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Conceptualising translational research in schools: A systematic literature review

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ABSTRACT

Since Stenhouse (1975) called for teachers to have ownership of research, there have been initial forays into teacher led research and evidence-based practice in schools. However, the notion of translational research in schools remains contested, in significant part because it still has not been rigorously conceptualised. This is an issue of increasing concern, in our rapidly developing world. Now, more than ever, we need research-informed education, to address the complex challenges faced by school communities, and those with the most significant role in supporting them: teachers. To address the gap in understanding how best to promote translational research in schools, this systematic literature review asked, what do innovative and impactful translational, teacher research infrastructures look like? By translational research, we mean a process of agentic and agonistic democracy within which teachers critically develop and, or use research to support their classroom practice. The purpose and focus of this paper therefore, is to present the current extent and form of translational research practices in schools by undertaking a comprehensive, systematic review of the published literature on the issue. We found that the potential for translational research in education can be considerably enhanced when five key themes are taken into consideration, these being: Teacher-Researcher Collaboration; Teachers as Researchers; Research Cultures in Schools; Teacher Agency; Sharing, Accessing and Utilizing Research. The notion of technology - as a theme in its own right - was notable by its absence. From the findings we have been able to propose a foundational framework of translational research in schools. To date there have been no other systematic literature reviews on translational research in education, nor any frameworks proposed; and thus this paper addresses a significant gap in the field.

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1. Introduction

Every day, teachers around the world make decisions about how to help learners and thus need easy to access and up-to-date evidence to inform those decisions. Ensuring the efficacy and impact of infrastructures to support teachers is critical because, "the quality of an education system cannot exceed the quality of its teachers" (Barber & Mourshed, 2007, p.19). However, access to evidence informed knowledge is not readily available and where it is, busy teachers who are time-poor find it hard to translate this into practice. In recent years there have been initial explorations into the practical application of translational research in classrooms (Connolly et al., 2020), as detailed in Section 2.2 of this article. Wethington & Dunifon (2012) suggest translational research is a systematic approach to turn research knowledge into practical applications. To date, such research has most widely been associated with the field of science and particularly medicine, where it is seen "as research steps to take discoveries from the bench to the bedside and back again" (Fort, et al., 2017, p. 60).

However, it has yet to be fully explored or made a wide-scale reality in the field of education. Indeed, the very place and relevance of research in education and teaching remain contested. For example, Wiliam (2019) draws our attention to the inherent challenges and arguably problematic positioning of educational research, especially the idea of education as *evidenced-based:* "Classrooms are just too complicated for research ever to tell teachers what to do".

It is important to note the authors are involved in national and international teacher-research initiatives that are being designed with and for teachers. In this, the authors work closely with teacher representative organisations in their respective countries. The express purpose of this collaboration is to support teachers and what they will authentically value and need from research, as opposed to uncritically imposing policy directives that are removed from the day-to-day exigencies and priorities of classrooms. Rather than exacerbate a creeping neo-liberalism within education, our approach is to conceptualise a model that we hope will achieve precisely the opposite, supporting teachers to engage critically and dialectically with research. Consequently, in positing a model of teacher research, based on the extant literature, we predicate our thinking on agonistic democracy. We explicitly acknowledge and support the value of what has been explicated so well in the critical literature on school research leadership, including: the importance of contestation and plurality of voices in classrooms and schools; the inherent and valuable messiness of education, teaching and learning as social processes; and research supporting educational futures that are truly inclusive, where the status quo is challenged and changed, by and for teachers (Hammersley-Fletcher et al., 2018). Our educational futures can often be characterised as necessarily more metrics-focused and market-driven. However, Bayne & Gallagher (2021) have rightly outlined how designing educational futures must be inclusive and place learners and teachers at the heart of the process. Our approach is not to contribute to a neo-liberal agenda in education, but rather develop a critical framework through which teachers themselves critique and challenge the influences and forces that prevail negatively upon classrooms. Our model is therefore dialectical rather than metrical, an agonistically democratic framework through which teachers will be supported in their work in ways that are authentic, meaningful and realistic for their respective classrooms and schools.

Joyce & Cartwright (2019, p.1074) highlight very well the intrinsic limitations that obtain in evidence-based education (EBE) and the determinism of randomized controlled trials (RCTs): "at best, educational RCTs evidence causal ascriptions, which, without further assumptions, are irrelevant to general effectiveness claims and effectiveness predictions". As a consequence, they rightly "propose a serious rethinking of the EBE model to figure out how better to produce evidence and theory relevant to effectiveness predictions directly", which necessarily centres on a "far broader, context-centered research agenda. Additionally, materials for decision makers should highlight local planning and prediction as an indispensable step."

Our work in teacher research, including the initiatives: MESHGuides, Teachers' Research Exchange (T-REX), and European BRIST Project, aims to put *context-centredness* at the heart of a more expansive teacher research agenda, including context-sensitive supports for decision-makers, teachers and school leaders. Our use of scenario-based and design-based research methodologies, as proposed and developed by Hennessy et al. (2021), further underscores the growing importance across our national and international educational contexts of research that bridges the gap between practice and theory, giving further lie to the notion that research 'tells teachers what to do'. Design-based research methodologies aim to align and integrate practice and theory through accretive and iterative cycles of shared, participatory design and evaluation that agentically and centrally involves learners and teachers as co-designers. Central to our aim to put context-centredness at the heart of our work is the need for a robust theoretical foundation for emancipatory, participatory design-based research that is led by teachers. We aim in this article to contribute to the conceptualisation of this different kind of EBE model, as advocated by Joyce & Cartwright (2019), one that foregrounds and prioritises *context-centredness* as both essential and a priori, best realised through dialogic, participatory research with and for teachers and schools.

