clinical models.

## Clinical models

The terms "clinic", "clinical" and their application to models are not used consistently within the literature in education or beyond. For example Conroy et al. (2013) describe a clinical model of teacher education based on collaborative inquiry into authentic pedagogical problems, with the key factor for them being that the "expert" goes into the field (here, schools); the schools become "critical sites for sustained professional deliberation and co-inquiry" (Conroy et al., 2013, p. 564). Clinical models have also been used in law, characterised by: complex problem-solving; user advocacy; not being bound to one particular subject; social justice priorities; and being responsive to the needs of the community (Carpenter, 2013). This accords with Mosher et al.'s (2014) view of knowledge brokering which is focused on "empowering people and unleashing possibilities" (2014, p. 7).

The use of the term 'clinical' has been variously used across the literature to mean:

- Connecting research and practice through collaborative inquiry; "a commitment to more effectively sew together scholarly and research insights, practical skills and abilities, and professional dispositions" (Conroy et al., 2013, p. 565)
- Retaining connections to practice while being embedded in research production (Stern, 1990)
- Referencing an integration of learning, practising and researching activity (M. J. Smith, 1990)
- Innovative or cutting edge (Vitale, 2014)
- Almost any activity that is involved in teacher education but particularly that which uses research to inform practice (McKnight & Morgan, 2020)
- Activity focused on the needs, problems and contexts of users (Spencer, 2003)

In this study my use of the term *research clinic* specifically means an open, accessible space where anyone is welcome; discussions are driven by the needs, problems and contexts of the research user; and where research and practice are considered in detail. The "clinical model" I have adopted has at its heart the principles of empowerment, utility and critique, aiming to consider not only what research *can* do to illuminate and solve problems but also where it cannot do, only claims to do, falls short, collides with practice and the practical, and can be misused, mishandled and misapplied by actors both malicious and simply incompetent.

## Conceptual framework

Mosher et al. (2014) provide a coherent and persuasive framework for analysis of knowledge brokering, using four conceptualisations that move beyond simplistic question-framing and instead focus on the types of knowledge relationships, intentions, action and impact that may occur in each. They begin from the statement that research can and should ignite change or action, and that this change or action "may occur at multiple levels and scales, in direct and predictable ways and in indirect and highly unpredictable ways" (Mosher et al., 2014, p. 1). They named their four categories of knowledge movement into action **knowledge implementation; capacity enhancement of collaborators; collaborative entanglement** and **systemic action research**, emphasising that they are not necessarily distinct, mutually exclusive, or exhaustive. In Table 5.2 more detail on the four types is shown.

*Table 5.0.2 four conceptualisations of knowledge mobilisation adapted from Mosher et al. (2014)*

| Conceptualisation of knowledge mobilisation | Defined as | For what type of problem? | When does change occur? | How do we know change has occurred? |
|---|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| knowledge implementation | the straightforward movement into action– of research findings, understood as fixed and transferable | "bounded problems" with relatively clear solutions | at the end of the linear process | asking whether a stakeholder has done new things or done things differently |
| capacity enhancement of collaborators | still fixed and transferable, the potential to enhance the capacity of the research collaborators through the new learning that occurs for research partners; new knowledge of the community; appreciation of the varied perspectives and multiple forms of expertise of community members; enhanced skill in establishing relationships of meaning (i.e. using boundary objects) expanding critical consciousness and increasing empowerment | community-based participatory research projects | throughout and beyond | asking stakeholders about changes to their own agency and understanding of one another's perspectives, as well as changes to practices or services |
| collaborative entanglement | a dynamic process in which the thoughts and behaviours proposed by researchers merge with and are altered by the thoughts and behaviours of others; intentional collision and interplay (as opposed to layering) of expertise and perspectives | anything involving co-creation/collaboration, in particular challenging the notion of separate domains of research and application, or researchers and practitioners | throughout and beyond | Asking stakeholders and others about perspectives, knowledges and knowing; considering long-term effects such as structural or policy change; traces of impact or change may occur whenever and wherever ideas and thoughts are exchanged |
| systemic action research *(This can be understood as 'systemic action' research to differentiate it from 'action research')* | a shift from a focus on problems to systems, where multiple interconnections and relationships are the subject of inquiry; problems may seem intractable, yet under the surface, attitudes may be changing, innovations may be garnering support, and suddenly there is a phase change | complex and seemingly intractable social issues whose roots are multiple and intertwined | change happens throughout and beyond, in an iterative and distributed way | establishing causal links between a particular social impact and a specific research undertaking is exceptionally limited; traditional, linear, cause-and-effect models do not apply; we can only evidence opportunities for, and actual, meaningful contact between those involved in the research collaboration and a host of actors; as traces of impact proliferate, the potential that new ideas may catch hold is enlarged |

The advantage of the Mosher et al. framework is that it allows a zoomed out perspective, which shows that much of the empirical literature on effectiveness of knowledge brokering often focuses on the first, and simplest (yet most limited), conceptualisation of research into use - the linear implementation of knowledge – because it is easy to measure, and because the field is new and therefore long-term or more systemic effects have not yet been considered in depth. For this reason I consider this framework to be the most developed and useful produced in the research to date when analysing knowledge brokering. Throughout this study I refer back to these four categories as particularly useful in structuring work around knowledge brokering.

# Methodology

This study sought to investigate the work of knowledge brokering in educational practice: problems, solutions, mechanisms and themes. The research questions considered were:

- What problems are brought to an educational knowledge brokering clinic?
- In what ways did I respond to these issues as an educational knowledge broker?
- How does educational knowledge brokering work in a research clinic model?

## Remote modality

Remote education has provided the solution to many problems of access and equity, expanding the learning environment for students (Stenman & Pettersson, 2020). Ikebuchi (2023) found that remote education models can be both more and less accessible for students; there is a need for support and flexibility. Remote access itself does not guarantee better accessibility and inclusion; intentional design is required (Fennelly-Atkinson, 2023). In this study, I chose to offer the *research clinic* through a remote modality for four reasons:

- It improved accessibility and inclusion for participants, allowing them to participate without geographical or other physical constraints, the need for travel time, or other logistical concerns such as childcare
- It fulfilled my own accessibility needs as a disabled researcher who practices zero-COVID transmission as an ethical non-negotiable in my research
- It allowed for easy recording and analysis of the clinic sessions
- It created a third space – not owned or inhabited by either the knowledge broker or the participant – which had a grounding in equity and collaboration

## Data collection

In this study I used mixed methods – some quantitative data exploration, but mostly the method of reflexive thematic analysis as defined by Braun and Clark (2021), which involves a disciplined, critical interrogation and analysis of data, focusing on meaning-making and themes within layers. One key underpinning principle of this approach is not to find topic summaries or surface level groupings, but to work with the data recursively in order to explore central organising concepts which help to address the research question/s. The themes should provide the researcher with a summary of the diversity of meanings contained in the data set as well as the researcher's analytic take on them.

The data set consisted of 16 recorded videos and transcripts of *research clinics* of 45 minutes each [except in the case of one clinic in which I had to leave after 18 minutes due to an emergency] which took place over the period of September 2023 to June 2024. I publicised the clinic by advertising it as a free remote *research clinic* through the mathematics subject associations in England, the University of Cambridge Education Faculty newsletter, the Chartered College of Teaching, Twitter, BlueSky, and Facebook.

I used the tool SimplyMeet for bookings. Participants were told that:

> *This is a **research clinic** session and will last 45 minutes. It is focused on knowledge brokering in educational research, meaning you can **ask me anything** from practical, problem-based, or classroom questions to political, policy-based or managerial questions to philosophical, theoretical or conceptual issues and everything in between.*
>
> *For instance, you can bring personal/professional issues and problems relating to:*
>
> *-education research as a field: what it can, and cannot, do, for policy and practice*
>
> *-what particular articles or pieces of research may mean or imply*
>
> *-how to find, access, review, select, or weigh educational research*
>
> *-how you feel/are positioned in relation to education research*
>
> *-how you may currently or may like to use education research in different ways*
>
> *-what the research may/may not suggest about a particular question*
>
> *-tools, practices and tips for working with education research*
>
> *-any other issues relating to education, research, policy and practice*
>
> *You have the right to leave the session at any time, to ask that I do not use all or some of the information in the session for my research, and/or to ask further questions if anything here is not clear to you (the principle of **informed consent).***
>
> *You will:*

- *bring me questions related to educational research*
- *remain professional and courteous*
- *have reasonable expectations of my time and book several sessions if needed*

> *I will:*

- *remain professional and courteous*
- *be clear about the limitations of my knowledge and the limitations of the research as I understand it*
- *take care to answer questions thoughtfully*

Participants were invited to self-identify from the following options when they booked a session:

- A teacher of students mostly aged 0-4
- A teacher of students mostly aged 5-10
- A teacher of students mostly aged 11-15
- A teacher of students mostly aged 16-18
- A teacher of students aged 18+
- A designer (of resources, assessment, textbooks)
- A professional development facilitator or teacher trainer
- A researcher or research professional
- An education professional based in a school but not a teacher
- A knowledge broker
- Not captured here

## Ethics

Critical feminist standpoints rely on the need to "acknowledge..one's biases, power, motivations, and privilege to produce research that serves the interests of those whose lives it examines" (Malacrida, 2007, p. 1330). My theoretical framework thus draws on emancipatory approaches to research use (Habermas, 2015); that is those that are focused on practical meaning and interpretation, and critiquing power and control. In other words: "for scientific purposes, treat people as if they were human beings" (Harré & Secord, in Laycock, 1975, p. 180). In contrast to dehumanising methodologies, I seek approaches rooted in the science of persons, researching rooted in ways that are (to all participants) whole, positive, active, purposive, intentional, and creative (Cohen et al., 2007).

This study was underpinned by the principle of informed consent and participant co-construction of knowledge, as well as equitable visions of knowledges and their power. Participants signed a consent form and were also reminded if their ability to withdraw consent at the beginning of each session. The study was approved by the University of Cambridge ethics process.

# Analysis

The number of sessions booked, attended, and used in the data is shown in Table 5.3.

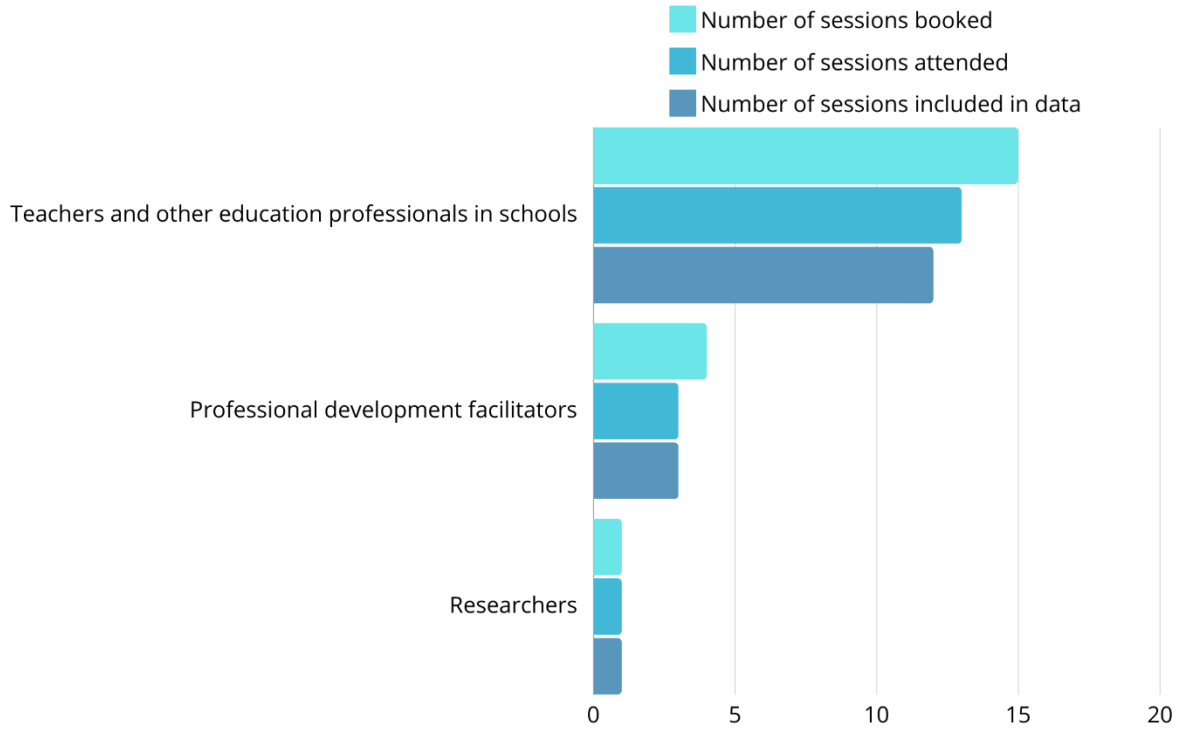
*Table 5.0.3 a summary of the research clinic sessions by participant*

| Participant | Number of sessions booked | Number of sessions attended | Number of sessions used in data analysis |
|---|---|---|---|
| A professional development facilitator or teacher trainer: P1 | 1 | 1 | 1 |
| An education professional based in a school but not a teacher: E1 | 1 | 1 | 1 |
| A researcher or research professional: R1 | 1 | 1 | 1 |
| A teacher of students aged 18+: T1 | 1 | 1 | 1 |

| | | | |
|---|---|---|---|
| A teacher of students mostly aged 11-15: T2 | 9 | 9 | 8 |
| A professional development facilitator or teacher trainer: P2 | 1 | 1 | 1 |
| A teacher of students mostly aged 11-15: T3 | 1 | 1 | 1 |
| A professional development facilitator or teacher trainer: P3 | 1 | 0 | 0 |
| A teacher of students mostly aged 5-10: T4 | 1 | 0 | 0 |
| A teacher of students mostly aged 16-18: T5 | 2 | 1 | 1 |
| A professional development facilitator or teacher trainer: P4 | 1 | 1 | 1 |

