AMERICAN UNIVERSITY OF BEIRUT

SCALING-UP EDUCATIONAL INNOVATIONS: A SYSTEMATIC LITERATURE REVIEW OF INFLUENCING FACTORS (2000-2023)

by
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I dedicate this thesis for social entrepreneurs, development practitioners and passionate educators that are grappling with the challenges of scaling-up; along with global organizations I am affiliated, JA Worldwide & Teach for Lebanon/ Teacher For All, with that have impacted me and are doing system change in education.

ABSTRACT
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Scaling educational innovations has gained attention, but the conceptual framework remains unclear and key factors are underexplored, leading to a reactive rather than proactive approach. This study examines factors affecting scaling at the designer, teacher, school, and system levels to clarify their interconnections across the education system.

In a final sample of 25 research articles identified systematically, the study highlights multiple influencing themes at each level. Overarching themes are resources, capacity building, strategy, leadership, governance, politics and culture - within each are multiple sub factors. At the designer level, factors include resources, design and implementation strategies. At the teacher level, cultural norms, working conditions, and professional development are key. At the school level, leadership, policies, and resources are critical. At the system level, politics, policies, funding, and capacity are significant.

We propose that collective leadership at every level is key to effective system scaling. Adapting a health innovation scaling implementation model to education, the study addresses reactive strategies. The study highlights how socio-political instability and donor-driven, uncoordinated efforts in fragile Education in Emergency states like Lebanon hinder sustainable reforms. The lack of Arab region-focused literature on scaling may stem from language barriers, though the discourse is growing. We urge a critical perspective on educational innovations, emphasizing the need to address not just immediate practice problems but also historical and systemic factors to avoid exacerbating existing inequities.

The study concludes with a conceptual framework on scaling-up education innovation across systems for systems change emerged from the key findings and analysis of this study. Recommendations for both researchers and practitioners were included. To enhance future scaling efforts, researchers should do country-specific research, include diverse sources and develop informal networks for knowledge sharing and establishing research priorities. Education practitioners should encourage, integrate scaling principles into training, and develop structured plans for sustainable and proactive implementation.

Keywords: scaling; scaling educational innovations; planning for scaling; design for scale; factors affecting scaling education innovations.

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ABBREVIATIONS

CPD: Continuous Professional Development

EDLM: Education Leadership and Management

EiE: Education in Emergencies

RQ: Research Question

SBM: School Based Management

SLR: Systematic Literature Review

TPD: Teacher Professional Development

CHAPTER 1

INTRODUCTION

In this chapter, I open with a positionality statement to situate this study with my experience then with an introductory section about the topic under study.

Positionality

It is important to situate this study within my background as a researcher and practitioner, having worked in education development for a decade and reflecting on my drivers and assumptions to investigate scaling education.

As a social entrepreneur, my primary focus has been to scale impact. From co-founding Inspiration Gardens in 2014, a learning community space in Tripoli Lebanon, growing from 7 to 90 students annually, to founding a community of 6,000+ educators, Learning Land in 2019 to scale professional best practices and influence policy (CLS, 2021), my journey has been deeply intertwined with scaling initiatives. Since 2018, I have joined Teach For All's scaling social entrepreneurs community (Teach For All, 2020, 2024) which has provided valuable insights into how diverse social entrepreneurs approach scaling differently. This global network allowed me to observe various strategies and challenges in scaling. It made me more critical to look into scaling when its definition across different social entrepreneurs is overstated, weak and not critical. Through collaborating with social entrepreneurs from India, I had a deep experience to look and design for scale differently (Teach For All, 2021). This collaboration is rooted in focusing on design initiatives to scale at the system level.

In 2021, I co-founded Nafda to institutionalize these efforts at the school level, developing a model for scaling educational innovation while reading for this research. Preparing for this research study helped develop a model for scaling educational

innovation for nafda and made me reflect on what was in the literature and how it was applicable to a context like Lebanon. I designed a model of a school taking ownership to scale a specific innovation into 3 other schools. Over three years, I observed how School A's innovation was scaled to three other schools, and then further replicated into 9 other schools aka seeing its multiplier effect. nafda piloted this design with 2 mentor schools scaling to 4 mentee schools (2023) then expanded the model to include 7 mentor schools scaling to 21 mentee schools in 2024. We mainstreamed our operations, observing how innovations evolved from one context to another - while continuing looking at the design to strengthen it.

Over three initiatives (Inspiration Gardens, Learning Land and nafda Lebanon), my perception of scaling has evolved from focusing primarily on numbers, such as the count of students, teachers, or schools, to critically considering how to sustainably adapt educational practices across various contexts.

In 2023, I joined the board of a global organization, JA Worldwide, one of the largest youth serving organizations, having programs focused on entrepreneurship education, financial literacy and work readiness both at the school and university levels. This organization aims to reach 100 million youth by 2050. As a board member, I had a role to play, to challenge and enable critical thinking about scaling to a global organization. Pursuing this research has provided me with the tools to become more grounded, analytical, and effective in addressing the complexities of scaling.

There is a tension between both of my professional identities, the researcher and the social entrepreneur. As a social entrepreneur, I am centered on amplifying social impact through innovative solutions, which directly connects to the concept of scaling.

However, the journey of this research made me become more critical about concepts of scale and its underpinnings where in the discussion, I will reflect on it further.

Introduction about Scaling-Up Education Innovations

Scaling-up innovations has attracted the attention of health and educational researchers (Constas and Sternberg 2006; Milat et al. 2012; Yamey 2011). As a field of study, also named "translation or diffusion science," scaling up existed in fields of medicine, pharmacology, health sciences and health education for quite some time now. As such, it is considered as a relatively young field of study in education since much of the published academic articles and research reports started in the present century (Lim, Hung, & Huang, 2011). Scaling-up educational innovations is a development practice that aims to introduce a specific educational solution into new contexts to produce positive effects on larger populations (McDonald, Kessler, Kauffman and Schneider, 2007). "Full Scale" is generally defined based on the problem that a specific innovation intends to solve. For instance, in a case when an innovation aims to improve pedagogical practices in schools in Colombia, full scale means going from one school to all schools at the national Colombia level (Colbert & Arboleda, 2016). When an innovation is solving specific reading issues in private schools in India, full scale means going towards all private schools in India (Jain, Ifran, Kirtane & Vanikar, 2018).