The purpose and focus of this paper is to understand the current extent and form of translational research practices in schools. This is particularly important in our rapidly developing world where we face common challenges, such as the educational consequences of the COVID-19 global pandemic, which has been noted as a potential generational global catastrophe for education by the UN Secretary-General (UNESCO, 2020), thus requiring us to be more responsive in the way we develop pedagogies to engage and effectively teach students in schools.

This systematic literature review (SLR) provides a novel lens through which to view translational research in schools. To date there have been no other SLRs on this topic and consequently this paper addresses an original and significant gap in the literature.

2. Background

We first provide a working definition of translational research situated in the context of education. We then foreground this SLR by examining educational translational research through three salient perspectives, these being: policy and practice; current trends; and

schools as places of research.

2.1. Translational research

Since the term first began to appear in the early 1990s, translational research has most often been interpreted within the contexts of engineering, health science and the medical fields, where it is also sometimes referred to as 'translational science' or 'translational medicine' (McGartland Rubio et al., 2010). Pomeroy & Sanfilippo (2015) suggest that in medical research there are two stages of translational research, these being 'basic to clinical' where lab based and preclinical research is then developed for the purpose of clinical trials. The second is 'clinical to population' where the findings of the clinical trials are then adapted for practice in the mainstream.

2.2. Translational research in schools

Education is fundamentally different to engineering, health science and medicine particularly because it is most highly influenced by cultural factors, which affect how knowledge is conceptualised and used (Organisation for Economic Co-operation and Development, OECD, 2000). Whilst the concept of translational research has been widely explored and embedded in these other fields, it remains an emerging area in education (Jones et al., 2015), notwithstanding propositions from, for example, the UK Government (Goldacre, 2013) and the Organisation for Economic Cooperation and Development (OECD) (2010) to gather evidence on best practice in education and develop this for practical application.

There are examples of isolated educational projects which have begun to explore the notion of translational research through teacher-led research, underpinned by social constructivist literature (Vygotsky, 1978) and communities of practice (Wenger 1998; Wenger et al. 2002) where the technology is integrated as a tool of social emancipation for teacher researcher. Examples of such platforms include T-REX(http://t-rex.ie); evidence informed teaching (e.g. MESHGuides https://www.meshguides.org); and teacher research based innovations (e.g. OSOS https://www.openschools.eu (Connolly et al. 2020). However, a rigorously conceptualised and integrated definition of what translational research infrastructure for schools should look like remains lacking in the literature.

Education translational research has been described as "the movement of available research knowledge into active professional use" (Lavelle, 2015, p. 460) and is sometimes used in conjunction with the notion of knowledge mobilisation to describe the processes that enable research to be shared and made accessible to others. But how this takes place in practice and by whom is unclear; and this view does not account for the relationship between teachers and researchers who may not be the same people.

Whilst the British Educational Research Association (2014) argue that teachers need access to research which can inform practice, Tan (2015) suggests that this is problematic as university academics, who are often the people who carry out research, have different agendas for undertaking research, which may be at odds with the needs of teachers in classroom settings. Moreover, teachers lack the "lived examples of implementation" (Black & Wiliam, 1988, p. 15) which they require from other teachers. Thus in any notion of translational research, it seems that the relationship and roles of teachers and researchers need to be considered. Furthermore, as noted by Wiliam (2019), the view of research in education must shift from a deficit perspective, that research is there to 'fix problems in teaching practice', and towards an understanding of research as inherently a shared process that teachers have ownership of, one that authentically supports their professional development and learning.

This initial exploration into the terminology has proved useful in enabling the SLR team to develop a working definition of translation research. In addition, it was important for this research to settle on a definition that would enable a thorough exploration of the research question. We thus define translational research as:

> a systematic educational inquiry or investigation, where the findings have been developed by and/or shared effectively with practitioners, with the purpose of informing educational practices.

Implicit herein, is the importance of people and process, including the notion that teachers themselves may be the researchers. This definition was used to explore the word strings in the search as well as to provide a lens through which to review the content of the articles in relation to the research question.

2.3. The context of this SLR

This SLR is part of a 3 year European research project which is a collaboration across institutions, charities and organisations in Greece, Poland, Ireland, Spain and the UK. This consortium have come together to design an international technology-enhanced research infrastructure for schoolteachers. This SLR foregrounds the project by identifying where and how translational research and evidence-informed practice is currently taking place in schools across the globe. The SLR is particularly interested in barriers, challenges and opportunities that inhibit or enable the adoption of translational research and evidence informed practice. Through four extensive discussions; a scan of the current key literature and policy in the field; and informed by the extensive background and experience of the partners as educational researchers and former schoolteachers, the following research question was carefully distilled and posited to shape the SLR:

> *What do innovative and impactful translational research infrastructures look like for schoolteachers?*

3. Method

The aim of a systematic review is to follow "explicit, rigorous and accountable methods" (Gough et al., 2012, p. 6) which enables the researchers to logically carry out their work and for the reader to trust in the findings. The SLR process followed in this research uses the model adapted from Gough et al. (2012). This paper begins with step 3, the Search Strategy followed by various stages leading to the full review of a final selection of relevant articles.

3.1. Search strategy

In order to comprehensively search for relevant articles to answer these questions, we took the following steps:

- Derived major search terms arising from the Research Questions;
- Identified relevant terms, synonyms and alternative spellings for the major terms, as used in published literature;
- Constructed a search string from the resulting terms, connected using Boolean operators;
- Selected a range of online digital libraries for searching. The search string was customized as required by the different interfaces of online databases;
- The string was applied on abstracts;
- We managed the results (citations and abstracts) using RefWorks (www.refworks.com)

In addition:

- The searches were open for the following dates 01.01.2010 - 31.12.2019 to give currency of recent work in our rapidly changing world.