As shown in Figure 5.2, teachers/education professionals based in schools were the most frequent visitors to the *research clinic*, followed by professional development facilitators; finally, there was one person who self-identified as a researcher. Most participants attended one session only but one participant booked two and another booked 9 in total. I attend to the ways that this may have affected the data in more detail below.

*Figure 5.2 the number of research clinic sessions booked, attended and recorded by participant type*



## What problems are brought to an educational knowledge brokering clinic?

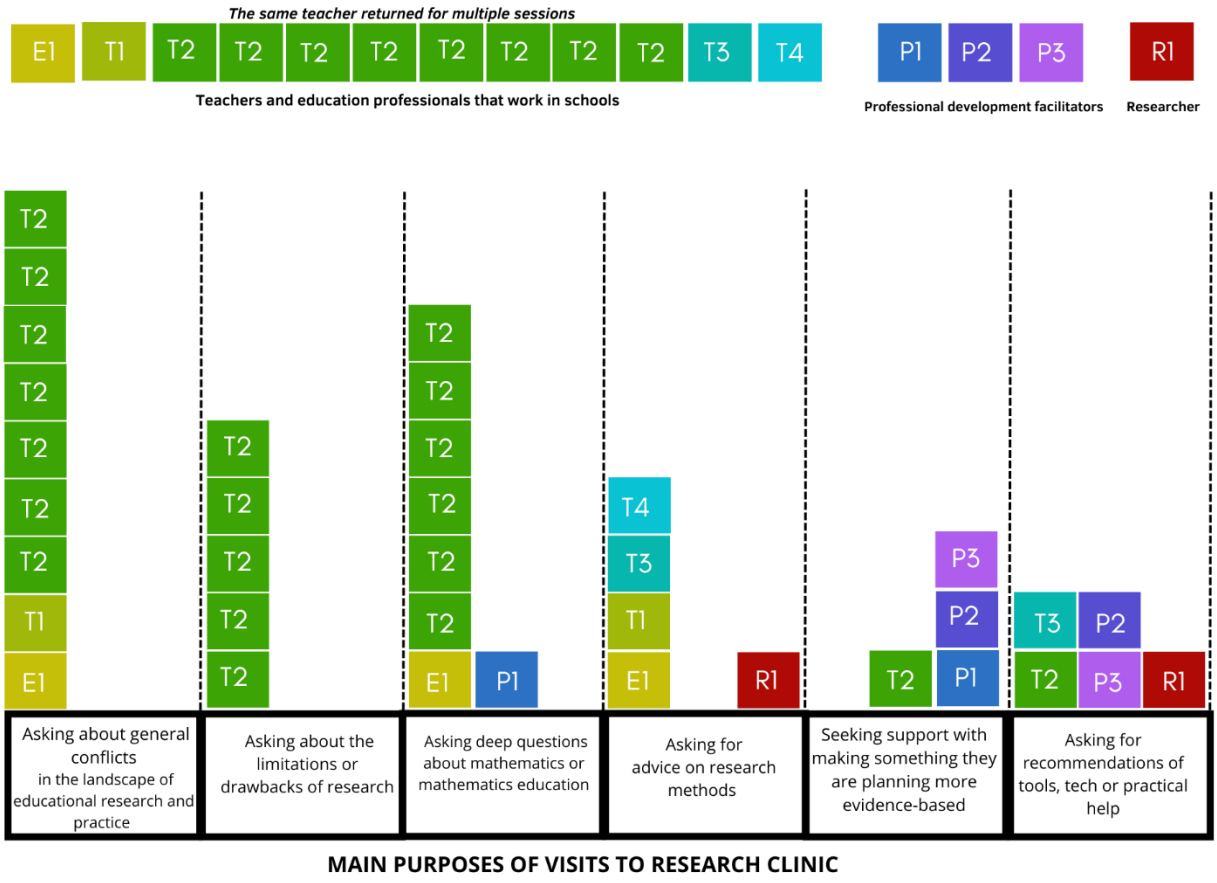
As part of my initial analysis, I characterised each session by type of issues brought (some sessions were comprised of several of these, whereas some only one or two). These *purposes* are not the same as the *themes* that were developed through later layers of analysis, although they share some features. This data is likely to be affected by the participant who completed 8 sessions that appeared in the research.

*Table 5.4 types of issue brought to the research clinic and their frequency*

| **Main issue type brought to clinic by participant** | **Frequency** |
|---|---|
| Asking about general conflicts in the landscape of educational research and practice | 9 |
| Asking deep questions about mathematics or mathematics education | 8 |
| Asking for advice on research methods | 5 |
| Asking about limitations or drawbacks of research | 5 |
| Asking for recommendations of tools, tech or practical help | 5 |
| Seeking support with making something they are planning more evidence-based | 4 |
| Unclear | 1 |

In Figure 5.3 these are shown organised by participant type. The general pattern reveals that overall it was teachers - at least three of the five - who wished to trouble the landscape between research and practice, and two of them were interested in investigating how this might affect deep questions in their subject. Professional development facilitators were more likely to accept the idea of 'evidence-based' at face value, and ask how it might be applied.

*Figure 5.3 what issues were brough to a research clinic and by whom?*



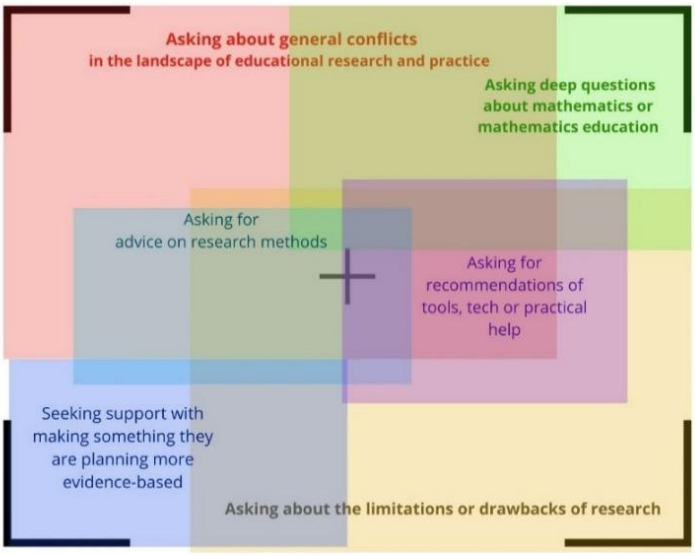

Examples of issues from each category included:

- Asking about general conflicts in the landscape of educational research and practice: "I'm a research skeptic... should I be?"; "the challenge of what does research mean and who is allowed to interact with research?"; "how much can one teacher do within a bad curriculum, and how much can a good curriculum lift up a bad teacher?"

- Asking about the limitations or drawbacks of research: “I'm always kind of reading other people's versions of it. Does that make sense?”; “and they might be very research based and that, you know, there's lots of evidence based…And I think, you know, we have to use that kind of that sort of thing with caution sometimes with our learners in maths”
- Asking deep questions about mathematics or mathematics education: “would you say that someone who factorises and expands brackets using FOIL isn't just using a different method to do the same thing, but has a different understanding of the thing?”; “The maths confidence can be really, really strong and therefore not much understanding of all the students, or like you say there could be some maths anxiety as well..”
- Asking for advice on research methods: “Do you agree? I mean to be… I mean obviously to do a case study to establish what the difficulties are is the first problem, isn't it?”; “By ‘mixed methods’, what…?”
- Seeking support with making something they are working on more evidence-based: “What would you include, do you think, from research?”**;** “But what we want to do… essentially our aim is to give some guidance to teachers about [redacted] and you know, having some research about that”
- Asking for recommendations of tools, tech or practical help: “Is there some [literature review software] that you would recommend?”; “Maybe this could be something they could look at on a padlet or something?”; “just how to how to find the research”

I was surprised and delighted by the dynamic movement between “zooming in” - on particular mathematical topics, research methods, and contextual questions – and “zooming out” to consider broad and complex issues regarding the value of research, teacher agency, and the place of research in pedagogy, resources and assessment as part of wider education systems, shown in Figure 5.4.

*Figure 5.4 a way to visualise the ‘zooming in and out’ dynamic nature of the movement between broader/general and more focused/specific discussions in the research clinic sessions*




## In what ways did I respond to issues brought as an educational knowledge broker?

In answer to this research question, I collected data on several categories of **actions** that I took during the *research clinic* sessions.

*Table 5.5 categories, frequencies and examples of action taken across all research clinic sessions*

| Category of action | Frequency across all sessions | Example of action |
|---|---|---|
| I ask participant a question | 283 occurrences | 'and I'm thinking of the student who doesn't necessarily make documented progress in maths but stops hating it – do we care about that?' |
| I state a principle or make an analysis | 147 occurrences | 'The reason I'm asking these pointedly ridiculous questions is companies who do this sort of thing tend to bury negative results, and that might not be good for you if you just want information' |
| I make a recommendation | 55 occurrences | 'I've just finished reading this book called 'Atlas of AI', which, if you have time to at least skim it, is amazing on this' |
| I wear an identity | 49 occurrences | 'And actually that's true, but it's very hard to accept as a teacher because you're like, what am I supposed to do with that?' |
| I state the limitations of my own knowledge | 44 occurrences | 'I was just thinking my knowledge in either of those areas probably won't be good enough to give you any particular recommendations right now in any case... But yeah, I I'd love to talk about both of those.' |
| I use a metaphor or analogy | 23 occurrences | 'I like to think of it [maths] as a kind of mycelium thing underground, |

| | | |
|---|---|---|
| | | with lots of instances popping up, but you know, I'm weird like that.' |
| I outline an assumption | 18 occurrences | 'And I guess that's the other thing that there might be a challenge there in terms of assuming how teachers normally source tasks' |

In terms of the questions I asked, these fell into four main categories:

- Clarifying (23%)
- Asking their opinion (35%)
- Challenging them (15%)
- Rhetorical (27%)

Since the *research clinic* sessions were captured on video, I also spent some time drawing a summarised version of my typical facial expression in each session, which is shown in Figure 5.5. The range of expressions is notable: my emotional responses can be characterised as at times moving between pensive, sceptical, fascinated, unsure, amused, questioning, delighted, conflicted, amazed, and sad. I include this image as part of my data analysis because, as found in my literature review, it is important not to ignore the socio-emotional aspect to knowledge brokering; alongside the descriptions of the topics discussed, I highlight here the connection-building that took place, which I return to in the discussion of the themes.