Elements of Scale

Coburn et al. (2021) explain that there are multiple elements that can be scaled such as:

- Identity: People's understanding of who they are and how they relate to others.
- Ideas: A plan or a design according to something being constructed.
- Tools: Tangible ideas are used as mediating devices to shape action.
- Work Practices: Individuals or group's agreed activities.

- Innovation*:* An innovation is defined as an idea, practice, tool, or object that is perceived as new by an individual or other unit of adoption within a social system (Rogers, 2003). It could be a new curriculum, technology or material that is intentional to tackle a specific unit at the school (classroom, department or school) (Looi and The, 2015). It is a branded item that is meant to increase brand visibility to foster affiliation to an organization (Coburn et al., 2021).
- Intervention/ Models: Intervention is the use of a specific innovation in one or more classrooms given additional support to carry out the innovation-implementation as planned (Looi and The, 2015). This model is an integrated system of ideas, tools and work practices with the purpose to change a certain behavior in a pre-specified way.
- Organizations: A group of people who are structured internally to achieve a particular purpose.

In this research study, the primary focus is on scaling education innovations as a lot of the reviewed literature most falls under "scaling education innovations" However, it is important to note that researchers have used some of these terms interchangeably. The field of scaling in education has not matured enough yet for the language to be nuanced and specific.

Our preliminary literature review revealed that numerous empirical studies have delved into the implementation and evaluation stages of scaling up educational innovations. Within this body of literature, scholars have examined various factors influencing scaling as one of their research questions, (e.g., Clarke and Dede, 2009; Coburn et al., 2021; Colbert and Arboleda, 2016; Crawford et al., 2020; Fullan, 2020; Horner et al., 2014; Hung et al., 2015; Jain et al., 2018; Krainer et al., 2019). However, a

cohesive framework that synthesizes these findings and categorizes them systematically is lacking. Based on the preliminary review of the literature, no one framework that sheds light on the hindering and enabling factors of scaling was found in the knowledge base that scholars have aggregated.

Problem Statement

There is at present a need to understand how the complex scaling of education innovations can be more effective. In this section I unpack the problem statement tht is the base of this study.

Unpacked Interconnected Factors

Scaling up has been described as a complex phenomenon for educational reform due to its dependency on multiple factors to produce better outcomes (Crawford et al., 2020; Hroner et al., 2014; Krainer et al., 2019; Tan and Hung, 2020). These multiple factors include, but are not limited to, context, the system/ sub-system where the program is scaled in (teachers, schools, regional or national level), delivery method, and cost (Crawford et al., 2020, Gibbs et al. 2021; Gugelev et al., 2015; Krainer et al., 2019). Neglecting contextual nuances, like teachers' curriculum development skills and students' self-efficacy, can detrimentally affect scaling outcomes (Clark and Dede, 2009; Crawford et al., 2020; Krainer et al., 2019; Gibbs et al., 2021; Gugelev and Stern, 2015). Additionally, not all small-scale innovations successfully yield into better outcomes upon scaling given that success in one context doesn't guarantee replicable results elsewhere (Brooks, 2021; Gibbs et al., 2021; Hung et al., 2015; McDonald et al., 2007). Understanding the nature and relationship of different factors is complicated as there is still not enough evidence about how to design and implement an optimal scale-up strategy that yields better scaling outcomes (Krainer et al., 2019; Tan et al., 2020). In summary,

the factors and its interconnectedness is not clear, what, why and how these factors affect one another is not clear.

Lack of Conceptual Clarity

There is lack of conceptual clarity of scaling education innovations (Clark and Dede, 2009; Coburn, 2003; Coburn et al., 2012; Morel et al., 2019). Starting from the original word, scholars use scale, scaling, scaling-up or scalability interchangeably. Some scholars argue that scaling is some argue replication is not effective and claim adaptation is required for effective scaling (McDonald et al., 2007) and others believe scaling is multi-dimensional rather than just focusing on mere numerical expressions of number of students or schools (Coburn, 2003). There is a need to define scaling up education innovations conceptually and understand how this conceptual definition and factors affecting scale at multiple levels connect with one another.

Reactive Implementation Strategy

Both unpacked interconnected factors and lack of conceptual clarity mentioned above are leading to an ineffective optimal design for scaling up. This prompts development practitioners to design scaling-up in a reactive, organic, ad-hoc, and idiosyncratic manner rather than in a proactive, mechanical, and rigorous manner (Hung et al., 2015; Mitat et al., 2015). The overarching goal that is driving this study is to look into how can we best design for scale? The absence of a coherent framework complicates the identification of key leverage points, making it challenging to systematically scale successful initiatives. Furthermore, the varying contextual dynamics across different settings necessitate an intentional yet adaptive responses, further straining the capacity for standardized approaches. This lack of uniformity and strategic planning ultimately undermines the sustainability and scalability of educational innovations.

In summary, while there is a growing body of knowledge on evaluating scaling up initiatives (Lim et al, 2011), there is still a limited shared comprehension regarding the diverse factors that influence scaling of educational innovations, proactive implementation strategies and how scaling-up is being conceptualized for optimal design. Therefore, this systematic literature review aims to address the below main research question.

Research Question

Overarching Question: How can we best design education innovations for scale?

- What factors affect scaling up educational innovations on the following levels?
    - Designers
    - Teachers
    - Schools
    - Systems

Significance

The significance of this systematic literature review on scaling educational innovations is twofold. One on theory and one on practice.

On a theoretical level, this research advances our understanding of how educational innovations scale. By meticulously examining the factors affecting scaling-up and how scaling-up has been conceptualized by researchers, the study contributes to the refinement and expansion of existing theoretical frameworks in the field. By the end of this study, a more nuanced conceptual model was generated that capture the complexities of scaling educational innovations effectively. Additionally, by synthesizing diverse perspectives and empirical evidence, the study lays the groundwork for the

development of new theoretical frameworks, thus informing researchers on the nuanced gaps in the literature based on the systematic review.

On the practice level, this research advances our understanding to conceptualize and design educational innovations to scale effectively. With a deeper understanding of effectiveness of scaling-up approaches, practitioners including teachers, coordinators, teacher leaders, principals, policy makers, system leaders, and educational development practitioners gain access to a wealth of evidence-based knowledge and practical insights that can inform their decision-making processes. With understanding of factors influencing scaling, this not only guides practitioners to identify enabling best practices but also empowers them to address challenges and hindering factors affecting their scaling-up approach in a proactive manner. Ultimately, this research aims to enhance the effectiveness and efficiency of educational development initiatives, paving the way for positive impacts on student outcomes and educational outcomes at large.