Using the main research question, we identified three key search terms as follows:

String 1: Translational Research
String 2: Schools
String 3: Innovation

Using these three search terms, we then identified all the associated synonyms and alternative terms that might be used for them, drawing on the full project team representing the Republic of Ireland, Poland, Spain, Greece and the UK. The search terms included:

("evidence based decision making" OR "evidence-based decision making" OR "evidence informed practice*" OR "evidence-informed practice*" OR "knowledge management" OR "knowledge mobili*" OR "knowledge sharing" OR "practitioner* research" OR "research informed teaching" OR "research-informed teaching" OR "research led teaching" OR "research-led teaching" OR "teacher led research" OR "teacher-led research" OR "teacher researcher*" OR "translational research") AND ("classroom" OR "continued professional development" OR "elementary age*" OR "elementary-age*" OR "elementary education" OR "elementary school" OR "high school age*" OR "high school-age*" OR "high school" OR "K6" OR "K-6" OR "K12" OR "K-12" OR "middle school age*" OR "middle school-age*" OR "middle school" OR "P6" OR "P-6" OR "P12" OR "P-12" OR "primary age*" OR "primary-age*" OR "primary education" OR "secondary age" OR "secondary-age*" OR "secondary education" OR "school*" OR "school teacher" OR "7-12" OR "7-10") AND ("creativ*" OR "disrupt*" OR "ground breaking" OR "ground-breaking" OR "imaginative" OR "infrastructure" OR "ingenius" OR "inquisitive" OR "innovat*" OR "network" OR "original*" OR "partnership" OR "progressive" OR "reimage*" OR "re-image*" OR "revision*" OR "re-vision*" OR "technology" OR "transform*" OR "vision*")

The search terms were then used to search for abstracts of relevant articles across a series of databases. The databases accessed included:

- Education Research Complete (https://www.ebsco.com/products/research-databases/education-research-complete)
- ERIC (https://eric.ed.gov)
- Gale (https://www.gale.com/databases)
- Informit A+ Education (https://www.informit.org/informit-education)
- ProQuest (http://www.proquest.com)
- Sage Journals (http://online.sagepub.com)
- Scopus (https://www.elsevier.com/solutions/scopus)
- Web of Science (https://clarivate.com/products/web-of-science)

Initially 810 abstracts were identified from this search. Thereafter a series of stages were followed to select the final abstracts for detailed study.

3.2. Study selection

Stage 1 of the study selection consisted of the first author eliminating a) duplicates ($n = 369$) and b) irrelevant articles due to poorly

performing database search engines ($n = 111$). For example, a number of articles emerged from medical school contexts. The second author checked this by randomly reviewing the abstracts of excluded articles to reduce selection bias. No issues relating to the abstract exclusion process were found in Stage 1, which resulted in 330 abstracts being selected for Stage 2.

Stage 2 consisted of a calibration exercise where the 5 authors all independently, blind reviewed the first 30 abstracts. In so doing they were specifically making sure the articles were about translational research using the working definition, that they were embedded in a school context and that they demonstrated some form of innovation. The scores were then presented back in a master spreadsheet and where there were differences of opinion an author team discussion ensued to establish clarity of meaning. For example, we were only interested in articles where teachers were research 'agents', not simply 'subjects' of the research. From the calibration exercise, 15 of the 30 abstracts were excluded from the study and the remaining 15 abstracts were moved to the final spreadsheet.

Once we had identified a shared understanding of the inclusion / exclusion criteria, (Table 1) these were then applied to the 300 remaining articles, which were divided between the authors.

Again, authors were paired to reduce selection bias (see Table 2) and the review was carried out blind, with authors meeting once they had completed their review to check their selection against those of their colleagues. In this way, we were able to establish a rigorous and systematic process to the selection of final abstracts. In the case where authors disagreed with each other, the whole team reviewed the abstract to come to a final decision.

This process then left 101 abstracts as identified in Table 2.

Stage 3 consisted of reading the full articles to make sure that the abstracts were a true reflection of the content of the articles. The articles were distributed evenly amongst the team. After the articles had been read in full, it was found that 19 articles were not accurately represented by their abstracts and had no relevance to the study. These were removed, leaving 82 articles for final detailed analysis. An additional 3 articles could not be found in their full version and were thus eliminated from the study leaving a final total of 79 articles for Data Extraction. The full process is summarized in Fig. 1.

3.3. Data extraction and analysis

Data were then extracted from the articles so that an analysis across the final study selection could take place. This occurred in two phases. The first phase included a calibration exercise to ensure the correct extraction criterion had been chosen. Each author was given two different articles and disaggregated the data according to headings determined by the first author. After this process, the headings were slightly amended so that data could be extracted effectively. The final headings included year of publication, authors, title, key words, key areas of literature covered, scale of study, methodology, level of schooling, who is involved in the study and how, geographic location of the study, discipline focus, type of translational research, school context, innovative features, what was investigated, outcomes/results/impact, innovative features, and relevance to the research question. The data were then analysed using the extraction headings. Some of the data (e.g. geographical location) were analysed in excel and other data (e.g. innovative features) were imported to Nvivo for coding, categorization and theme analysis.

3.4. Parameters & limitations

It is of course possible that not all articles were captured during the selection process. For example, as rigorous as we have been in selecting relevant search terms, we many have missed out a specific term used by a particular group. This especially applies to the term innovation, which may be open to wide interpretation. As a team, we held several meetings to unpick what we meant by innovation in the context of this study to make sure we had absolute clarity and consensus between the research team. Also, these discussions were informed by reference to and interpretations of academic literature. In relation to other limitations, our search was time bounded and we only accessed English speaking peer review journals. Nor did we include conference papers and, the journal articles we did use, needed to be available both in full and electronically. Lastly, the study is limited in that we did not include grey literature. This was agreed after long debate, acknowledging that in so doing, we might exclude articles, reports or other accounts authored by teachers detailing their experiences and processes of carrying out teacher research. However, we took the decision that the final selection of articles should be peer reviewed academically to provide a level playing field. This has ensured the trustworthiness of processes followed.