*Figure 5.5 a visual map of some of my emotional reactions in the sixteen research clinic sessions*

## How does educational knowledge brokering work in a *research clinic* model?

I analysed the video data and transcripts from each of the *research clinic* sessions together, considering dialogue from the participants and from me together in my analysis. According to Braun and Clarke's (2021) method for reflexive critical thematic analysis, I first familiarised myself with data (watching each video several times and 'cleaning up' the transcripts). I then began to form codes to group the data, and finally discarded and collected codes together to form themes. These resultant themes do not represent all my data, nor do they attend to all of the concepts and mechanisms at play in the rich dynamic discussion that took place. They are, instead, illustration of some of the ideas that occurred and reoccurred in the *research clinic* sessions that I found to be significant in answering my research question "how does

educational knowledge brokering work in a *research clinic* model?". The themes are explored below.

**Making decisions using research**

Here, participants brought a specific question, conflict or mathematical topic and asked me to suggest the ways that research might resolve them. Examples included asking what research might suggest about ways to teaching factorising a quadratic, how variation theory might be applied to a specific lesson, and how to design professional learning for teachers on a specific area.

**Making use of professional knowledges of participants**

As part of attending to the agency of participants but also because of my beliefs around knowledges, I often asked the participants to tell me more, to contextualise, or to clarify their ideas before I offered any advice. I tried to integrate knowledges by asking probing questions, outlining assumptions, and offering careful analysis – often by illuminating possible models or mechanisms from research rather than overlaying or imperativising research. A dominant part of this theme was me saying "I don't know" or "I am not an expert in this" – in fact I said this multiple times in every *research clinic* session. Explicitly valuing the professional knowledge of those participating in conversation also attends to Mosher et al.'s principle of "finding voice" as part of both individual and collective empowerment (Mosher et al., 2014, p. 5).

**Relationship-building**

This theme was very prolific, and included personal anecdotes, confessions, use of humour, discussion about identity (especially misogyny), finding things in common, and encouragement. This work supported some of the other themes – for example, participants were often hesitant in offering their professional knowledge at first, but gradually increased in confidence as I asked more questions, left more space, and built more rapport with them. Many participants referenced feeling like the sessions were "like therapy" in that they felt comfortable and free of judgement enough to "air a conundrum". I found that many participants joined the sessions seeking encouragement and legitimisation for actions they already wanted to take – to try a lesson a certain way, to talk about a concept when training others, to conduct a research study themselves, or to pursue further qualifications – and I represented the authority or credibility they needed to crystallise these decisions. In the nine sessions that were booked by a single participant, there is an increase in the rapport and trust levels of the relationship evident over time, resulting in more frequent use of humour, more personal talk, and more depth and complexity to the discussions.

**Critique of research ideas, organisations or people**

Most participants came to the sessions wanting to express their frustration and critique of research ideas, organisations or people. I not only encouraged participants to offer critique, but also offered my own, and explored through dialogue ways to challenge orthodoxy and be empowered by research. As part of the critical reflexivity when sifting for themes I questioned whether my participation in this critique might have been too enthusiastic, perhaps diminishing the credibility of research or people/organisations using it in ways that were counter-productive to brokering; this is an important tension in knowledge brokering that I discuss in the Implications section.

**Exploring research methodologies and what they mean**

Some participants came to the *research clinic* asking for advice around doing research or interpreting research that focused on research methodologies. Again, the legitimisation function of the knowledge broker seemed to be significant. One of the key parts of this theme in terms of how I responded was that I often referenced the nature of evidence and its relationship with "certainty", and the ways in which qualitative and mixed-methods research can be undervalued. I encouraged participants to consider alignment of methods with their philosophies of both education and research, meaning we often then discussed other themes.

**Conflict and tensions in the use of research in education**

Although by frequency this could be considered the most prolific theme, this data is likely skewed by the one participant who returned to the clinic for eight sessions and for whom this theme was particularly prominent. Overall, these theme curates participants questioning, with my encouragement, the value and use of research, and in particular outlining tensions between "what the research says" and their context or freedom to apply ideas.

**Systems thinking, identity shifting, and boundary blurring**

On of the most frequent things that I did in the *research clinic* session was claim an identity as a mathematician, researcher, teacher, or parent, and I often did so flexibly. This boundary blurring and identity shifting was also sometimes echoed by participants, who spoke variously as parents or family members, teachers, mathematicians, professionals and (rarely) researchers. We also discussed system and boundaries explicitly at times, usually part of "zoomed-out" discussion of deep and complex ideas around education and agents and incentives within it.

In Table 5.6 I show examples of expressions of each of these themes, both from me and from participants.

*Table 5.6 examples of main themes found by reflexive critical analysis in the study*

| **Theme** | **Example from me** | **Example from participant** |
|---|---|---|
| Making decisions using research | 'So if you want to know how you can make under represented groups feel better about and mathematics and participate more mathematics...the short answer is you ask them' | *'is there a way to teach that that doesn't become a 'We do this step because we do this step to factorise nonmonotonic monic quadratics'?'* |
| Making use of professional knowledges of participants | 'And do you think that's the maths isn't well connected or the curriculum in this country doesn't connect them well?' | *'So there's definitely a contextual element to it, and we know, for example, that the results will have improved this next year because of the change in cohort that will be in that year group.'* |
| Relationship-building | 'Speaking as somebody who's neurodivergent as well, that's a really interesting point.' | *'One of the biggest things I struggled with as a younger person was I got so much of my identity and who I was as being someone who was good at maths and smart'* |
| Critique of research ideas, organisations or people | 'There is a way of filtering people by 'intelligence' that mathematics does that is somehow robust and replicable - I don't agree with that' | *'I'm very allergic to overconfidence in which is why I find [name of researcher/broker] so sickening as an individual.'* |
| Exploring research methodologies and what they mean | 'you could go for a a large sample and try and get breadth, but you could also do case studies or a case study and go for depth and they're all legitimate and they're all very valuable and there is nothing to say that you couldn't do both - mixed methods - either.' | *'Well, I need to be saying, well, this is the method I'm going to use and I know you when you're doing research, it isn't just the random 'Let's have a discussion.' It has to be a very structured research method, doesn't it, to be legit?'* |
| Conflict and tensions in the use of research in education | 'people are constantly like, what does research say about how I should teach this? And I'm like, I need to balance that with my own ethical concerns of like, how that works in the real world, yeah.' | *'I feel like a lot of my students would look at and just ah, I don't really know where to start..I don't think they would get out of it what the writers would intend them to get out of it.'* |
| Systems thinking, identity shifting, and boundary blurring | 'I guess there's sort of half of me as a teacher and practitioner, I think.. And then the part of me that's researcher thinks...' | *'what my I think my question was.. how should I be teaching A level maths as it currently stands... like.. we're constricted by the system which we're in.'* |

It is notable that for each theme, there were examples from both me and participants, perhaps suggesting some sense of equitable co-construction of meanings.

In Table 5.7, I consider these themes in relation to both the original activities I hoped and expected to see, and the four conceptualisations from Mosher et al.'s framework (2014).

*Table 5.7 considering the themes that were found from reflexive thematic analysis as compared to my conceptual framework and my intended knowledge brokering actions*

| **Conceptualisation from Mosher et al.** | **Me** | **Them** | **Name of theme** | **Relates to** |
|---|---|---|---|---|
| **Knowledge implementation,** including translation and political considerations, barriers, practicalities | I make recommendations of next steps with reasoning | They ask how research can be used to make a decision | *Making decisions using research* | **Making use of research**<br>**Making recommendations** |
| **Capacity enhancement**<br>Attending to the research process itself and how it works/limitations; finding voice | I respect and integrate their professional knowledge | They are empowered to use their professional knowledge | *Making use of professional knowledges of participants* | **Conferring agency**<br>**Highlighting and integrating existing knowledges**<br>**Admitting limitations**<br>**Making recommendations**<br>**Supporting an equitable co-definition of the problem** |
| **Capacity enhancement**<br>Attending to the research process itself and how it works/limitations; finding voice; | I invite, support or respond to critique of research or those who broker it | They critique research or those who produce/broker it | *Critique of research ideas, organisations or people* | **Inviting critique and transgression** |
| **Collaborative entanglement**<br>Questioning whose knowledge is useful and important and for what; research methods and critiques; the conscious development of connections, relationships and flows of information | I offer anecdotes, personal moments confessions or invite these from participants as part of relationship and trust building | Participants offer anecdotes, personal moments or confessions | *Relationship-building* | |
| **Collaborative entanglement**<br>Questioning whose knowledge is useful and important and for what; research methods and critiques; the conscious | I explore research methodologies and philosophies | They ask about research methods and their implications | *Exploring research methodologies and what they mean* | |

| | | | | |
|---|---|---|---|---|
| development of connections, relationships and flows of information | | | | |
| **Collaborative entanglement** Questioning whose knowledge is useful and important and for what; research methods and critiques; the conscious development of connections, relationships and flows of information | I explore the conflict and tensions in the use of research in education | They explore the use or importance of research | *Conflict and tensions in the use of research in education* | **Naming tensions** |
| **Systemic action research:** shifting focus from problems to systems; questioning the very nature of 'impact'; dynamic group membership, putting people in touch with one another across boundaries and explicitly resisting those boundaries | I resist boundaries, make transgressions, explore new identities or ideas, reference systems | They resist boundaries, make transgressions, explore new identities or ideas, reference systems | *Systems thinking, identity shifting, and boundary blurring* | **Naming tensions** |

These items are arranged in the order of the Mosher et al. (2014) conceptualisation – that is, the further down the list, the more complex the issues, the more equity in the relationship/s, and the less likely it is that change, impact or action will be easy to evidence. As the list progresses, it could be said that my actions and the actions of the participant evolve from them asking and me responding to a much more equitable and balanced partnership, both co-defining and co-exploring the tensions, problems and systems that emerge. To that end, it is telling that my initial conceptions of knowledge brokering activity (in the right-hand column) are incomplete with reference to the themes that emerged, and focused more on the first half of the table, suggesting these require development. In particular, as I address in the implications section, it is crucial that further research explores educational knowledge brokering activity in terms of collaborative entanglement and systems action research.

# Implications

Below I consider the implications for knowledge brokering in education in terms of the themes from the study.

## Knowledge implementation

**Theme: Making decisions using research**

Mosher et al. (2014) suggest that, even in the most straightforward cases of acting on research, knowledge brokers have a key role to play in translating and interpreting by understanding of factors that may support or prevent the use of research ideas, such as ingrained institutional practices, costs, relationships, cultures, politics, and other competing sources of knowledge. One of the most prevalent themes discussed in the *research clinic* was the conflicts, tensions and dilemmas present for practitioners who wished to read and use research – from concerns about their heads of department or headteachers not taking research seriously to pushback from researchers on social media when they tried to create research-informed resources. Hence, this study confirms that sharing research findings with people who might use them to do things differently is far from straightforward, and requires a deep understanding of the barriers and enablers to doing so at every stage in the system – a kind of skill I call *knowledge catalysis*, rooted in multiple identities. The key feature of an educational knowledge broker might well be their honest capacity to admit that they - and/or the research – does not have definitive 'answers' to questions posed, merely possibilities and suggestions to offer.

## Capacity enhancement

**Theme: Making use of professional knowledge of participants**

This study emphasises the need for knowledge brokers to ask about, value and integrate the embedded knowledge of research users, and in particular to have conversations regarding conflicts that arise from so doing. In the study it is clear that I view research as "the beginning of the conversation", and sought to support participants in considering the ways that this research might be used, including not using it at all.

**Theme: Critique of research ideas, organisations or people**

Knowledge brokering should not just be about research findings, but about research itself; what Rycroft-Smith & Macey (2021) term the *metaevidential*. This is partly due to its central place in the knowledge brokering function of capacity building (Ward et al., 2009) but equally as a foundational facet of ethical, candid knowledge brokering activity that does not oversimplify or overstate research findings, but caveats and explains them in terms of models, theories, methods, philosophies and standpoints. It is also a key feature of research that it *should* be open to critique, perhaps most importantly by those who might apply it in practice. Many of the participants in the study demonstrated frustration at people or organisations brokering knowledge and were grateful for a space in which to express their critiques. It is important that ongoing research regarding knowledge brokering considers ways in which this dialogue could be encouraged and used.

Earlier, I questioned whether me co-critiquing research ideas, people or organisation might diminish their credibility in ways that could be counter-productive to brokering. This key tension is one that deserves focus in future study of educational knowledge brokering, linked to questions of the value of research, and balanced with the function of encouraging critique and agency. In particular, the question of how we hold people and organisations accountable for poor quality knowledge brokering, or brokering which does harm, needs urgent attention.