CHAPTER 2

METHODOLOGY

Systematic literature reviews involve using well-established procedures and standards to find and study research on a specific topic. This research followed specific guidelines suggested by Hallinger (2012) while being complemented by Pantic and Hamilton (2024) to conduct the systematic literature review. The approach was influenced by previous reviews that used similar methods e.g. Hallinger and Hammad (2017) and Hilal et al. (2024). In this chapter, the methods used to find relevant sources, gather information, and analyze data are explained.

Systematic Literature Review

In this sub section, the aim is to clarify the differences between systematic literature review and general literature reviews, while highlighting the adopted model of literature review.

Systematic Literature Reviews versus Literature Review

Literature reviews are valuable tools used to summarize and provide an overview of knowledge from various sources. They involve a methodical approach to gathering and analyzing prior research, combining results, gaps, tensions and perspectives from multiple studies (Aromataris & Pearson, 2014; Syder, 2019). However, traditional literature reviews may lack thoroughness and consistency (Pantic & Hamilton, 2024).

On the other hand, systematic reviews offer a more structured approach, aiming to synthesize all relevant data to address a focused research question. They stand out for their rigorous procedures and distinct objectives, minimizing bias and subjectivity (Aromataris & Pearson, 2014; Mallet et al., 2012). The process begins with a comprehensive search strategy to retrieve relevant literature, followed by stringent

criteria for study selection (Magarey, 2001). Systematic reviews are replicable and employ explicit, accountable, and rigorous methods. They play crucial roles in resolving controversies, generating hypotheses, and informing decision-making (Snyder, 2019). Systematic reviews go beyond aggregating findings by critically appraising study quality and synthesizing evidence. They empower evidence-based decision-making by quantifying effect sizes and identifying patterns (Kolaski et al., 2023).

Models Adopted for the Systematic Literature Review

Two complementary models were adopted as a reference guideline to follow through in this systematic literature review. Halinger (2012) model of systematic literature review provides standards for systematic literature reviews in the field of EDLM. This standard guidelines is thick, descriptive and thorough based on 8 elements of an SLR. In parallel, Pantic and Hamilton (2024) model was also adopted for its simple step-by-step guide to follow when performing and writing the systematic review. This model provides a procedural process to follow specially for graduate students. This section provides an overview of the models adopted.

Hallinger (2012) Model. Hallinger (2012) lists 8 standards for systematic reviews of research in education management and leadership field. Below is the list of standards:

Explicit Research Questions or Goals. The guiding purpose of the review should be clearly communicated through specific research questions or goals.

Conceptual Framework. The selection, analysis, and interpretation of studies should be guided by a clear conceptual framework.

Search Criteria and Procedures. The search criteria and procedures should be explicitly communicated and justified in accordance with the study's objectives.

Types of Sources. The types of sources included in the review (e.g., mixed, journals, dissertations) should be explicitly communicated and defensible based on the study's goals.

Data Extraction Procedures. There should be a clear description and justification of the procedures used for data extraction.

Composition of Reviewed Studies. The composition of the group of studies reviewed should be explicitly identified, regardless of whether the data is qualitative or quantitative.

Data Analysis and Synthesis. The procedures for data analysis and synthesis should be clearly described, soundly justified, and effectively executed.

Communication of Findings. The findings, limitations, and implications of the review should be clearly communicated.

Pantic and Hamilton (2024) Model. Pantic and Hamilton (2024) explain that in the initial stages of research, researchers define a topic and formulate research questions (RQs), seeking input from advisors as needed. They survey existing systematic literature reviews (SLRs) to gain insights and refine their inclusion criteria accordingly. Once established, they identify pertinent search terms and conduct searches across databases, iterating as necessary to ensure comprehensive coverage. After compiling a list of articles, they eliminate duplicates and assess abstracts for relevance, documenting their decisions. They then read selected articles in full, extracting key findings and organizing them according to a chosen theoretical framework. This process may involve multiple iterations to refine themes and ensure alignment with the RQ. Finally, researchers synthesize their findings into a coherent SLR, drawing upon their notes and thematic charts. Throughout, they rely on guidance from advisors and leverage academic resources

to enhance their understanding and writing proficiency. Below is an outline of the selection process retrieved from Pantic and Hamilton (2024).

Step 1: Conduct the Search. In this phase, researchers should establish a designated folder to organize all literature discovered during the search. Creating subfolders for each database is recommended. Researchers are advised to perform identical searches across multiple databases, monitoring the number of articles found (Pantic & Hamilton, 2024; Halligner, 2012). Databases offer the advantage of digital accessibility, enabling simultaneous searches across various years of the same periodical. However, researchers have alternative options beyond databases. For instance, Hamilton and Morgan (2022) explored various article databases like Education Source, PsycINFO, and JSTOR, alongside journal databases such as ACM and JAIE. Their search initially yielded 333 articles. Pantic and Clarke-Midura (2019) commenced their search in ERIC and Education Source databases, resulting in 34 studies. To expand their findings, they scrutinized reference lists of identified literature reviews and articles that cited these reviews, adding 48 more articles. Additional searches on Google Scholar and ACM Digital Library yielded vast numbers of titles, requiring careful sorting and inspection. This emphasizes the importance of decision-making regarding the depth of search results to be reviewed, especially when dealing with large datasets like those from Google Scholar.

Step 2: Refine Search Terms and Criteria. Preliminary searches aid researchers in refining their inclusion criteria. Identifying search terms is an iterative process, often necessitating multiple adjustments before achieving an optimal combination of articles. Initial searches may prompt researchers to broaden their search terms to encompass various identifiers, as demonstrated by Hamilton and Morgan (2022), who expanded their

terms to include identifiers for Indigenous and/or Aboriginal peoples. Collaboration with a content librarian can greatly assist in brainstorming potential identifiers and examining key literature to refine search terms.

Step 3: Repeat Refinement Steps. Defining the scope of the systematic literature review may require multiple rounds of refinement. Researchers should repeat the steps of refining inclusion criteria, search terms, and search processes as needed before proceeding to the next stage. This iterative process ensures thoroughness and precision in the search process, with guidance from advisors and librarians as necessary.

Step 4: Refine the List. After conducting a comprehensive search, researchers should begin refining the list of located literature. Duplicate articles must be identified and accounted for. Researchers should meticulously document eliminated articles and the reasons for their removal to ensure transparency and reproducibility in the review process. Thorough descriptions of these steps should be included in the methods section to demonstrate methodological rigor and systematicity.