Table 1
Inclusion / exclusion criteria.

Include if:	Exclude if:
it covers Translational Research according to our definition	teachers are 'subjects' of the research, rather than 'agents'
the school context includes teachers	it is not about schools
it clearly identifies an emerging theme that has relevance to our RQs	there is no evidence of innovation

Table 2
Stage 2 summary of inclusion / exclusion of abstracts.

	Calibration Exercise	Authors A&B	Authors A&C	Authors B&D	Author C&E	Authors E&D
Excluded	15	38	50	38	45	43
Included	15	23	10	22	12	19
Total	30	61	60	60	57	62

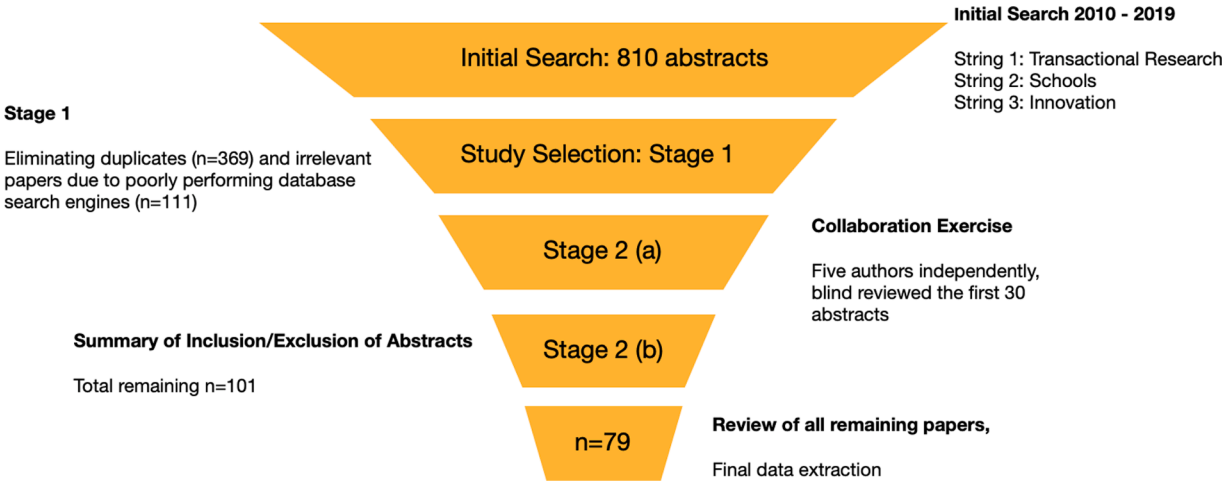

Fig. 1. A summary of the study selection process.

4. Results

4.1. Frequency analysis study attributes

4.1.1. Number of articles by Year

As can be seen from Fig. 2, the top three years with the highest occurrence of articles are 2014 (n=15), 2017, (n=12) and 2018 (n=11). The bottom three years with the lowest occurrence of articles are 2013 ($n = 3$), 2015 ($n = 3$) and 2012 ($n = 4$).

4.1.2. Articles by country

As can be seen from Fig. 3, the region with the highest number of articles is North America ($n = 26$). The region with the lowest number of articles is Africa ($n = 1$). South America returned no papers, possibly as a result of the language limitation as discussed in Section 3.4.

4.2. A summary of the qualitative SLR findings

Having interrogated the qualitative extraction data using coding and thematic analysis processes in Nvivo software, five key themes emerged in relation to the research question: What do innovative and impactful translational research infrastructures look like for school teachers? The final stage in selecting the themes involved two meetings. Firstly, where the authors discussed the potentially salient themes that were emerging for each of us, and then one member of the team was asked to synthesise the group's deliberations and generate a provisional set of themes for further discussion. In the second meeting, these penultimate themes were presented, discussed and further refined, until the final set of themes was unanimously accepted and agreed by the team.

The first theme is associated with the nature of teacher-researcher collaboration, which is based on equality rather than hierarchy. The second theme relates to teachers as researchers, noting in particular how research impacts on student learning. The third theme suggests a research culture is necessary within schools and/or amongst teachers and relates to the fourth theme, teacher agency being prevalent in the research process. The fifth theme to emerge relates to the sharing, accessibility and utilization of research. A summary of these themes can be seen in Fig. 4 and are discussed in the following section.

Fig. 2. Number of articles by year of publication.

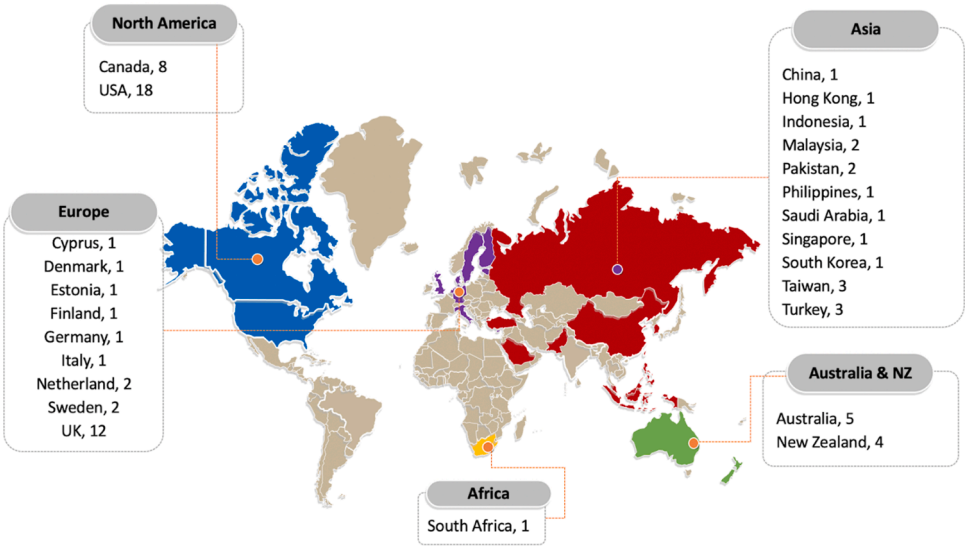

Fig. 3. Global distribution of study selection articles.