## Collaborative entanglement

**Theme: Exploring research methodologies and what they mean**

Participants came to the *research clinic* needing to be *seen* to be using research "correctly" – one word that was used was "legitimate", with the implication being that using research in the "right" way leads to doing good, being allowed in to a community, and having authority; and conversely, using research in the "wrong" way leads to doing harm, being marginalised or derided, and a loss of power or status. This reveals the formatting power of research. As knowledge brokers, it is up to us to demystify research, to make it clear that all research choices are simultaneously about constructing us, our philosophies and our identities; and also paradoxically not that important: subject to change and evolution over time, as we do better and know better. In other words: to humanise research.

**Theme: Conflict and tensions in the use of research in education**

This was the theme that was most prolific in the data overall (although likely skewed by the recurring participant) which was confirmation for me that the research clinic model was an effective way to support knowledge brokering. As I said to one of the participants during one of the *research clinics*: "I really like your conception there of thinking about research from a sort of surface instrumental level..and how critical you are of that... And the deeper you go, the less evidence there is to the claims". This sort of deep discussion of research is vital to knowledge brokering that sees research as an ecosystem with change *possible* by every actor.

## Systemic action research

**Theme: Systems thinking, identity shifting, and boundary blurring**

I suggested in my analysis that it is crucial that we further explore knowledge brokering activity in terms of collaborative entanglement and systems action research. Knowledge brokers must be systems thinkers, understanding not only concepts but relationships between them and ways in which changes in one part of a system may affect another. There is also a potential therapeutic function to knowledge brokering to be explored – as I found in this study, many knowledge users wanted a non-judgemental space to express feelings about research and

practice, as well as their identity, and found that “It's nice to just have reassurance that I'm not crazy and that there isn't an easy answer.” A deep empathy for the challenges of those seeking to put research to work includes not only functional aspects, but also emotional effects caused by systemic pressures; as one participant put it “I know what to do but there’s no way I can do it”.

## References

Adler, J., & Sfard, A. (2018). Research for educational change: Transforming researchers’ insights into improvement in mathematics teaching and learning.

Aldridge, D., Biesta, G., Filippakou, O., & Wainwright, E. (2018). Why the nature of educational research should remain contested: A statement from the new editors of the British Educational Research Journal. British Educational Research Journal, 44(1), 1–4. https://doi.org/10.1002/berj.3326

Bacchi, C. (2012). Introducing the ‘What’s the Problem Represented to be?’ approach. In A. Bletsas & C. Beasley (Eds.), Engaging with Carol Bacchi: Strategic Interventions and Exchanges (pp. 21–24). The University of Adelaide Press. https://doi.org/10.1017/UPO9780987171856.003

Braun, V., & Clarke, V. (2021). Thematic analysis: A practical guide to understanding and doing (1st ed.). SAGE Publications.

Burkhardt, H., & Schoenfeld, A. H. (2003). Improving Educational Research: Toward a More Useful, More Influential, and Better-Funded Enterprise. https://doi.org/10.3102/0013189x032009003

Carpenter, A. E. (2013). The Project Model of Clinical Education: Eight Principles to Maximize Student Learning and Social Justice Impact. Clinical Law Review, 20, 39.

Chew, S., Armstrong, N., & Martin, G. P. (2022). Understanding knowledge brokerage and its transformative potential: A Bourdieusian perspective. Evidence & Policy, 18(1), 25–42. https://doi.org/10.1332/174426421X16149632470114

Cohen, L., Manion, L., Morrison, K., Manion, L., & Morrison, K. (2007). Research Methods in Education. Routledge. https://doi.org/10.4324/9780203029053

Collins, M. (2004). Critical approaches to research in practice. In J. Swann & J. Pratt (Eds.), Educational research in practice: Making sense of methodology (pp. 67–83). Continuum.

Conklin, J., Lusk, E., Harris, M., & Stolee, P. (2013). Knowledge brokers in a knowledge network: The case of Seniors Health Research Transfer Network knowledge brokers. Implementation Science, 8(1), 7. https://doi.org/10.1186/1748-5908-8-7

Conroy, J., Hulme, M., & Menter, I. (2013). Developing a 'clinical' model for teacher education. Journal of Education for Teaching, 39(5), 557–573. https://doi.org/10.1080/02607476.2013.836339

de Freitas, E. (2008). CRITICAL MATHEMATICS EDUCATION: RECOGNIZING THE ETHICAL DIMENSION OF PROBLEM SOLVING. 17.

Farley-Ripple, E., & Grajeda, S. (2020). Avenues of influence: An exploration of school-based practitioners as knowledge-brokers amd mobilizers. In J. Malin & C. Brown (Eds.), The Role of Knowledge Brokers in Education: Connecting the Dots Between Research and Practice (p. 193). Routledge.

Farley-Ripple, E., May, H., Karpyn, A., Tilley, K., & McDonough, K. (2018). Rethinking Connections Between Research and Practice in Education: A Conceptual Framework: Educational Researcher, 47, 235–245. https://doi.org/10.3102/0013189X18761042

Fennelly-Atkinson, R. (2023). Ableism Versus Inclusion: A Systems View of Accessibility Practices in Online Higher Education. In B. Hokanson, M. Exter, M. M. Schmidt, & A. A. Tawfik (Eds.), Toward Inclusive Learning Design: Social Justice, Equity, and Community (pp. 99–114). Springer Nature Switzerland. https://doi.org/10.1007/978-3-031-37697-9_8

Gorard, S., See, B. H., & Siddiqui, N. (2020). What is the evidence on the best way to get evidence into use in education? Review of Education, 8(2), 570–610. https://doi.org/10.1002/rev3.3200

Gutierrez, R. (2013). The sociopolitical turn in mathematics education. Journal for Research in Mathematics Education, 44, 37–68. https://doi.org/10.5951/jresematheduc.44.1.0037

Hargadon, A. B. (2002). Brokering knowledge: Linking learning and innovation. Research in Organizational Behavior, 24, 41–85. https://doi.org/10.1016/S0191-3085(02)24003-4

Habermas, J. (2015). Knowledge and Human Interests. John Wiley & Sons.

Ikebuchi, S. (2023). Accessing Education: Equity, Diversity, and Inclusion in Online Learning. Canadian Journal of Learning and Technology / Revue Canadienne de l'apprentissage et de La Technologie, 49(1), 1–20. https://doi.org/10.21432/cjlt28349

Kara, H. (2015). Creative research methods in the social sciences: A practical guide. Policy press.

Karcher, D. B., Cvitanovic, C., Colvin, R. M., van Putten, I., Pozza, R. D., & Posner, S. (2025). Key attributes for effective knowledge brokering at the interface of environmental science and management. *Sustainability Science*, *20*(1), 117–133. https://doi.org/10.1007/s11625-024-01575-6

Kislov, R., Wilson, P., & Boaden, R. (2017). The 'dark side' of knowledge brokering. Journal of Health Services Research & Policy, 22(2), 107–112. https://doi.org/10.1177/1355819616653981

Knoblauch, H., Tuma, R., & Schnettler, B. (2014). Video Analysis and Videography Qualitative Methods.

Lawler, B. R., LaRochelle, R., & Thompson, A. (2017). Enhancing Activities in Mathematics Methods Courses to Achieve Sociopolitical Goals. In S. E. Kastberg (Ed.), Building support for scholarly practices in mathematics methods. Information Age Publishing, Inc.

Laycock, H. (1975). [Review of Review of The Explanation of Social Behaviour, by R. Harré & P. F. Secord]. Canadian Journal of Philosophy, 5(1), 173–180.

Lockton, M., Caduff, A., Rehm, M., & Daly, A. (2022). Refocusing the Lens on Knowledge Mobilization: An Exploration of Knowledge Brokers in Practice and Policy. 教育政策與管理, 7, 001–028. https://doi.org/10.53106/251889252022060007001

Lyotard, J.-F. (2005). *The postmodern condition: A report on knowledge* (Repr). Manchester Univ. Pr.

Malacrida, C. (2007). Reflexive Journaling on Emotional Research Topics: Ethical Issues for Team Researchers. Qualitative Health Research, 17(10), 1329–1339. https://doi.org/10.1177/1049732307308948

Malin, J., & Brown, C. (2020a). Joining worlds: Knowledge mobilization and evidence-informed practice. In J. Malin & C. Brown (Eds.), The role of knowledge brokers in education: Connecting the dots between research and practice (pp. 1–12). Routledge.

Malin, J., & Brown, C. (Eds.). (2020b). The role of knowledge brokers in education: Connecting the dots between research and practice. Routledge.

McKnight, L., & Morgan, A. (2020). Why 'clinical teaching'? An interdisciplinary analysis of metaphor in initial teacher preparation. Journal of Education for Teaching, 46(1), 87–98. https://doi.org/10.1080/02607476.2019.1708629

Meyer, M. (2010). The Rise of the Knowledge Broker: Science Communication. https://doi.org/10.1177/1075547009359797

Michaels, S. (2009). Matching knowledge brokering strategies to environmental policy problems and settings. Environmental Science & Policy, 12(7), 994–1011. https://doi.org/10.1016/j.envsci.2009.05.002

Mosher, J., Anucha, U., Appiah, H., & Levesque, S. (2014). From Research to Action: Four Theories and Their Implications for Knowledge Mobilization. Scholarly and Research Communication, 5(3). https://doi.org/10.22230/src.2014v5n3a161

Rycroft-Smith, L. (2022). Knowledge brokering to bridge the research-practice gap in education: Where are we now? Review of Education, 10(1), e3341. https://doi.org/10.1002/rev3.3341

Rycroft-Smith, L., & Macey, D. (2021). Deep questions of evidence and agency: How might we find ways to resolve tensions between teacher agency and the use of research evidence in mathematics education professional development? Proceedings of the British Society for Research into Learning Mathematics, 41. https://bsrlm.org.uk/wp-content/uploads/2021/08/BSRLM-CP-41-2-18.pdf

Sfard, A. (2005). What Could be More Practical than Good Research?: On Mutual Relations Between Research and Practice of Mathematics Education. Educational Studies in Mathematics, 58, 393–413. https://doi.org/10.1007/s10649-005-4818-5

Smith, M. J. (1990). Clinical: The Meaning of the Term. Nursing Science Quarterly. https://doi.org/10.1177/089431849000300302

Spencer, J. (2003). Learning and teaching in the clinical environment. BMJ, 326(7389), 591–594. https://doi.org/10.1136/bmj.326.7389.591

Stenman, S., & Pettersson, F. (2020). Remote teaching for equal and inclusive education in rural areas? An analysis of teachers' perspectives on remote teaching. The International Journal of Information and Learning Technology, 37(3), 87–98. https://doi.org/10.1108/IJILT-10-2019-0096

STERN, T. N. (1990). Where Are the Clinical Role Models? Archives of Internal Medicine, 150(12), 2594. https://doi.org/10.1001/archinte.1990.00390230132026

Thomas, G., & Pring, R. (Eds.). (2010). Evidence-based practice in education (Reprinted). Open Univ. Press.

Vitale, E. (2014). Clinical teaching models for nursing practice: A review of literature. Professioni Infermieristiche, 67(2), 117–125. https://doi.org/10.7429/pi.2014.672117

Ward, V. L., House, A. O., & Hamer, S. (2009). Knowledge brokering: Exploring the process of transferring knowledge into action. BMC Health Services Research, 9(1), 12. https://doi.org/10.1186/1472-6963-9-12

# 6. CONCLUSIONS AND IMPLICATIONS

## Summary of findings

In this thesis, I draw on my experience, expertise and reputation as a knowledge broker in mathematics education: my many identities in the space. I am a teacher, a researcher, a knowledge broker, a parent, and a student, and I have made use of these multiple and fluid identities to explore the processes of knowledge brokering in detail and from several angles. Taken together, these four papers represent a significant contribution to the literature on knowledge brokering by critically examining its processes from the inside out.

This thesis explores the complexities of knowledge brokering in education, emphasising its multifaceted nature and the emergent challenges in defining and evaluating its effectiveness. It identifies knowledge brokering as a set of processes involving the transformation and movement of research into practice through boundary-spanning roles, relationship-building, and constructing, suggesting and embedding accessible and context-sensitive knowledge. However, it also demonstrates that the field lacks robust theoretical frameworks and sufficient empirical evidence to test them, making it difficult to define or measure effectiveness. Critical considerations that require urgent attention are the relational underpinnings of the work that emphasises the need for trust and credibility, and ethical responsibilities of brokers.