The other following 4 steps after step 4 is explained in the data analysis section.

Theoretical Lenses for the Problem Statement

Both Hallinger (2012) and Pantic and Hamilton (2024) emphasize that after formulating the SLR's research questions, researchers must select theoretical models to systematically analyze the knowledge base through a specific lens to answer them comprehensively. Aligned with the three key problem statements - lack of conceptual clarity, unpacked interconnected factors, and reactive scaling implementation strategy—I structured this section into 3 different subsections with the aim to have lenses that look at the two RQs on evolving concepts and factors.

Historic Evolution of Scale Concepts & Dimensions

Scaling has been historically viewed from a spread design mindset, focused on a numerical and multiplication lens. This perspective, rooted in a product-oriented approach, quantifies scaling outcomes based on metrics such as the number of teachers, schools, or clusters, optimizing packaging for large-scale rollout (Brooks, 2021; Gibb et al., 2021; Hung, Lee, & Wu, 2015; Lim et al., 2011). However, Coburn (2003), in her famous “Re-thinking Scale: Moving Beyond Number to Deep and Lasting Change” article explains that "spread" represents only one design facet of scaling innovations to numerous classrooms and schools. This perspective assumes that scaling efforts can be centrally planned to minimize costs and maximize efficiency, leading to improved student outcomes. Along Coburn’s argument, many scholars align that designing for scale encompasses more than mere numerical expansion, challenging the conventional notion of reaching additional beneficiaries (Brooks, 2021; Gibbs, 2021; McDonald et al., 2007). Such definitions focus on the intricate task of achieving broad outreach while overlooking nurturing the depth of change necessary for sustainable impact (Coburn, 2003).

Building upon research in the scaling knowledge base from domains beyond education, Coburn (2003) draws upon Roger's (1983) theory of successful adoption, which elaborates on key factors influencing the diffusion of innovations through social systems, such as relative advantage, compatibility, complexity, trialability, and observability. As a result of adapting Rogers’s work to the education context, Coburn (2003) argues for a more comprehensive approach to design for scaling-up, providing a structured approach that addresses the limitations of traditional spread-focused definition. Designers must consider 4 multiple elements 1) depth of change, 2) sustainability, 3) shift of ownership, and 4) spread. Clarke and Dede (2009) later expanded this framework to

include "Evolution" as another critical element, summing them to 5 key design elements for scale.

Coborn's (2003) piece was cited in exactly 1770 research papers from 2000-2023 according to Google Scholar (July, 2024). Through an initial literature review which will be presented below, the main model has evolved from 4 elements to 5 through Clark and Dede (2009). Some articles as late as 2024 (Balli and Singla, 2024), 2021 (Coborn et al, 2021), or books (Hung et. Al, 2015), have still used the Coburn (2003) framework. Given the substantial traction garnered by Coburn (2003) in the absence of a definitive scaling model, this article serves as the focal article of this systematic literature review when it comes to conceptualizing scaling-up. It is key to note that no critique articles to Coburn (2003) were found throughout conducting this study. As a result of this key finding, RQ#2 has been revised from being general on how scale has been conceptualized and evolved to how Coburn (2003)'s model has been used and evolved as a conceptual model by researchers in the literature during the period of 2000-2023.

Below is a presentation of Coburn (2003) model along its evolution from 4 to 5 key elements through Clark and Dede (2009): Depth, sustainability, spread, shift and evolution:

Depth. It refers to the deep and consequential change in classroom practices, altering teachers' beliefs, norms of social interactions, and pedagogical principles. Depth includes evaluation and research (design-based research) to understand and enhance causes of effectiveness. The program is consistently revised based on research and evaluation to understand and enhance its effectiveness. Program designers must employ design-based research methods in order to understand what conditions are less rigid and adaptable to meet needs of different local contexts. Design-based research is an iterative

research process that helps generate and extend knowledge in consistently developing innovative learning environments through quantitative and qualitative research methodologies to examine and analyze how student learning outcomes are enhanced within a specific intervention. This could include classroom observations, interviewing students, examine student work and social interactions (Clarke and Dede, 2009, p.358). Results of the studies shape the interactions of the program design from one context to another based on different contextual factors.

Sustainability. Refers that the innovation can maintain over a long period of time the consequential changes in the classroom practices due to its depth. There is a correlation between depth and sustainability. Sustainability is linked to the ‘‘robust design’’ that enables adapting the innovation into inhospitable contexts. Program design is robust to enable inhospitable contexts adaptation to maintain the consequential changes in classrooms and enable the program’s depth through the use of the design-based research methods. Sustainability is also viewed from a social-justice lens to optimize success in different types of settings and learners.

Spread. It refers to the diffusion of innovation to a large number of classrooms and schools. It requires thinking of efficient ways to retain effectiveness, for example to automate as many processes as possible, while reducing resources and expertise required. Program resources and expertise required are reduced while retaining its effectiveness to diffuse it to a large number of classrooms and schools. Some of the ways to do so is by making an online dashboard for teachers to generate automated reports. The online dashboard has to be simple to make it accessible to a large number of teachers. Teachers are considered the main actors in providing the needed data about the program and students’ demographics that will help in shaping the iterations needed. The self-generated

report can be emailed directly to teachers with the needed information that can inform their practice. In addition to the online dashboard and self-generating reports, providing day-to-day teachers' guides and resources can help too. These quick guides can be videos, step-by-step manuals, plans, etc…

Shift. School practitioners assume ownership of the innovation, its depth, sustainability and spread of impact. Designers that focus on shift of ownership do not give teachers a scripted curriculum but rather encourage them to adapt the curriculum to their students' needs. It is about moving beyond ''brand'' to support users as co-evaluators, co-designers, and co-scalers through an iterative design process. Some of the steps could be:

Teacher-to-Teacher Help. Connect teachers who have experienced the innovations with those who are new adopters to it to share their insights and information about their experience with the innovation.

Teachers as Co-Evaluators. In addition to the usual feedback cycle from teachers about the innovation, newly designed features are important to be piloted by end-users to provide extensive feedback.

Evolution. Program learns from users' adaptations to rethink the innovation's design model. A community of practice that brings-in adopters to become designers can become a good strategy so that researchers can learn from the users and rethink the innovations' design model. Evolution encompasses the product depth, spread and shift. Without building on the previous dimensions, it would be hard for the innovation to evolve without a holding and enabling environment. Program components are many and they need to evolve with each other. For instance, one of these is professional

development. Evolving the PD model from training teachers to train the trainer model could help in scaling the effort by capitalizing on the local trainers at the school level.