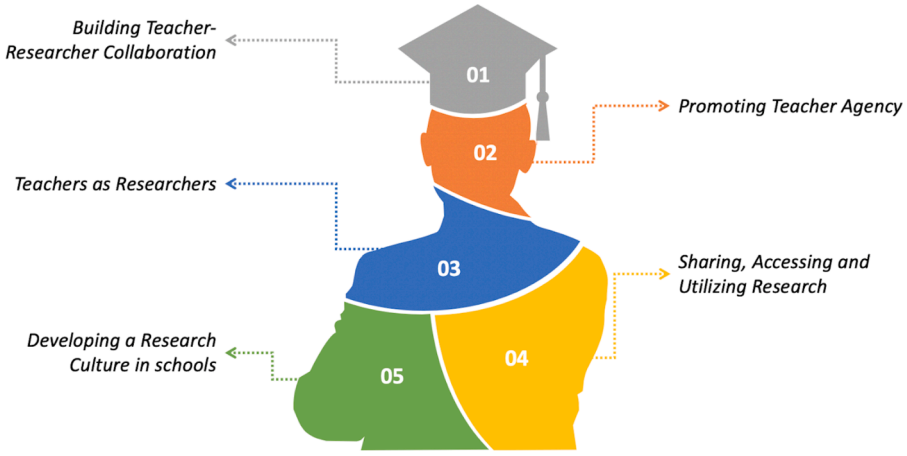

Fig. 4. A summary of the five themes that emerged from the SLR.

5. Discussion

The first item to note is that the articles taken on their own, do not demonstrate what innovative and impactful translational research infrastructures look like for schoolteachers. However, viewing articles in their totality through an SLR process, themes have emerged to demonstrate necessary conditions or elements, which appear to be core to the notion of effective translational research practices in schools, especially in terms of effectively supporting teachers. Additionally, the five emergent themes are interlinked and should not be seen in isolation. In articles where we found evidence of translational research successfully taking place, all five themes were present to some degree, although the articles tended to focus mainly on one theme. It is also worth noting that none of the articles provided longitudinal evidence of systemic change, where research had become embedded seamlessly into schools. This is perhaps a reflection of the emergent state of translational research in schools. We would also like to note that these points are not criticisms of the articles, rather it should be observed that in the main, authors were reporting on a specific instance, whereas we are looking at the broader landscape of what constitutes effective and innovative practices in schools so as to better understand the complexity of translational research in wider educational contexts.

5.1. *Building teacher-researcher collaboration*

The SLR drew attention to salient aspects of the collaborative relationship between teachers and researchers. In many education research situations, teachers can be viewed as passive participants (Cowie et al., 2010), answering questionnaires or being interviewed,

however, in this SLR, teachers played a more active part, even leading the research process, (for example, see Kuntz et al., 2013 or Ryerson, 2017). However, teachers often did not possess research skills and relied on researchers to model best practice as demonstrated in articles by Locke (2010) or Yuan & Burns (2017). This modelling of practice aligns with the support infrastructures suggested by the Organization for Economic Cooperation and Development (OECD) (2016). It was also noted that teachers' engagement was contingent on being properly supported in the fundamentals of applying and, or doing research which links this theme with that of research culture and is suggestive of adequate research infrastructures being in place. Furthermore, the development of trust between the two diverse professions emerged as a significant interpersonal factor. Parity of esteem represents a fundamental requirement, where teachers and researchers are genuinely committed to learning from, and supporting each other. This finding is also supported by Cowie et al. (2010) who found that 'mutual trust, respect and rapport are essential' in teacher-researcher collaborations. Without this, teachers are less likely to share their thoughts or try out new ideas.

The SLR also highlighted how new combined forms, or hybrids of the roles of researcher and teacher might offer significant potential for challenging and changing the research-teaching binary in education. This was particularly illuminated in the paper by Hamza et al. (2018) who found that collaborations between teachers and researchers opened up possibilities for new configurations of research and teaching that challenge prevailing, historical barriers between the two professional traditions. Indeed, when we can conceptualise the mutuality of research and teaching as closely related within the dynamic of a 'scholarship of teaching', like that envisioned by Boyer (1990), we may facilitate a greater integration of the two, where they can mutually enhance and positively remake each other. This synergy helps research to enhance teaching, what we generally call research-led teaching, but also enables teaching to improve research, through *teaching-led research*.

Furthermore, the SLR demonstrated that where collaborations were more effective in the research process, both teachers and researchers benefitted from moving outside of their own community and entering the outskirts of the other, described by some as "moving across the chasm of inside-outside in ways that have the potential to positively impact both communities" (Herrenkohl et al., 2010, p. 75).

5.2. Teachers as researchers

Critically, a priority that emerged in the SLR was that teachers needed to see how the research ultimately had positive effects on students' learning. Engagement in research was not seen as valuable or worthwhile by teachers unless it enhanced the quality of learning in the classroom. If it was not clear how research could help teachers to enhance the educational experience or attainment of students, then it was dismissed and even avoided (for example, see Cantalini-Williams et al., 2015; Rust, 2017). This was an incontrovertible consideration for teachers in deciding whether they would use or undertake research.