The studies presented here also introduce innovative approaches, such as using art-based methods to elicit process themes (such as storytelling, accessibility, and boundary work), which revealed and illuminated some of the crucial tensions in the field at present. Practical insights from another innovative method - a *research clinic* model - further support this work by underscoring the need for identity adaptability, awareness of own limitations, critical engagement with research, and systems thinking for knowledge brokers to navigate conflicting priorities and support decision-making in educational contexts.

In the introduction to this work I defined the overarching research problem: we know relatively little about knowledge brokering, and in particular how it actually works in practice. I suggested that there is a pressing research gap around what knowledge brokers do, how to characterise it as knowledge brokering in the first place; and then how to further characterise and evaluate it (as “good”). The specific research questions used in the studies in this work that have helped address this research gap are shown in Table 6.1.

*Table 6.1 a summary of the research questions from each of the four papers*

| | |
|---|---|
| **Paper 1** | • What kinds of knowledge brokering work, processes and products are there in the international education research-practice space and how have they been characterised?<br>• What has been found to be effective, and less effective, in knowledge brokering in education?<br>• How might we evaluate, critically examine and otherwise hold to account the work of knowledge brokers in education? |
| **Papers 2 and 3** | • What themes, discourses and boundaries are elicited for me from the process of creating art as knowledge brokering in mathematics education?<br>• What themes, discourses, and boundaries **related to truth and truth-telling** emerged for me through the process of creating art as a form of knowledge brokering in mathematics education? |
| **Paper 4** | • What problems are brought to an educational knowledge brokering clinic?<br>• In what ways did I respond to issues brought as an educational knowledge broker?<br>• How does educational knowledge brokering work in a *research clinic* model? |

In the following section, I outline the answers to these questions, summarising the findings from each study, and synthesise their meaning when taken together as a whole.

**What kinds of knowledge brokering work, processes and products are there in the international education research-practice space and how have they been characterised?**

In my first study, I found that:

- it was difficult to distinguish between policy and practice in educational knowledge brokering
- there are a variety of terms used in the research-into-use space in education in confusing and non-distinct ways, which is holding the field back; I proposed reconciling knowledge mobilisation and knowledge brokering, but preferred knowledge brokering
- knowledge brokering in education is not well defined, but is often regarded as a process of transforming knowledge from research into practice by crossing or spanning boundaries
- various models and metaphors have been proposed, such as knowledge brokering as mediating, straddling, Janusian integration, boundary blurring, boundary spanning, translation and matchmaking, all with various connotations about the type of work involved
- several frameworks have been proposed to characterise, describe, prescribe, evaluate or measure knowledge brokering, but they often lack detail, clear aims, or a wide perspective of the field; I suggested Mosher et al. (2014) as the most useful for analysis at the level that this paper seeks to take

I found that educational knowledge brokering is an ill-defined process of transforming research into practice (and policy), currently complicated by blurred distinctions between policy and practice and inconsistent terminology. While various models and frameworks exist, many lack clarity, detail, and a broad perspective, with Mosher et al. (2014) identified by me as the most useful for analysis and therefore used throughout this thesis.

I concluded that knowledge brokering in educational contexts and beyond has been characterised as:

- The **flow, movement or transfer of knowledge**, usually multidirectional, between contexts where it is produced and used
- The **facilitation** of this flow through creating connections, understandings and empathy between communities, organisations, artefacts and individuals
- The **transformation** of knowledge created as research to new forms and formats of knowledges
- The **creation of artefacts** which might form the focus of these knowledges and connections
- The **construction of systems** which might build capacity to continue this work
- The **attention to accessibility** which might reduce barriers to accessing research for everyone
- The **understanding of contexts** that allows them to interpret research findings, see policy and practice in education as intertwined, and inhabit different roles when needed

Knowledge brokering in education thus involves the multidirectional flow and transformation of research into accessible formats, forms and findings, facilitated through improving or creating connections between individuals, communities, and systems. It also includes building capacity, creating artefacts, and navigating contextual complexities to bridge policy and practice effectively.

**What has been found to be effective, and less effective, in knowledge brokering in education?**

I found that:

- there is a lack of good quality empirical evidence around educational knowledge brokering, particularly with regards to practice
- there is a suggestion that measuring effectiveness of knowledge brokering in education is difficult; connecting what is being brokered with effectiveness is proposed

- the scant evidence that exists suggests just providing practitioners access to research knowledge, even if transformed, is not usually effective
- it is suggested that effective knowledge brokering may involve social and relational networks
- evidence from healthcare tentatively supports ideas of boundary-blurring and relational activity at the heart of effective knowledge brokering; but caution is suggested when applying ideas from healthcare contexts in education.

In summary: we know almost nothing about the effectiveness of knowledge brokering, which is unsurprising given we have yet to create robust theory around criteria for determining effectiveness. Without a sound knowledge base on what we are trying to achieve with knowledge brokering activity, we will remain unable to define 'effective' in this context, which is a necessary condition for evaluating what kinds of knowledge brokering activity, and operationalised in which ways, are effective. Similarly, we then require a framework to evaluate this activity fairly, robustly, and consistently, which I note in the next section.

**How might we evaluate, critically examine and otherwise hold to account the work of knowledge brokers in education?**

With regards to this question, I found that:

- it is suggested we begin to consider evaluating knowledge brokering efforts by measuring how they address barriers to research use for practitioners, which are described in the literature as: time; usefulness/relevance; information overload; applying research ideas in context; access to research; and access to good quality syntheses of research
- knowledge brokers have a responsibility to be fair, honest, ethical, trustworthy and credible; currently it is not clear how, if at all, they are being held to account for being so
- it is suggested that knowledge brokers should have (at least) double identities, with deep contextual knowledge of both research and practice
- since misrepresentation or misinformation could have potential to cause harm, it is an urgent priority to establish who can or should do the work of knowledge brokering
- the idea of research use is contested and politicised, and knowledge brokers without a clear sense of the issues, in particular power and status, risk ineffective practice or harm
- there is an important question surrounding the capacity-building activity of knowledge brokers, who may, for example, aim for their own obsolescence over time.

Therefore in Study 1 I concluded that knowledge brokering in international education research and practice is and should be characterised by multidirectional knowledge flow, facilitation through relationships, transformation of research into practical formats, and the construction of systems to enhance accessibility and capacity. However, there is little empirical evidence on its effectiveness, making evaluation difficult; efforts should focus on addressing barriers to research use, ensuring ethical accountability, and clarifying the roles and identities of knowledge brokers to prevent misinformation and enhance impact. I then used these findings to situate the next three studies, beginning with Study 2 and Study 3, which I discuss next.

**What themes, discourses and boundaries are elicited for me from the process of creating art as knowledge brokering in mathematics education?**

In my second and third studies I explored this question, focusing in the third study of the idea of truth and truth-telling. Shown in Table 6.2 are the six main themes that were elicited for me, and what they imply for knowledge brokering.

*Table 6.2 A summary of themes from Papers 2 and 3*

| Theme | What does this tell us about knowledge brokering? |
|---|---|
| **The importance of storytelling** | Knowledge brokering balancing truth-telling activity with crafting a compelling, clear, simplified and coherent narrative, structured to support audience understanding and engagement |
| **Rule-abiding and rule-breaking** | Rules and conventions act as both guideposts and guardrails; knowledge brokering should develop a set of guidelines and support structures that support its activities being effective and ethical without stifling creativity and innovation |
| **The interplay between process and product** | Knowledge brokering is not just about creating artefacts; the idea of product and process are intertwined |
| **The interplay between accessibility and gatekeeping** | Knowledge brokers control not only knowledge flows, but knowledge forms; they have a responsibility to choose and use knowledges ethically and with discernment, truth-telling about the topic but also about research use more widely, as well as encouraging decisions makers to form their own relationships with the evidence |
| **Boundary-eliciting work** | Knowledge brokering should have defined boundaries, particularly as regards what is considered (truthful, useful) informing as opposed to misinforming and disinforming |
| **Boundary-blurring work** | Knowledge brokering involves blurring boundaries, specifically by exposing false binaries, bridging previously disparate ideas or modalities, and bringing people together |

In these two studies I concluded that art-based methods revealed knowledge brokering in mathematics education contains tensions between truth-telling and storytelling, the balance of rule-following and innovation, and the intertwined nature of process and product. I also underscored the ethical responsibility of knowledge brokers in shaping access to knowledge, defining and blurring boundaries, and facilitating meaningful connections between ideas, evidence, and audiences by finding and using boundaries between informing, misinforming,

and disinforming. This led me to Study 4, in which I used this ideas as part of investigating my own practice as a knowledge broker in mathematics education using a *research clinic* method.

**What problems are brought to an educational knowledge brokering clinic?**

In my fourth study, I found that these were the main problems brought to my educational knowledge brokering clinic:

- Asking about general conflicts in the landscape of educational research and practice
- Asking deep questions about mathematics or mathematics education
- Asking for advice on research methods
- Asking about limitations or drawbacks of research
- Asking for recommendations of tools, tech or practical help

I concluded that these problems necessitated a kind of zooming in and out between specific issues and more general and meta-issues around research-in-use and research itself, including limitations and critiques.

**In what ways did I respond to issues brought as an educational knowledge broker?**

The main ways that I responded to issues brought as an educational knowledge broker were:

- I asked the participant a question (clarifying, asking their opinion, challenging them, or rhetorical)
- I outlined my own limitations
- I stated a principle or made an analysis
- I made a recommendation
- I wore a specific identity
- I stated the limitations of my own knowledge
- I used a metaphor or analogy
- I outlined an assumption

These actions suggested that my work as a knowledge broker required a deep understanding of the professional contexts my participants were working in, an ability shift roles and identities and hold multiple perspectives, and the humility and integrity to openly examine not just the shortcomings of research (either general or specific) but my own knowledge and interpretation of it.

**How does educational knowledge brokering work in a *research clinic* model?**

In my fourth study, I found that educational knowledge brokering in my clinic operated through the following main recurrent themes:

- Making decisions using research
- Making use of professional knowledges of participants
- Relationship-building
- Critique of research ideas, organisations or people
- Exploring research methodologies and what they mean
- Conflict and tensions in the use of research in education
- Systems thinking, identity shifting, and boundary blurring

This adds to the current literature around knowledge brokering in practice by emphasising the depth and breadth of concepts discussed as part of knowledge brokering, highlighting the need to examine tensions and conflicts (without necessarily resolving them), and demonstrating the need for complex systems thinking on the part of the knowledge broker in order to support a successful and transparent dialogue around research use.

My original hypothesis for this entire thesis, in answer to the question '"how does or could knowledge brokering work, and how can we move the field forward?" was, put simply, "it currently relies on the skill, identity navigation, knowledge, knowledge-about-knowledge, understanding of context, and ethics of the broker, and this is likely too inconsistent at present to be trustworthy for the research user". This hypothesis stands, and is backed up by the work, as demonstrated in these summaries of findings. In the next section I explore what this means for the field, the knowledge broker, and the knowledge user, and set out some directions for future research based on this work.

# Limitations

## Critique of methods

I justified the use of mixed methods in this research by suggesting it would not only triangulate my data, but also work towards undermining the mistaken idea that only quantitative data (or sometimes only randomised controlled trials) had value in research. The resultant work has often veered off the beaten path in terms of methods (using art-based methods and the concept of the *research clinic*), meaning that much of this work is using new and innovative ways of working with data, applied to a new field. There are many risks and limitations with this:

- **limited existing literature:** a lack of prior research in the field (and none using these methods) means I do not have benchmarks or comparative studies for validation
- **lack of established frameworks:** the methods I used often lacked standardised procedures, making replication and validation of results more challenging

- **risk of overemphasis on novelty:** the emphasis on innovation in this work, in particular the creation of artistic artefacts such as songs, may detract from the (perceptions of) rigor or reliability of the methods
- **risk of researcher bias:** many of the ideas I have found here have felt like common sense for me as a knowledge broker, suggesting a risk that the work is researcher-biased
- **unpredictable participant responses:** participants may have engaged with art-based methods or research clinics in unpredictable ways, complicating data analysis
- **methodological integration challenges:** my combination of highly diverse methods may be seen as creating conceptual or practical challenges in data synthesis
- **subjectivity:** interpretation of data from art-based methods can be highly subjective, potentially leading to biases or inconsistent conclusions
- **scepticism from academic and professional communities: u**sing unconventional methods may provoke resistance or scepticism from peers, reviewers, or stakeholders who prioritise traditional approaches, or see the work as trivial or surface-level
- **resource-intensiveness:** mixed and innovative methods in this way has required significant time, expertise, and resources, potentially making the research more complex and difficult to evaluate for others
- **difficulty in proving generalisability/transferability:** these innovative approaches, applied to a new fields may mean that my findings are generalisable and/or transferable, but this may be difficult to evidence without other work to draw on
- **difficulty in communicating findings:** my results, as they are derived from unconventional methods, may be harder to communicate or interpret for audiences accustomed to traditional methodologies
- **publishing barriers:** journals or funding bodies with a preference for traditional methodologies may be less willing to accept or support research using innovative approaches.