Adapted Ecological Model of Scaling

Hung et al. (2015) "Ecological Model of Scaling" categorizes the level of innovations diffusion into 3 layers and takes a scaling system-view to consider context and environmental factors. This ecological model is derived from Bronfenbrenner (1994) ecological model of development which aims to visualize different system layers starting from the individual at the center, micro-system (ex. classroom), meso-system (ex. school) and macro-system (policy/system). Below is a presentation of the model:

Teacher Oriented Innovations: "Seeding". These can be defined as straightforward innovations that can be easily adopted with available resources. Teachers develop contextualized understanding as they enact the innovations within their classrooms.

School Oriented Innovation: "Spreading". Described as "from teacher to school levels". These innovations happen on a larger scale requiring further support, resources, technical expertise, funding and teacher professional development. Hung et al. (2015) explains that there is additional support needed from school leaders to create the schools' enabling structures and culture to institutionalize and sustain these innovations.

System Oriented Innovations: "Dispersing". Described as "towards more schools with system support". These include projects and initiatives that the ministry of education intends to implement on a system level to create large-scale impact. System oriented innovations consider the innovations' characteristics and school profiles for large-scale and system-wide innovation diffusion. These kinds of innovations are

adaptive to local context and ensure teacher ownership, sustainability and evolution from the original innovation.

In addition to the above 3 layers, an additional important layer emerged from the literature reviewed that has a high influence of how education innovations scale: the designer layer. Rodgers (2016) explains that "educational innovations do not scale without a design" (p.13). Although the designer could be a teacher, part of the school administration or system administration, yet there is a major role that emerged from the literature that should be clearly defined.

Designers Oriented Innovations: "Strategizing". "Designers" strategize ways to design and facilitate the process of scaling and diffusion of an innovation to teachers, schools and systems. Designers have a pivotal role to balance the need for fidelity and adaptability, between what is ideal and what is realistic, allowing the innovation to be scaled accurately while accommodating necessary adjustments for different contexts (Rodgers, 2016).

The above adapted ecological 4-layer framework will be used as a conceptual framework to capture the influencing factors of scaling across the literature.

Implementing Strategy for Scaling Up

Through the literature review, Milat et al.'s (2014b) scalability framework was found offering a practical guide for scaling up health policies and programs, aimed at practitioners, policymakers, and researchers involved in evidence-based population health interventions. This framework was adopted as there was no such framework that could organize the implementation strategy in this way, aiming to solve the issue of reactiveness of scaling-up education innovations mentioned in the problem. The framework is structured into four steps:

1. **Scalability Assessment**
    - Evaluate the intervention's effectiveness.
    - Assess its potential reach and adoption.
    - Ensure alignment with strategic content.
    - Determine acceptability and feasibility.
    - This step determines if the subsequent steps should be followed.
2. **Develop a Scaling-Up Plan**
    - Document the rationale for scaling up.
    - Describe the intervention in detail.
    - Conduct a stakeholder analysis.
    - Identify key functions and responsible parties.
    - Select an approach to scaling up.
    - Consider evaluation and monitoring options.
    - Estimate the resources required.
    - Write up the comprehensive scaling-up plan.
3. **Prepare for Scale-Up**
    - Consult with stakeholders.
    - Legitimize the change.
    - Build a supportive constituency.
    - Realign and mobilize resources.
4. **Scale-Up the Intervention**
    - Modify and strengthen organizations.
    - Coordinate actions and governance.
    - Monitor performance and efficiency.

- Ensure sustainability.

While the framework assumes starting from the scalability assessment, later steps are also useful for reviewing ongoing implementation processes. Each step and its sub-steps provide detailed guidance for effective scaling-up of health interventions.

Research Questions

Overarching Question: How can are education innovations designed for scale?

- What factors affect scaling up educational innovations on the following levels?
  - Designers
  - Teachers
  - Schools
  - Systems

Research Design

In a systematic literature review, instead of collecting data from primary resources through empirical research, researchers "collects, evaluates and synthesize" data from a specific set of research studies, search method for data has to be "comprehensive", "explicit", "systematic" and "defensible" in light of the study's goals (Hallinger, 2012, p. 133). Thus, in crafting the search strategy, it is important to specify which sources will be searched and how they will be searched. A thorough search approach is explicitly mentioned below including the data bases chosen, inclusion and exclusion criteria. Below is a list of the search procedures attempting to be "selective, bounded and exhaustive" according to Hallinger (2012, p.134).

Databases

The below selection of databases was advised by a member of the thesis committee and the librarian, given the diversification of literature available and how these knowledge bases are considered key for education administration literature.

- ProQuest Central
- ERIC
- Scopus
- Web of Science

Inclusion Criteria

To meet the standard of exemplary reviews, inclusion criteria must be explicit and defensible in light of the study's goals (Hallinger, 2012). Given that this research focuses on scaling as a phenomenon, this research prioritized articles examining how education innovations are being scaled within a K-12 context. Key inclusion factors considered in the search for studies included:

- Case studies investigating influencing factors, successes, or challenges of scaling-up K-12 educational innovations.
- Case studies investigating influencing factors, successes, or challenges of scaling-up K-12 educational practices or interventions, implicitly considered as "education innovations."
- Other studies not necessarily case studies yet addressing scaling as a phenomenon with a secondary focus on influencing factors.

The rationale behind not strictly choosing "educational innovations" as the sole inclusion criterion is based on the varied definitions found in the literature. While the term is included in the search, different authors refer to innovations by different names,

such as interventions or innovative practices. Due to the broad scope of my research questions, particularly those examining factors across four levels, the decision was made to include studies that address scaling without necessarily being case studies of scaled educational innovations. Many case studies heavily focus on a single level of factors, such as teachers in Colbert and Arboleda (2016) or systems in Ulftain et al. (2022), whereas Cohen-Vogel et al. (2016) focus on designers, a less common perspective. This approach diversifies the data pool and provides a depth of research that might not be achievable through case studies focusing on a specific innovation, such as reviews of scaling innovations.