Other studies (Cain, 2015a, 2015b) also noted that teachers will only engage with research if they have permission to experiment and can use their own professional judgement as to how research is used and/or have created trusted relationships with researchers as illustrated in the article by Barnett et al. (2010). Equally teachers are more likely to use ideas that support their own experiences (Walker et al., 2019).

The SLR also illustrated (see Muhonen, 2014 and Fulmer & Bodner, 2017) the meta-cognitive potential of research in the classroom, where teachers and students learn alongside each other. Research is thus seen as pedagogically powerful, where the teacher even shares and discusses the purpose and design of the research with students. It creates possibilities for learners to become more self-aware and reflective in terms of their own learning process. This is similar to findings from Ford & Sutton (2009) who suggest that when teachers and researchers work effectively together in classroom settings, students have more authentic learning experiences; thus involvement is not only transformative for teachers and researchers, but for students also.

Previous studies (Flutter, 2007; Pedder & McIntyre, 2006; McIntyre et al., 2005) have also explored how students' views and ideas, or what has been termed 'student voice' can be used to inform changes to teachers' practice with students being capable of analysis of their own learning experiences. In the primary sector for example, a conceptualisation of students as researchers has been used in school improvement (Flutter & Ruddock, 2004).

5.3. Developing a research culture in schools

School cultures provide symbolic frames for giving meaning to and understanding of school practices (Helsper, 2000) and can be viewed on multiple levels (Finnan & Levin, 2000). For example, we could consider the classroom as the micro level, the school community as the meso level and schooling more broadly as the macro level. The theme of research culture that has emerged from the articles reviewed in this SLR are mainly concerned with the meso and macro level. Crucially, we found that research needs to be valued by both the school and the wider educational context. The SLR highlighted how the potential impact and level of engagement by teachers in research are significantly enhanced when it is properly valorised within the cultural life of a school (Cantalini-Williams et al., 2015; Cramp & Khan, 2019); where research has real professional currency. To achieve such a culture, Ebbutt (2002) suggests that schools need to evolve through a series of developmental stages along an evolutionary path from no culture of research, to emergent research culture, to established research culture and finally to established-embedded research culture.

Schools located in this SLR, which had established routines and systems for research, such as in-house innovation units and research-related promotion and support structures were significantly more likely to see their teachers use and undertake research. This seemed particularly to apply for research to be consistent or undertaken on a continuous basis, as exemplified in the article by Song et al., (2014) who noted how school leaders play an integral part in setting the school innovation climate which significantly affected teachers' behaviours. Indeed, evidence from the SLR, suggests that the role leadership plays is central. For example in the article by

Brown & Zhang (2016) they discussed the need for school leaders to promote the vision of evidence use; show how research and evidence can be employed to enhance aspects of teaching and learning; and establish effective learning environments.

This is especially important, as teachers themselves can help to develop and maintain research cultures within schools by conducting research and thus reinforcing the dominant culture and solidifying the values and attitudes which the leaders aim to develop. This view is supported by other literature, such as Humphries & Burns (2015) who suggest that school cultures are, developed and reinforced by managers, teachers, and students, which impact on teaching practice. Teacher researchers can thus become influencers and catalysts for change in the behaviours and values of a school (Skinner & Stewart 2017), helping to establish and embed research culture within the school (Ebbutt, 2002).

It also appears from the articles that research needs to be valued and prioritised in the external, systemic context by key decision and policy makers, educational partners and other stakeholders. It could be that the wider culture of teacher professional development and accreditation, which typically includes national or regional educational ministry and agencies with responsibility for CPD, has a significant bearing on levels of research engagement by teachers (Carr, 2015). For example, encouraging a research-based teacher education programme where teachers are able to utilise educational research as part of their work in school settings, reflecting and developing their own professional development (Sahlberg et al., 2012) might help promote long-term engagement in research. In some countries, such as Ireland, this is now starting to happen, where the national Teaching Council advocates that initial teacher education programmes should be research-based in the sense that pre-service student teachers would both generate and use research in their practice, advocating for teacher-as-researcher (O'Donoghue et al., 2017).

5.4. Promoting teacher agency

Teacher agency is considered a specific form of professional agency with active contributions by teachers shaping their work and conditions. It is assumed to be an indispensable element of good and meaningful education (Biesta et al., 2015). It is clear from the SLR that teachers need to feel a strong sense of ownership of research: an active and central involvement in the process of conceptualising, implementing and evaluating research. The article by Muhonen (2014) suggests that teacher agency is better supported through being a constant learner alongside the students. The classroom community becomes a field of collaborative learning experiences where the students' ideas and initiatives may be seen as possible sources of meaningful direction for further inquiries when they seem constructive, perhaps sometimes also leading to collaborative construction of meaningful learning practices (Muhonen, 2014). Moreover, the SLR supports the earlier assertion that teachers need to see how the research they are applying or undertaking is going to support and help them in their work. The seminal work of Stenhouse, emphasises this point, stating that the "research act must conform to the obligations of the professional context" (Stenhouse, 1983, p. 20). Again, the paper by Muhonen (2014) demonstrated that where research seems unrelated from the everyday educational challenges and concerns of teachers and their professional development, it is generally not valued by them. As a consequence, this highlights the essential nature and desirability of research that is proximal to the practice setting (McKenney, 2013) and locally contextualised through approaches such as design based inquiry research (Hennessey et al., 2021) or context local planning (Joyce & Cartwright, 2020).