## Examination of criticality

In my introduction to this work, I aimed for criticality in two main ways: theoretical underpinnings and the holding of self to account. I aimed to critically engage with my researcher positionality, multiple identities, and the power dynamics within my work, drawing on feminist, queer, and big Q qualitative perspectives to challenge positivist assumptions and structural inequalities. Through reflexivity, open-mindedness, and deep questioning of my motivations, biases, and academic identity, I also aimed to embrace contradictions, seek diverse feedback,

and remain vigilant against performative criticality. Below I examine ways in which I may not have fulfilled these aims in this work:

- **researcher positionality**: this may not have been explicitly stated or deeply explored, leaving values and influence unclear (e.g., superficial statements rather than reflexive engagement)
- **feminist, queer, and big Q qualitative ideas**: inconsistent application, especially across multiple papers (e.g., insufficient integration in research framing, interpretation, and conclusions)
- **multiple identities in research**: a limited interrogation of how identities shape research (e.g., neglecting their impact on participant interactions and study focus).
- **reconciling research 'truths'**: an implicit lean toward singular narratives, limiting pluralism (e.g., overemphasis on one perspective, aligning with knowledge broker role)
- **power dynamics**: insufficient critical analysis of power structures, especially the researcher's role (e.g., missed opportunities to evaluate influence on interactions)
- **questioning motivations and rationales**: a limited self-questioning of theoretical and methodological choices (e.g., uncritical use of established theories, insufficient reconsideration of motivations)
- **structural inequality and oppression**: a weak engagement with how knowledge production may reinforce inequalities (e.g., prioritising dominant narratives, overlooking marginalised voices in recruitment)
- **academic identity negotiation**: a lack of reflection on how research shaped academic identity and vice versa (e.g., tensions between academic, practitioner, and knowledge broker roles left unaddressed)
- **open-mindedness**: my preconceptions may have narrowed inquiry and analysis (e.g., uncritical acceptance of initial assumptions)
- **insider vs. outsider perspectives**: a limited reconciliation of dual roles as researcher and knowledge broker (e.g., failing to address tensions or leverage insights from both perspectives)
- **contradictions and tensions**: a tendency to resolve contradictions prematurely or overlook them (e.g., treating tensions as problems rather than meaningful phenomena).
- **seeking and using feedback**: not engaging with diverse or challenging feedback (e.g., favouring confirming perspectives, superficial engagement, scepticism towards peer review)

- **criticality and reflexivity**: a risk of performative rather than deep reflexivity (e.g., focusing on surface-level reflections instead of critical self-examination).

## Generalisability

Braun and Clarke (2021, p. 143) suggest, in big Q qualitative research paradigms, using transferability rather than generalisability– that is, making sure the research "is richly contextualised in a way that allows the reader to make a judgement about whether, and to what extent, they can safely transfer the analysis to their own context or setting". Many of the conclusions I have drawn in this work, I suggest, apply to knowledge brokering in mathematics education, education more generally, and even beyond – because the issues, concepts and tensions I have outlined here are very likely transferable across contexts. For example, if it is important for a knowledge broker with specialism in mathematics education to be able to construct a coherent and compelling narrative in order to help a teacher understand the available evidence to make decisions in practice, it is logically coherent that this would apply to science education, or music education, or pedagogy more widely, and even beyond education, to settings such as healthcare or business management. For clarity, I am not suggesting that subject specialism isn't important for the broker, or that, for example, specific and detailed ideas in mathematics don't matter in brokering; but I am suggesting that many techniques for exploring evidence with decision-makers, framed as I have in this study as ways of addressing barriers, blockages or problems with connecting decision-makers with research in some way, are almost certainly transferable. In particular, ideas about what constitutes useful *informing*, as opposed to *misinforming* or *disinforming*, should apply to all knowledge brokering: it is difficult to see an argument that brokers could or should mislead or misappropriate evidence, whatever the context. Similarly, if I consider the iceberg diagram (shown again in Figure 6.1) that I produced as part of my first paper (a review of the literature), the issues outlined as part of the discourse, emerging, and below the waterline are almost all deep and general issues that affect the entire field of knowledge brokering. Many of the barriers, blockages or problems themselves are also suggested to be the same, although some issues may be context-dependent. More study on knowledge brokering in education and beyond will confirm or deny this theory, and examine in more detail particular differences.

*Figure 6.1 the iceberg diagram I produced as part of Paper 1*


## Implications for knowledge brokering as a field

I outlined in the introduction the problem of replication of one of the initial problems that knowledge brokering seeks to resolve, namely the shift of the problem from "which *research/researchers* can I trust to do good and useful work?" to "which *brokered work/brokers* can I trust to do good and useful work?". I suggested that resolution to this problem would come from creating frameworks to both support knowledge brokers and to hold them accountable in their professional practice, protecting both individual brokers but also the profession as a whole from threats to credibility and trust. As an outcome of this work, I call for guidelines for good practice, regulation, evaluation, support for ethical dilemmas, reward and recognition for doing good, and/or consequences for causing harm, in the field of knowledge brokering. I call for better understanding of what knowledge brokering is, but also what it can and should be – prescriptive as well as descriptive work, and I suggest this is urgent if we are to prevent further harm from being done in the name of knowledge brokering. I concur with Malin and Shewchuck (2024) who see good knowledge brokers as *strategic actors* who—to be effective—must be attuned and responsive to social and political systems, as well as equity-centred by addressing issues of distribution, recognition, and representation.

## Political education for knowledge brokers

One of the strongest findings of this thesis is that knowledge brokering is inherently relational, social, and political, yet this latter aspect is notably absent from the current literature (MacKillop et al., 2020). Knowledge brokers should consider political work – and making their work politically critical - an active part of their role. This means that knowledge brokers, whether working directly with policymakers or any other practitioners or decision-makers, require good-quality training in the art of the political, in particular in three aspects as defined in earlier in this work:

- **The distribution of resources**: Since brokers choose which knowledge, or knowledge types to *exclude* from consideration/presentation (Duncan et al., 2020), as part of controlling *what* knowledge and *when* it is introduced, they should deeply understand the consequences of these decisions in terms of equity, power and status, and be well embedded in the communities they serve in order to understand their priorities and needs.
- **The framing of problems**: Since brokers negotiate relationships between decision-makers, themselves and knowledge, especially as part of what constitute "problems" and "solutions" (MacKillop & Downe, 2022), they should receive training in attending to constructing this problems with community insight and input, perhaps making use of the "What's the problem represented to be" approach and guidelines (Bacchi, 2012).
- **A battle of ideas**: Since brokers navigate tensions and boundaries in whose knowledge is privileged and considered relevant and valuable (and this is inevitably constrained by the limits of their (and others') knowledge, biases and paradigms), they should receive good-quality training on types of knowledges, the histories of patriarchal and kyriarchal ways of knowing, and research paradigms, and be able to explain these ideas with depth and clarity to all kinds of audiences.

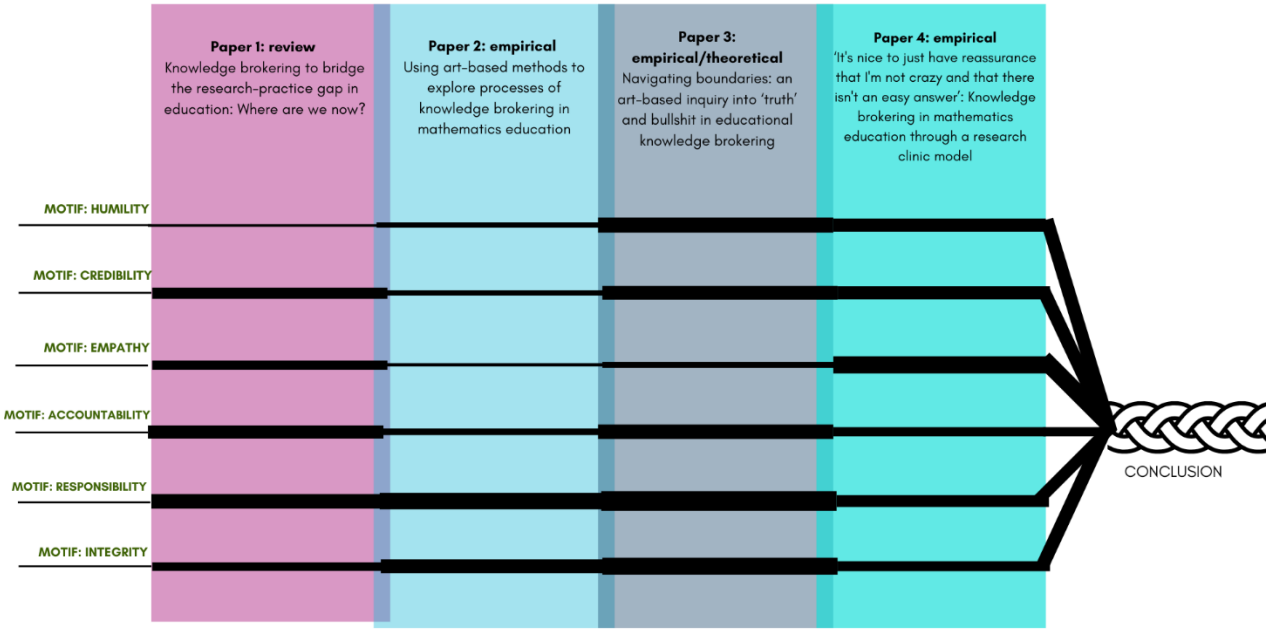
As part of their training on political aspects of knowledge brokering, brokers should also be finely attentive to informing, misinforming and disinforming, and in particular alert and resistant to the possibilities of environmental and social incentives to bullshit, as well as knowledgeable about the significant consequences (i.e. Brandolini's law) of doing so. I explore this more in the next section on evaluation and accountability implications.

## Evaluation and accountability

In the introduction to this thesis I noted that there were several motifs which occurred, reoccurred and accumulated over the process of research education knowledge brokering for

the work as a whole. In Figure 6.2 I show an approximation of the relative importance of these motifs over time as I researched and wrote each of the four papers that comprise this thesis.

*Figure 6.2 the motifs that are threaded through this work*




Having completed the four papers that comprise this thesis, I have concluded that these motifs are key to the successful future of knowledge brokering. This is because:

- Knowledge brokering requires **humility**: brokers cannot know everything, and admission of what they do not know is crucial
- Knowledge brokering requires **credibility:** brokers must have and keep a good reputation (for being knowledgeable, ethical, transparent, thoughtful and clear) with the various communities that they work with
- Knowledge brokering requires **empathy:** brokers must belong to in some way (understanding the priorities, language, needs and principles) multiple communities, including those who produce research and those who use it to make decisions; they should carefully attend to issues of equity, diversity, access and inclusion
- Knowledge brokering requires **accountability**: brokers must be clear about where the ideas they discuss come from, keep and show transparent and meticulous records, be aware of their own and others' biases, and acknowledge and handle errors
- Knowledge brokering requires **responsibility**: brokers must be clear about the limitations as well as the advantages of the knowledge they broker, maintain their own

professional learning and training, and understand and work with embedding ideas in context

- Knowledge brokering requires **integrity:** brokers should make transparent and adhere to guidelines and principles around brokering, even when no one is watching or checking.

People are fallible, and developing these professional qualities requires training, time, and dis/incentives to do so. At present, knowledge brokering is not yet a clear career path with established guidelines and guardrails; our next task as a field is to implement some of these theoretical concerns as policies and frameworks, supporting, coaching and training brokers to see the value in these qualities in terms of business sense (financial capital), reputational risk reduction (social capital) and professional integrity (moral capital).