Given that scaling in education is a relatively young field, with much of the literature emerging in this century (Lim et al., 2011), the search was limited to publications from 2000 to 2023. This aligns with Hallinger's (2011) explanation that the rationale for selecting a specific time frame often relates to the evolution of the literature on the topic. Additional inclusion criteria focus on ensuring that references are solid, accessible, and peer -reviewed. Hallinger (2012) highlights that there is no single rule for selecting the type of studies; rather, it largely depends on the density and quality of the relevant identified literature. For this reason, the following criteria were considered for inclusion.

- Full texts available online
- Peer-reviewed
- The study was published in English
- Studies are either in journal articles, books, masters' dissertations and PhD dissertations due to the limited number of studies in the field

Exclusion Criteria

Exclusion criteria are the following:

- Articles not related to scaling in K-12 contexts
- Articles that are not peer-reviewed
- Articles published in other languages than English
- Articles not limited between 2000 and 2023

Validation of the Methodology

Collaboration with an experienced librarian was sought to refine the keywords. The librarian's expertise aided in optimizing the search strategy, ensuring its thoroughness and precision. This collaborative effort underscored the meticulous approach taken in crafting the search strategy. Additionally, 2 professors, specializing in Education Administration and Education for Sustainable Development, reviewed and agreed upon the list of terms for the search procedure.

Search Words

Through consulting the librarian, the subjects were searched based on specific databases. Below is a presentation of the summary of the subjects for each research question. It is presented in the way it was searched over the search engine: Includes explicitly the possible following words either in the title or in the abstract: (factors OR challenges OR lessons OR implementation OR success) AND (scaling or scale or scaling up or scalability) AND (design or designers or designing) AND (educational innovations OR education innovation).

Identification of Eligible Sources Process for the RQ

The systematic literature extraction process undertaken in this research questions a rigorous and methodical approach aimed at identifying scholarly works pertinent to the research focus. Hallinger (2012) explains that there should be an explicit description and justification of the procedure employed for data extraction. Below, the process is

explained step-by-step on how and why certain decisions were made towards selecting the final sample. Inserting the main search words in the 4 different databases retrieved a total of 811 records. However, to ensure the utmost relevance and alignment with the research objectives, inclusion and exclusion criteria were subsequently applied. The selection was meticulously tailored to educational journals, with publications outside this domain systematically excluded to maintain thematic coherence and scholarly rigor. For instance, journals like Journal of Physics; iBMC Public Health; Bulletin of Earthquake Engineering; International Journal of Strategic Property Management; Journal of Engineering Education; Journal of Foot and Ankle Research; Reproductive Health; Nursing And Health Sciences; Journal Of Surgical Education; International Journal Of Disaster Resilience In The Built Environment, were excluded. Subsequent refinement was achieved through targeted keyword and subject area exclusions, using the online database tools strategically helped eliminate articles not directly connected to the research focus. Keywords such as "Health Services Research" and "Medical Staff, Hospital," alongside excluding subject areas such as Engineering and Business Management, the selection process was adeptly guided toward the desired thematic area. Only terms that could be interpreted to education were kept. Additionally, conferences not explicitly linked to the educational domain were systematically researched, to further enhance the precision and relevance of the curated corpus. Consequently, this iterative process resulted in a refined corpus of 217 articles, characterized by their direct relevance to the educational landscape.

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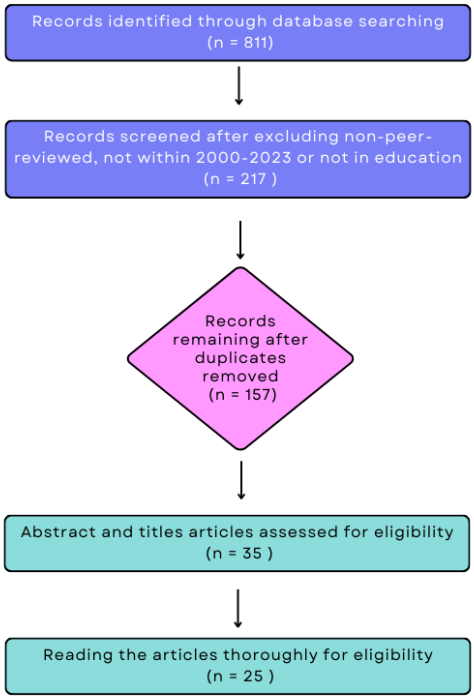
and "Medical Staff, Hospital," alongside excluding subject areas such as Engineering and Business Management, the selection process was adeptly guided toward the desired thematic area. Only terms that could be interpreted to education were kept. Additionally, conferences not explicitly linked to the educational domain were systematically researched, to further enhance the precision and relevance of the curated corpus.

Leveraging ChatGPT as an assistant tool supported the identification of duplicates to be eliminated. The total of identical pieces were 157 articles. Furthermore, a skimming of titles and abstracts was conducted, focusing on abstracts explicitly addressing factors or conditions pertaining to scaling, particularly within the K-12 educational context. This iterative refinement process ensured a nuanced and comprehensive evaluation of each article's relevance and contribution to the research inquiry. The final number of articles for full-text revision is 35. Finally, after further skimming and reading these articles to identify findings for the research questions, 25 were only shortlisted to be included in the research. Below is a flow chart explaining this process based on PRISMA (2009) guidelines.

Figure 1

PRISMA flow diagram showing stages in the identification and screening of sources



Data Analysis

Below, the steps of data analysis retrieved from Pantic and Hamilton (2024) are outlined.

Step 1: Read Article Abstracts

Researchers carefully review the abstracts of articles to ensure alignment with research questions and inclusion criteria (Patino & Ferreira, 2018). The goal is to refine the list of articles and minimize time spent on irrelevant ones. If an article does not meet the criteria, it should be removed. Researchers keep those that answer their research questions for further reading. During this process, researchers should document their rationale for keeping or eliminating each article.

Step 2: Read The Full Article

Researchers should proceed to read the selected articles. Reading, writing, and discussing the literature with advisors and colleagues helps researchers gain expertise in their research topic. Researchers should take notes on any ideas or patterns they observe while reading. Additionally, researchers should create documents to aid in the writing process, such as a matrix or spreadsheet to track bibliographic and methodological information from each article, and a separate document for notes related to study findings and potential quotes. A sheet in the main spreadsheet was created for each and every article.