It appears from the SLR that a teacher's experience of agency and their ability to work creatively is dependent upon a clear articulation of infrastructures and the identification of areas of flexibility and possibility, as illustrated in Kuntz et al (2013) and Charteris & Smith (2017). Kuntz, et al. (2013) champion a space for teacher researchers to discuss pedagogical goals being created; the creative teaching practices they use and want to use; and the cultural constraints and possibilities within the school, district, and state. Charteris & Smith (2017) highlight the importance of an interpretation of teaching as inquiry and reflective practice that can support critical and collaborative practitioner research. Of particular significance in this paper is the affordance of infrastructures and teacher space for agency, which can be facilitated through the inquiry practices of storying classroom events.

5.5. Sharing, accessing and utilizing research

Another critical theme to emerge in the SLR is the imperative that teachers have adequate access to core research materials, resources and tools (for example, see Cooper et al., 2017). These include professional learning opportunities to develop key research skills, open educational resources (OERs) in educational research, and supportive infrastructures for sharing innovations and ideas. Sharing constitutes a core aspect of research. Indeed it is argued (Hall et al., 2021) that an activity cannot be considered research unless it involves sharing. The SLR highlighted the importance of developing infrastructures that enable researchers and teachers to curate innovative ideas, methodologies and solutions, in ways that are meaningful for them.

Currently, the very nature of research sharing is changing radically, with the development of initiatives such as Open Access 2020 (OA2020). As outlined by the OA2020, "Even though Open Access is now a shared vision of the world's academic communities, research councils, and funding bodies, nearly 85% of the world's scholarly outputs are still locked behind paywalls, inhibiting the full impact of research and putting enormous strain on institutional budgets." Lack of appropriate and effective access significantly constrains teachers in benefitting from, and utilising research. In some jurisdictions, there are welcome, progressive developments in this regard. For example, government agencies or teachers' representative organisations provide teachers with access to some online repositories and publications. However, these are not always in forms which are easy to understand and apply. Nor do initiatives such as these always encompass all educational research, (excluding important educational book and journal publishers), or necessarily support teachers to participate in key debates in education by sharing their research ideas and priorities.

This is not to say that there is not a significant corpus of research materials that can be accessed online. However, the SLR has shown that teachers can lack relevant expertise in how to access, use and undertake research as discussed by Getenet (2019). This highlights

the need also, not only for technologies to collaborate and share research, but for specific, bespoke professional development for teachers in how to judiciously access and undertake research, and open, well-designed resources to support them in becoming active in research. This is further emphasised by Wiliam (2019) who stated that "we need to build teacher expertise and professionalism so that teachers can make better judgments about when, and how, to use research".

Furthermore, as highlighted by Holland et al. (2016) research impact and sharing is now a very broad and dynamic field, including how we even measure research. The established measurements of bibliometrics/scientometrics - calculating citations and related impact factors - are increasingly being augmented by alternative methods or 'altmetrics', such as the impact of research sharing through social media. As a consequence, Holland et al. (2016) also note the importance of valuing or valorising educational research in diverse, creative and emergent forms, thus pointing to the need for different media and tools for sharing research expertise, which are bespoke for particular contexts. The traditional, academic journal article is but one way to publish/share research, and invariably not the optimal format for teachers.

5.6. Technology

Notable in the articles reviewed in the SLR was the lack of discussion or exploration of digital tools and associated processes to support research. Given that one of the search streams was to identify innovation, this was a surprise although it may demonstrate the need to focus on people and processes rather than how technology tools can assist with research. Where technology was mentioned, it was in relation to an intervention or a support or an outcome for student learning (e.g. use of social media platforms, wikis, building apps), rather than as a tool to support research itself. This seems to mirror the field more generally, where there is a mass of literature on how teachers can use technology for learning (Selwyn, 2017; Fullan & Langworthy, 2014; Laurillard, 2008), to establish a community of practice and collaborative learning (Wenger et al. 2002), or to support their own professional development (Jones & Younie, 2014), but very little on how it can be used to support research. However, digital infrastructures in education research are set to attract even more importance now given the wholesale disruption to learning and teaching internationally as a result of the COVID-19 pandemic. This underscores the need for further research on how we can design successful, technology-enabled infrastructures, which promote and support translational research in education.

5.7. Innovative and impactful translational research infrastructures

The SLR set out to answer the following research question: What do innovative and impactful translational research infrastructures

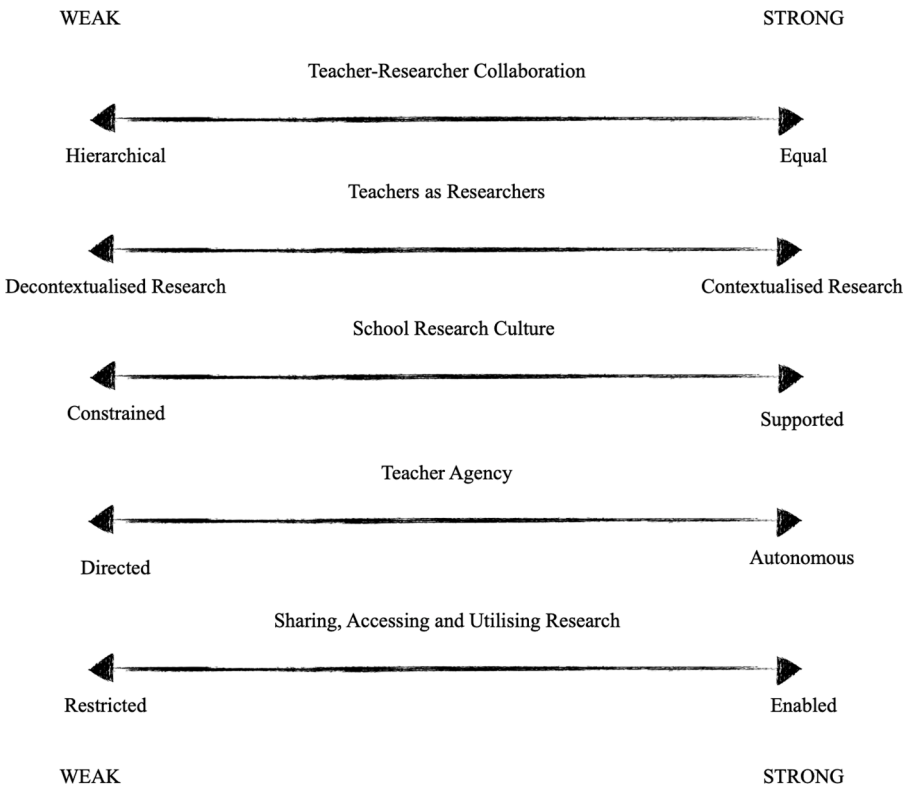

Fig. 5. A translational research in schools framework.