I noted in my first paper that Lubienski (2020, p.187) asks:

> in an increasingly post-truth age where evidence is questionable, malleable, or often just irrelevant…Will we see an increase in "boundary spanners" that bridge the research-practice divide, or just "spinners" that promote a practice based on image more than evidence?

Later, in Paper 3, I returned to this idea of truth and what it might mean for knowledge brokering as a field. Beer, writing originally about the field of cybernetics, posits that the purpose of a system is what it does, often known by the acronym POSIWID (e.g. Fachinelli et al., 2016); in other words one judges the purpose of a system by the output and function, rather than the stated aims or priorities. In the field of educational knowledge brokering, I have suggested that the current lack of guidelines, guardrails and criteria for evaluation are particularly problematic; what this may mean is that currently, systems that are described as *using evidence* to make better decisions may be having decidedly different – or just unintended – effects that we are currently failing to examine. What is clear from this work is that there is plenty of discourse around what knowledge brokering purports to do, but not enough about what it actually does and why. In particular, we need to examine with some urgency whether knowledge brokers are able (in both the sense of *free enough to* and *knowledgeable enough to*) to draw important boundaries between informing, misinforming and disinforming. I discuss this further in the next section on implications for knowledge brokers.

## Accessibility

In the first paper of this thesis, I concluded with the idea that the concept of 'accessibility' in knowledge brokering requires attention, in particular because it is often used to mean many different and distinct things. I separated these into six main categories, shown in Table 6.3.

*Table 6.3 six aspects of accessibility that educational knowledge brokers should attend to*

| Aspect | Focus | Example |
|---|---|---|
| 1. **changing languages** | how can knowledge be *translated* into useful and familiar language for practitioners? | Using simple, clear and readable language in summary texts, images, videos or explanations; explicitly relating research terms to classroom terms; defining unfamiliar terms wherever used, using analogy and metaphor to support contextual meaning-making |
| 2. **changing locations** | how can knowledge be *curated* and collected so that research that may be otherwise difficult for practitioners to find or read is brought to them? | Creating summaries of useful research on a similar subject; printing or providing documents that are behind digital walls or in particularly rural internet locations; collecting research ideas from a variety of sources that offer different perspectives and offering an overview that helps practitioners to choose between them |
| 3. **changing structures** | how can knowledge be formatted, organised and *designed* for useability by practitioners? | Using principles of effective graphic design (and other media design) to organise information intuitively, such as: bullet points, bold and italics, varied font size, colour, negative space, summary boxes, infographics, use of audio, tooltips, drop-down boxes etc; changing the order that information is presented in to make thematic sense/tell a meaningful story |
| 4. **changing scales** | how can knowledge be *transformed* so that it is of the appropriate scale, resolution or level of detail for practitioner needs? | Reducing (or sometimes expanding) the amount of information into, for example: a summary sentence; a short video; an abstract; a poem; a research summary; a question or series of questions; an infographic; a dialogue; a song; an image; an example lesson plan; a task; or a talk |
| 5. **changing thresholds** | how can knowledge be *presented* to make practitioners feel welcome and safe, that they belong in the space, and that they have the power to not only receive but critique, manipulate, subtract from and add to the knowledge? | Using principles of accessible graphic design and language and attending to power and status cues in design decisions; for example, allowing space to/encouraging practitioners to write on materials; having comments or a forum in digital spaces; allowing space and time for critical discourse |
| 6. **changing norms**: | how can knowledge be *filtered* or condensed so that practitioners with a range of needs are supported in connecting with it? | Attending to dyslexia-friendly fonts and graphic design, using colour-blindness filters, and using alt-text thoughtfully/intentionally on images; considering/listening to practitioner needs very carefully when planning events and talks; providing closed captioning as standard |

These six aspects of accessibility require further attention, linking them to equity and inclusivity impact, and considering the idea of knowledge gatekeeping versus knowledge access in knowledge brokering activity, further investigating our priorities and purposes as a field

specifically in terms of access. We also need to expand ideas of accessibility even further, considering not just the production of artefacts in knowledge brokering but also the relational and political, which will also have significant impact on accessibility and equity concerns. This also relates to the idea of *building capacity* (Ward et al., 2009) as knowledge brokers – we need better structures for describing the ideal trajectory of this kind of activity, and evaluating whether we are doing it in practice.

## Implications for knowledge brokers

There are two meanings of the verb *to lie*: one is the opposite of *truth-telling*, and the other is the opposite of *standing up*. As knowledge brokers, we can lie by misleading with regards to the truth, and we can lie by not standing up for something - by lazily conducting the lowest gravitational flow of knowledge, and in so doing failing to check, to evaluate, and to practice discerning judgement. Knowledge brokering requires active **standing for** something. Since knowledge brokering is an essentially interpretive activity, one aspect of which is creating narratives as well as relationships to persuade, explain, or influence, it is particularly important that knowledge brokers state explicitly their positionality and viewpoints, something that is not yet commonplace in knowledge brokering activity.

In my review of the literature I concluded that it is an urgent priority to establish the responsibilities as well as the aims of knowledge brokers in education (Fenwick & Farrell, 2012), and that **who** is able to broker knowledge is a key component of the next stage of researching credibility. This, along with a desire to see knowledge brokering as a professionalised and valued activity, suggest a need for better career pathways as well as training and evaluative guidelines for knowledge brokers. If we would like to see good-quality knowledge brokering begin to solve some of the well-documented problems we have outlined in terms of using research, we should make it a viable and important career for those who have the requisite skills and membership of different communities, not just an add-on or a lateral slide for those who find themselves in the role by happenstance. If we really value code-switching, boundary-crossing and multiple identities in knowledge brokering, we should also encourage people to do this work as part of a second, third or even fourth career, having built credibility and experience in the roles of those they are working with. This also suggests that we should look to the margins: valuing queerness, those who have been minoritised, those who are able to act as social and professional chameleons, not only for their role-switching but for their important understandings of equity and inclusion.

Perhaps the most uncomfortable, but arguably the most significant, outcome of this study is that we need penalties for those who peddle bullshit in the name of knowledge brokering. To do this we need the aforementioned evaluative frameworks, built on consensus of what "good" and "truthful" knowledge brokering might mean; but we also need knowledge brokers to take ethics and politics seriously, to attend to equity, to notice and correct errors and to be thorough and methodical in the way they track and transform evidence. We need someone – a professional body, an organisation, a set of agents – who will take responsibility for tracking down misinformation and disinformation, and we need to give them the power to do something about it. As previously mentioned, Brandolini's law notes that the amount of time and energy needed to correct disinformation is considerably larger than the time and energy taken to create it - therefore we need mechanisms to disincentivise it and stop it at source, not just to deal with it when it happens. We need support for knowledge brokers who, like the one in MacGregor (2024, p. 60), are honest enough to note "I'm out of my depth..there's a real discomfort and I must admit.. to not fake things here".

To guard against passing on both disinformation and misinformation, I suggest that one of the most impactful things that knowledge brokers can do is to familiarise themselves with logical argument, including common fallacies and "razors" (important heuristics that are useful in particular contexts but limited in others). An example of this is given in Table 6.4, which could be used as the beginning of a curriculum for knowledge brokers seeking to understand the principles of some of the ways in which knowledge can be used and misused.

*Table 6.4 a suggested list of useful principles for knowledge brokers to understand*

| Name | Principle | Interpretation | Possible application | Reference |
|---|---|---|---|---|
| **Occam's Razor** | Entities should not be multiplied beyond necessity. | The simplest explanation that accounts for all the evidence is often the best. | Science, philosophy, logical argument, problem-solving | Thorburn, W. M. (1915). "The Myth of Occam's Razor." Mind |
| **Hanlon's Razor** | Never attribute to malice that which can be adequately explained by stupidity. | Misunderstandings or errors are more likely due to incompetence or ignorance rather than deliberate intent or 'evil'. | Social organisation, communication | Hanlon, R. (1990). Murphy's Law and Other Reasons Why Things Go Wrong |
| **Hume's Razor** | If the cause assigned for any effect is not sufficient to produce it, the effect must be ascribed to something else. | Explanations must rely on sufficient causes, rejecting those that fail to adequately account for phenomena. | Evaluating causal claims in philosophy, research and science | Hume, D. (1748). An Enquiry Concerning Human Understanding |
| **Sagan's Razor** | Extraordinary claims require extraordinary evidence. | Unusual or implausible claims demand equally strong proof before being accepted. | Scepticism, scientific inquiry, research | Sagan, C. (1996). The Demon-Haunted World |
| **Newton's Flaming Laser Sword** | If something cannot be settled by experiment or observation, it is not worth debating. | Focus on empirical, testable claims rather than speculative or purely philosophical ones. | Differentiating science from metaphysics, testing theory (this is less useful in social sciences) | Feynman, R. P. (1985). Surely You're Joking, Mr. Feynman! |

| | | | | |
|---|---|---|---|---|
| **Popper's Razor** | Theories that cannot be falsified are not scientific. | A theory must be testable and falsifiable to be scientifically valid. | Philosophy of science, research, nature of theory vs concept or idea | Popper, K. (1959). The Logic of Scientific Discovery |
| **Grice's Razor** | Do not attribute more meaning to a statement than is necessary. | Prefer the simplest, most straightforward interpretation of communication. | Linguistics, philosophy of language, communication, research, writing | Grice, H. P. (1975). "Logic and Conversation." Syntax and Semantics |
| **Crabtree's Bludgeon** | No set of mutually inconsistent observations can exist for which some human intellect cannot conceive a coherent explanation, however complicated. | Assume that humans tend to overcomplicate explanations unnecessarily. | Identifying overcomplicated ideas, Scepticism, scientific inquiry, research, communication | Crabtree, C. (2001). Observations on Intellectual Complexity. |
| **Brandolini's Law** | The amount of energy needed to refute bullshit is an order of magnitude larger than to produce it. | False claims or bullshit are easier to create than to debunk thoroughly. | Debates, social media, misinformation analysis, communication, argument | Brandolini, A. (2013). "On Bullshit Asymmetry." |
| **Hitchens' Razor** | What can be asserted without evidence can be dismissed without evidence. | Claims require substantiation; without it, they hold no weight. | Debate, scepticism, critical thinking, research | Hitchens, C. (2007). God Is Not Great |
| **Conway's Law** | Organisations design systems that mirror their own communication structures. | The structure of a group of people engaged in problem-solving heavily influences the solutions they produce. | Systems design, software development, organisations, contexts | Conway, M. (1968). "How Do Committees Invent?" Datamation |

In Paper 3 I focused on the risks and boundaries in knowledge brokering activity with respect to ideas of informing, disinforming and misinforming, theorising a landscape for brokers that needed complex negotiation in order to interpret and analyse without extrapolating or fabricating. In Table 6.5 I present a reminder of one of the ways that I suggested different aspects of the practice of knowledge brokering might present as informing, misinforming and disinforming. It is critical that knowledge brokers are able to map their own work in this way, finding and respecting boundaries of practice with regards to these three areas so that they are able to plan and deliver work that is reputable and trustworthy, and justify why this is so. Brokers could adopt this kind of practice mapping periodically, filling details relative to their environment and context, which could apply per project or per year, and this could be part of their professional learning and professional accountability as both a formative and summative exercise.