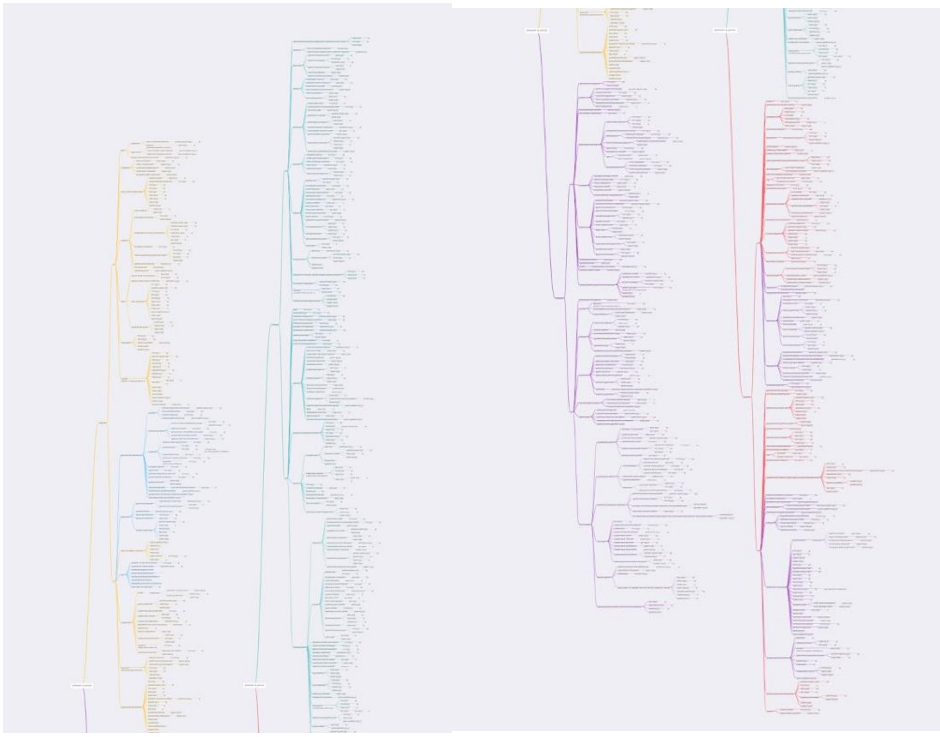
Step 3: Chart Themes

Researchers begin organizing the findings from the literature review and identifying ways to relate them to the chosen theoretical framework. They should look for emerging patterns and consider using qualitative analysis software or manual methods for organizing their thoughts.

For charting themes while reading, a mind map tool was used to visualize the key factors while writing the first author, date and page. Below is a screenshot of the final mind map.

Figure 2

Mind map of Key Factors Across 4 Levels



Step 4: Write

Researchers should use their notes and organized charts to write a high-quality systematic literature review. They should systematically synthesize findings across different studies and seek assistance from writing workshops, academic writing books, or online resources if needed (Snyder, 2019; Graff & Birkenstein, 2018; Behrens et al., 2012; Roschelle, 2016).

CHAPTER 3

FINDINGS

This section presents the findings of the describing the dataset and narrative analyses of the data for the research question.

Descriptive Analysis

This section provides a quantitative description of the reviewed literature. This section is inspired by (Hilal et al., 2024) believing that, even in a narrative systematic review, outlining the descriptive characteristics of a body of literature can still be valuable as it allows to sketch a comprehensive and clear picture of this literature and illuminate the prevalence of specific study types, research methods, authorship trends, and other aspects. Hallinger (2012) explains that a high-quality systematic literature review must determine and thoroughly describe its composition. This information can then be used to contextualize the narrative findings and demonstrate the significance of the results in a broader context rather than reading the results in vacuum.

Geographical Distribution

Interest was focused on exploring the geographical distribution of studies on scaling educational innovations as it can provide insights into the specific cultural, social, and political contexts in which these innovations are being studied and explored.

As shown in Table 1, the analysis of the dataset by region reveals that studies from North America and the Asia-Pacific region each represented 40% (n = 10) of the total corpus of scaling educational innovations literature. Europe contributed to 20% (n = 5) of the studies, while no studies were identified from the Middle East & North Africa, Latin America, or Africa. Further breakdown by country indicates that studies from about the United States (36%, n=9), Canada (4%, n=1), Singapore (16%, n = 4). The

Netherlands and Germany each contributed 8% (n = 2), while Australia, Indonesia, South Korea, Turkey, China, India, Hong Kong, Finland, Taiwan, and Canada each had 4% (n = 1) of the studies.

Table 1

Geographical distribution of sample on scaling education innovations

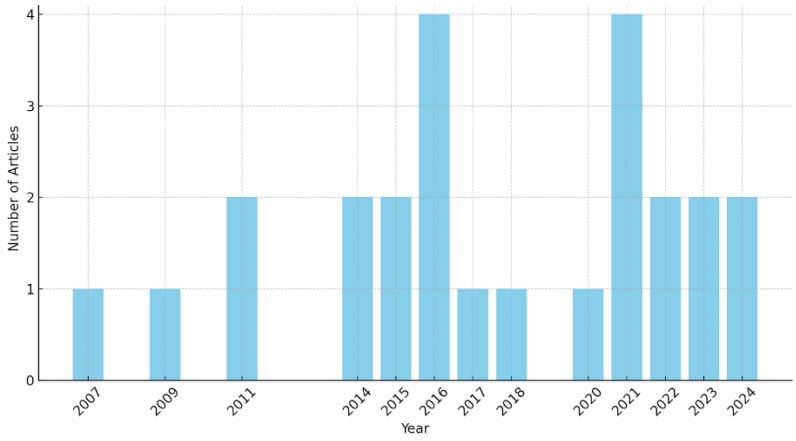
Region	**Number of Articles**
North America	10
Asia-Pacific	10
Europe	5
Middle East & North Africa	0
Latin America	0
Africa	0

Years Distribution

Analysis of the literature on scaling educational innovations according to publication date demonstrates a growing interest among scholars in the region to study the topic. The detailed breakdown by year is as follows:

Figure 3

Number of articles published per year



This indicates a trend of increasing scholarly attention towards the topic, as 2004-2014 bracket has a total of 6 articles while 2015-2024 timeframe has 18 articles reflecting its growing importance and relevance in the field of education.