look like for schoolteachers? Whilst the SLR has not provided a definitive answer, it has suggested that the potential for translational research in education can be considerably enhanced when five key themes are taken into consideration. There are important implications arising from this. Firstly, it highlights how there are a number of contingent and complex factors that need to be understood and legislated for in the design of research with teachers. Significantly, the SLR has highlighted the importance of 'infrastructure' in its broadest sense, and the need for coordination across themes, based on an understanding of how they mutually benefit and support one another. In the SLR, the research designs that were most successful in creating an ethos of sustainable and valued research in schools were those that engaged with a number of the key themes.

In an attempt to develop a practical application of the five themes, we have synthesised an initial continuum specification (Tay & Jebb, 2018) using the analysis to inform the meaning of the continuum poles. Each of the five themes are thus each expressed as a Continuum as seen in Fig. 5. In detailed discussion about the analysis of the articles, which included re-reading of the articles, we have found that where translational research infrastructures could be described as impactful in some way, the evidence pointed towards the stronger end of the continuum and where they were less impactful, they were located towards the weaker end of the continuum.

These constructs and continuum need further development to determine the nature of their gradations however the framework serves as an initial, foundational attempt to support teachers, researchers, school leaders, policy-makers and a wide range of other stakeholders, as they reflect on the development of translational research practices within school education contexts. It is not intended therefore to be prescriptive, rather the value of the continuum specification should be determined by those using it, as an orienting approach to stimulate internal discussions about what might be important to consider when planning research in a local context. For example, it can be used as a prototype or starter guide when considering how to develop translational research in schools and as a framework against which to informally interrogate research practices in school settings.

6. Conclusion

In investigating what innovative and impactful translational research infrastructures look like for school teachers, five interrelated themes have emerged within this SLR. The first of these is Teacher-Researcher Collaboration, which focuses on teachers playing a more active part and in some instances even leading the research process. The second theme is Teachers as Researchers, which is more likely to happen if the research is seen as valuable or worthwhile by teachers, most notably in enhancing the quality of learning in the classroom and impacting positively on student outcomes. The third theme is Research Cultures in Schools, which posits that research needs to be valued by both the school and the wider educational context if teachers are to engage in research. The value should be explicit with schools having established routines and systems for research, such as in-house innovation units and research-related promotion and support structures which were embedded into the school structures. The fourth theme is Teacher Agency, which can be summarized as teachers needing to feel a strong sense of ownership of the research through an active and central involvement in the entire process. The final theme is Sharing, Accessing and Utilizing Research. Here we found that where teachers were successfully engaged in school-based research, they had access to core research materials, resources tools and professional learning opportunities. This final theme not only highlighted the need for technologies to collaborate and share research, but for specific, bespoke professional development for teachers in how to judiciously access and undertake research, and open, well-designed resources to support them in becoming active in research.

The notion of technology was notable by its absence within the SLR. However it is our contention that designing and developing technologies that support innovative and open research sharing are critically important, both to support teachers' continuous professional development and also to engage them meaningfully in key debates and issues in educational research. This should have significant mutual benefits, both for teachers and for educational research, potentially enriching the discipline of educational research while at the same time rendering it more relevant to teachers' professional lives in classrooms and schools. Indeed, the importance of opening up research sharing is being highlighted even more so today with the current global pandemic. For example, some of the world's most established and prestigious journals, e.g. The Lancet, are making their COVID-19 research freely accessible and available. This mirrors innovations like preprint servers, which enable the early and immediate publication of salient research on the virus, e.g. to help expedite the development of a potential vaccine.

An infrastructure underpinned by innovative and effective technologies can enable more inclusive ways to encourage teachers to engage with and share research, of importance in helping to shift the relationship to one of parity of esteem between researcher and teacher, properly recognising the professional expertise and insight of teachers, "rather than treating teachers as technicians, where we have researchers figuring out how best to teach, and then telling what teachers to do in Lawrence Stenhouse's memorable phrase, treating each teacher as a kind of 'intellectual navvy' (Stenhouse, 1980, p. 5) who is told where to dig, but not why" (Wiliam, 2019, online). This in turn enables research to become more representative of teachers' work, and educational research priorities that are proximal to the practice setting.

The SLR has demonstrated that there remain gaps in our understanding of the design of research infrastructures for teachers, coordinating systematically across the key themes, and the role that technology may play in this. One reason for this is the paucity of articles that cover all five themes in detail, but also due to the lack of longitudinal studies. Often the articles reported on short term projects, or reported on initial findings of projects. So it is hard to know, for example, if when researchers leave a research relationship, whether teachers continue to carry out classroom based research. This has relevance both for how research becomes embedded and sustained beyond any initial impetus but also how the very notion of what it means to be a teacher or a researcher, might evolve over time. Our study also raises other important questions, for example, is it always necessary to have teacher-researcher partnerships for classroom research to take place; how do research practices evolve to become part of a teachers toolkit; and how do research cultures become more inclusive and participatory over time? These salient questions, emerging from the SLR, should form the basis of ensuing

research.

Declarations of Competing Interest

None.

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