*Table 6.5 an example of mapping the practice knowledge brokers through the boundaries created by informing, misinforming and disinforming; brokers could fill this in with details specific to their work*

| **Aspect of knowledge brokering** | **Informing** | **Misinforming** | **Disinforming** |
|---|---|---|---|
| Knowledge brokers **mediate** between research producers and research users, facilitating relationships, connections and sharing information | Mediation contains minimal amount of interpretation; brokers connect people with other people and/or information and minimise themselves, focusing on the truth and the needs of the user | Mediation contains too much interpretation; brokers connect people with other people and/or information in ways that extends or overextrapolates the truth | Mediation is all interpretation; brokers connect people with other people and/or information without regard for truth and/or the needs of the user |
| Knowledge brokers **embed** themselves into practice, or connect more deeply with decision-makers, supporting them to contextualise and question findings as well as 'use' them | Embedding involves learning and understanding contexts for use, including possible models and mechanisms, and limitations | Embedding involves minimising or ignoring contexts for use, including failing to pay attention to possible models and mechanisms, and limitations | Embedding involves learning and understanding contexts for use, including possible models and mechanisms, and limitations |
| Knowledge brokers **translate,** define and use analogy and metaphor to explain concepts from research more clearly | Translation involves thoughtfully moving research ideas into contexts or focus without losing the original intent or losing fidelity; ideas are not moved too far, and limitations discussed | Translation involves moving research ideas into contexts or spaces which loses the original intent or loses fidelity; ideas are moved too far, or the meaning is changed too much, and limitations not addressed | Translation involves a lack of regard for or understanding of original ideas, such that they are misrepresented |
| Knowledge brokers **transform** research ideas into differently structured or focused forms and formats, interpreting for decision-making and crafting narratives | Transforming involves restructuring, focusing or retelling ideas in forms that make them clearer or more compelling without losing fidelity; the transformation is of the telling, not the truth | Transforming involves restructuring, focusing or retelling ideas in forms that make them more difficult to understand or involve them in narratives that transform the truth, not the way of telling it | Transforming involves little or no engagement with the original ideas or their contexts; transformation makes knowledge unrecognisable or unrelatable and loses any meaning |

As I explored in the earlier section regarding implications for the field, knowledge brokers must have structures in place to guard against bullshit. They must also develop methods of tracking the truth and self-evaluation. Knowledge brokers need access to resources and support to help avoid situations in which they might be incentivised or pressured to bullshit, and a central body to which they can appeal for advice and support if this occurs. They need to be able to talk to one another, helping set realistic expectations about what they can know and do, and develop repertoires of practice to learn from one another. Since knowledge brokers are experts in moving ideas from theory to practice, who better to create such organisations, supports and structures than brokers themselves?

## Implications for knowledge users

Knowledge users need, and deserve, to trust knowledge brokers. In my review of the literature (Paper 1) I found that knowledge brokering is not neutral (Malin et al., 2018), and it is expert,

difficult work (Cordingley, 2008). There is a risk of the Dunning-Kruger effect (Dunning, 2011) when working with research and evidence in evidence; it is easy to oversimplify, overstate and overuse 'low hanging fruit', and knowledge brokers act as gatekeepers (Malin et al., 2018), and this is an important responsibility (Sharples & Sheard, 2015). Knowledge users have a right to know the values and perspectives of knowledge brokers so they can evaluate whether the brokering activity will be a good fit for them. Those who seek to use evidence to make better decisions in education should be encouraged and supported to do so by having a clear menu of options, set of expectations, and recourse if knowledge brokering activity is not truthful, responsible, or equitable.

This work explores some of the exciting and innovative ways that knowledge brokering could improve the work of knowledge users; but also demonstrates the joy and benefits of collaborative knowledge brokering and the deep, creative and important work that can arise from it, showing that the work of knowledge brokers can also be similarly improved by the knowledge user. It demonstrates that linear knowledge flow is not only undesirable, but also inequitable, and dull, and practitioners and policymakers deserve better.

## Directions for future research

In this thesis I have investigated the concept of educational knowledge brokering, focusing on its processes and implications for practice, particularly in mathematics education. The research employed varied methods, including narrative synthesis, art-based approaches, and mixed methods research, to explore theoretical, methodological, and practical dimensions of knowledge brokering. Key findings highlight the under-researched nature of educational knowledge brokering, the importance of interpersonal relationships and social contexts, and the need for clear definitions and evaluation frameworks in order to move the field forwards and work towards doing ethical and effective work. Art-based methods revealed themes such as storytelling, boundary negotiation, and the balance between accessibility and gatekeeping, while also addressing ethical considerations, in particular the risks of disinformation and misinformation. A mixed-methods study using *research clinic* model uncovered the complex dynamics of brokering interactions, including the importance of identity shifts and systems thinking. I found that several key motifs have been uncovered in this work as a whole, framed as qualities for knowledge brokers to develop and evaluate: humility, credibility, empathy, accountability, responsibility, and integrity. I conclude by advocating for further theoretical and empirical investigation into the ethical dimensions and evaluation of brokering practices and emphasising the potential of innovative methods like art-based inquiry and *research clinics*

which have been demonstrated here. I also conclude that possible future directions for research should include those in Table 6.6, related to the themes from Papers 2 and 3 and the motifs that have punctuated this work as a whole.

*Table 6.6 Possible directions for future research in knowledge brokering*

| **Theme** | **What does this tell us about knowledge brokering?** | **Related motifs** | **Possible directions for future research** |
|---|---|---|---|
| The importance of storytelling | Knowledge brokering balances truth-telling activity with crafting a compelling, clear, simplified and coherent narrative, structured to support audience understanding and engagement | Integrity, empathy, responsibility | **How can we train knowledge brokers to tell stories without compromising on truth-telling?**<br>**How can we usefully define the intersection between truth-telling and storytelling?**<br>**What innovative modes and formats could be pursued to broker knowledge more effectively for different audiences?** |
| Rule-abiding and rule-breaking | Rules and conventions act as both guideposts and guardrails; knowledge brokering should develop a set of guidelines and support structures that support its activities being effective and ethical without stifling creativity and innovation | Accountability, empathy, responsibility | **What knowledge brokering guideposts and guardrails could be developed that support effective and ethical knowledge brokering?**<br>**What new and creative ways of knowledge brokering can be designed?** |
| the interplay between process and product | Knowledge brokering is not just about creating artefacts; the idea of product and process are intertwined | Responsibility, humility | **When is activity with and about research constituted to be 'knowledge brokering', and when is it not? What different types of knowledge brokering exist?**<br>**How often should brokers update or check knowledge brokering products to ensure they reflect the latest research?** |
| The interplay between accessibility and gatekeeping | Knowledge brokers control not only knowledge flows, but knowledge forms; they have a responsibility to choose and use knowledges ethically and with discernment, truth-telling about the topic but also about research use more widely, as well as encouraging decision makers to form their own relationships with the evidence | Responsibility, humility, empathy | **How can knowledge brokers balance truth-telling about ideas and topics as well as the nature and texture of research more widely?**<br>**How can knowledge brokers effectively build capacity: encouraging decision makers to form their own relationships with the evidence over time?** |

| | | | |
|---|---|---|---|
| Boundary-eliciting work | Knowledge brokering should have defined boundaries, particularly as regards what is considered (truthful, useful) informing as opposed to misinforming and disinforming | Responsibility, accountability, integrity, humility, credibility | **How can knowledge brokers be encouraged, taught to, incentivised and held to account for informing as opposed to misinforming or disinforming?**<br>**How can the field of knowledge brokering be better regulated so that misinformation and disinformation is less likely?**<br>**How can we flexibly but usefully define 'good' and 'harmful' knowledge brokering?**<br>**What kinds of professional associations or organisations could be effective in promoting or evaluating good practice in knowledge brokering?** |
| Boundary-blurring work | Knowledge brokering involves blurring boundaries, specifically by exposing false binaries, bridging previously disparate ideas or modalities, and bringing people together | Empathy, humility, credibility | **How might the identities (specifically queer and/or marginalised) of knowledge brokers affect their work?**<br>**How do knowledge brokers negotiate different identities in their practice and what are the consequences?**<br>**What are the social, relational and political aspects of knowledge brokering?** |

Chew et al. (2022) and Kislov et al. (2017) call for more research into the *consequences* of knowledge brokering, including potential harms. Clearly, one of the most significant harms that could be caused by knowledge brokering is misrepresenting research and evidence, either by misinforming or by disinforming, as I have discussed in some detail in this work. An urgent priority, in my view, is to reconcile previous work and construct new theory for what is "good" (in the sense of both *effective* and *ethical)* knowledge brokering, examine how context-specific or context agnostic this may be, and create a framework for evaluation and accountability for brokers, alongside a network or organisation to enact it as well as give support and training to brokers, thereby professionalising their work in ways which benefit both them and the communities they serve.

## Critical reflection

This work has changed me in many ways. I began this thesis hoping to discover more about the field of educational knowledge brokering, and have ended it with discovering also much about myself as a researcher; the practice and texture of research; the barriers and disappointments of being a researcher; the tensions and issues in the communities I have joined; and mostly, how little we still know about this field. More than anything, this work is a drawing of attention

to critical gaps, and a call to action to work on them. Here I have offered thoughts, themes, ideas and suggestions as to how this may proceed, and I welcome critique and further dialogue about this process. We are, friends, not anywhere near *beginning of the end* of knowings about knowledge brokering; we may, however, be at the *end of the beginning*.

## References

Bacchi, C. (2012). Introducing the 'What's the Problem Represented to be?' approach. In A. Bletsas & C. Beasley (Eds.), *Engaging with Carol Bacchi: Strategic Interventions and Exchanges* (pp. 21–24). The University of Adelaide Press. https://doi.org/10.1017/UPO9780987171856.003

Braun, V., & Clarke, V. (2021). *Thematic analysis: A practical guide to understanding and doing* (1st ed.). SAGE Publications.

Chew, S., Armstrong, N., & Martin, G. P. (2022). Understanding knowledge brokerage and its transformative potential: A Bourdieusian perspective. *Evidence & Policy*, *18*(1), 25–42. https://doi.org/10.1332/174426421X16149632470114

Cordingley, P. (2008). Research and evidence-informed practice: Focusing on practice and practitioners. *Cambridge Journal of Education*, *38*(1), 37–52. https://doi.org/10.1080/03057640801889964

Duncan, R., Robson-Williams, M., & Edwards, S. (2020). A close examination of the role and needed expertise of brokers in bridging and building science policy boundaries in environmental decision making. *Palgrave Communications*, *6*(1), 1–12. https://doi.org/10.1057/s41599-020-0448-x

Dunning, D. (2011). Chapter five - The Dunning–Kruger Effect: On Being Ignorant of One's Own Ignorance. In J. M. Olson & M. P. Zanna (Eds.), *Advances in Experimental Social Psychology* (Vol. 44, pp. 247–296). Academic Press. https://doi.org/10.1016/B978-0-12-385522-0.00005-6

Fachinelli, A., Giacomello, C., Larentis, F., & D'Arrigo, F. (2016). *MEASURING THE CAPITAL SYSTEMS CATEGORIES: A PERCEPTION OF AN INTEGRATED VALUE SYSTEM OF SOCIAL LIFE FOR KNOWLEDGE-BASED DEVELOPMENT*.

Fenwick, T., & Farrell, L. (2012). Introduction: Knowledge mobilization the new research imperative. In T. J. Fenwick & L. Farrell (Eds.), *Knowledge mobilization and educational research: Politics, languages and responsibilities* (pp. 61–72). Routledge.

MacGregor, S. (2024). Theorising a spectrum of reasons for failure in knowledge brokering: A developmental evaluation. *Evidence & Policy*, *20*(1), 51–69. https://doi.org/10.1332/17442648Y2023D000000004

MacKillop, E., & Downe, J. (2022). Knowledge brokering organisations: A new way of governing evidence. *Evidence & Policy*, *1*(aop), 1–20. https://doi.org/10.1332/174426421X16445093010411

MacKillop, E., Quarmby, S., & Downe, J. (2020). Does knowledge brokering facilitate evidence-based policy? A review of existing knowledge and an agenda for future research. *Policy & Politics*, *48*(2), 335–353. https://doi.org/10.1332/030557319X15740848311069

Malin, J. R., Brown, C., & Trubceac, A. S. (2018). Going for Broke: A Multiple-Case Study of Brokerage in Education. *AERA Open*, *4*(2), 2332858418769297. https://doi.org/10.1177/2332858418769297

Malin, J., & Shewchuk, S. (2024). Equity-centered knowledge brokering: Taking stock of challenges, strategies, and possibilities. *Frontiers in Education*, *9*. https://doi.org/10.3389/feduc.2024.1436150

Mao, L., Mian Akram, A., Chovanec, D., & Underwood, M. L. (2016). Embracing the Spiral: Researcher Reflexivity in Diverse Critical Methodologies. *International Journal of Qualitative Methods*, *15*(1), 1609406916681005. https://doi.org/10.1177/1609406916681005

Sharples, J., & Sheard, M. (2015). Developing an evidence-informed support service for schools – reflections on a UK model. *Evidence & Policy: A Journal of Research, Debate and Practice*, *11*(4), 577–587. https://doi.org/10.1332/174426415X14222958889404

Ward, V. L., House, A. O., & Hamer, S. (2009). Knowledge brokering: Exploring the process of transferring knowledge into action. *BMC Health Services Research*, *9*(1), 12. https://doi.org/10.1186/1472-6963-9-12