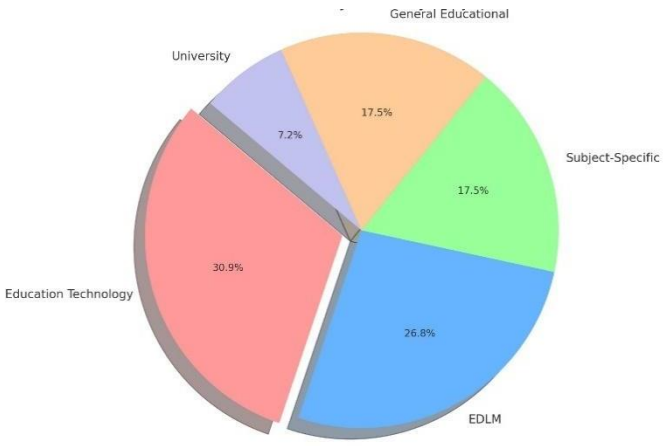
Sources Types: Journals & Books

From the 25 data sources, only 2 are identified as a book titled "Educational Innovations Beyond Technology: Nurturing Leadership and Establishing Learning Organizations" in 2011 and "Seamless Learning from Proof-of-Concept to Implementation and Scaling-Up: A Focus on Curriculum Design" in 2015. The remaining sources are journal articles. Below is a classification of these journals by subject. The primary analysis reveals four types of journals: education technology journals (n=7) or 30.9%, journals focused on education, leadership, and management (EDLM) (n=6) or 26.8%, subject-specific journals (n=4) or 17.5%, and general educational journals (n=4) or 17.5%. Additionally, there are university journals (n=2) or 7.2%.

From the Education technology journals the following journals are part of the study: the Association for Educational Communications and Technology (2), Education and Information Technologies (2), Journal of Computer Education, Contemporary Issues in Technology and Teacher Education and Computers & Education. The EDLM journals feature six publications: JEC (2), JED (2), JEA, and Management in Education. The subject-specific journals, with four publications, focus on particular disciplines and include the International Journal of Science and Mathematics Education, ZDM Mathematics Education, International Society of the Learning Sciences, and Journal of Science Education and Technology. The general educational journals also include four publications: Research Papers in Education, Frontiers in Education, Peabody Journal of Education, and the Journal of Education for Students Placed at Risk (JESPAR). Finally, university journals are represented by two publications from Teachers College Records. Below is a pie-chart showing the representation per journals:

Figure 4

Distribution of journal category



Among these, two journal categories stand out: education technology journals and subject-specific journals. The prominence of education technology journals can be attributed to the widespread scaling of educational innovations through technology. In parallel, the focus on subject-specific journals reflects innovations addressing particular issues within mathematics or science.

Study Type & Research Method Composition

It was also important to examine the composition of literature according to study type and research methodology as it helps to assess the maturity of the scholarship under investigation (Hallinger, 2012). Analysis by study type reveals that 92% of the publications (n = 23) were empirical studies. Research reviews made up 8% of the dataset (n = 2). Qualitative studies dominate with 20 entries, focusing on in-depth understanding and rich insights into the subject. There is only one quantitative study, which uses statistical methods to provide numerical data. Additionally, five mixed-methods studies combine both qualitative and quantitative approaches, offering a comprehensive perspective. This distribution shows a preference for qualitative research, supplemented by a few mixed-method studies for broader analysis due to the nature of the research questions posed.

Authorship

Only 3 out of 25 articles are single authored, the rest (88%) are co-authored.

Top 5 Most Referenced Articles

In an attempt to understand which articles contributed and shaped the studies, a search was conducted for the top 5 most referenced articles within the 25 samples. This was initially done using ChatGPT for the count, followed by a manual count to ensure accuracy. Below are the results:

Table 2

Top 5 referenced articles in the sample

Rank	Article Name	Listed Repetitions
# 1	Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change	8
# 2	Elmore, R. F. (1996). Getting to scale with good educational practice.	8
# 3	Fullan, M. (1991). The new meaning of educational change.	8
# 4	Rogers, E. M. (2003). Diffusion of innovations.	7
# 5	Coburn, C. E. (2021). Transforming educational pathways: Scaling professional learning for ambitious teaching.	6

Coburn (2003) is a central study for this systematic review, which validates its significance in the field and being ranked as top #1 ranked. Out of the top five, two articles (ranks #2 and #3) fall outside our specified years bracket (2000-2023). Rogers (2003) was mentioned in the literature review as a key reference to scaling in a general research field, which Coburn applied to education. Coburn et al. (2021) is a new article that was not featured in this review but highlights the ongoing relevance of scaling educational innovations.

Literature Categories

The reviewed literature on scaling educational innovations was classified into three distinct categories:

Category A. Case Study of Scaling a Specific Innovation. Articles in this category focus on detailed examinations of specific educational innovations and their scaling processes (n=10). These studies typically involve the implementation and expansion of a particular program, model, or curriculum within various educational settings. They analyze the conditions, strategies, and outcomes associated with the efforts to scale these innovations, highlighting the successes and challenges encountered during the process. Examples of Cases: River City Curriculum, Esceluda, Reading Recovery, Chicago Manual Training Schools, Connected Learning Initiative (CLIx).

Code B. Case Study of Scaling a Single Professional Practice. This category encompasses studies that explore the scaling of specific professional practices or approaches within educational systems (n=8). These practices may include differentiated instructions, management and leadership practices, or professional development programs. The focus is on how these practices are adopted, implemented, and expanded across different contexts and how they contribute to improving educational outcomes. Examples of Cases: Differentiated Instruction in Kindergarten, PDSA, School Based Management (SBM), Maths CPD, Transformational Leadership

Code C. Study of General Phenomena and Tackling Scaling in it. Articles in this category address broader phenomena related to scaling educational innovations (n=7). These studies do not focus on a single innovation or practice but rather investigate general principles, models, and frameworks that support scalability in education. They often provide a comprehensive view of various factors affecting the scaling process and offer theoretical and empirical insights into effective strategies for scaling innovations. Examples of Cases: Designing Research to Inform Sustainability and Scalability of

Digital Technology Innovations, Effects of ICT, Pedagogical Innovation Scalability Challenges.

Below is a summary table:

Table 3

Literature categories summary table

Code	Focus/ Count	General Description	Examples of Cases
A	Case Study of Scaling a Specific Innovation (n=10)	Articles in this category focus on detailed examinations of specific educational innovations and their scaling processes. They analyze conditions, strategies, and outcomes associated with scaling.	River City Curriculum, Esceluda, Reading Recovery, Chicago Manual Training Schools, Connected Learning Initiative (CLIx)
B	Case Study of Scaling a Single Professional Practice (n=8)	Studies that explore the scaling of specific professional practices within educational systems, including continuous improvement cycles, professional development programs, and leadership approaches.	Differentiated Instruction in Kindergarten, PDSA, SBM, Maths CPD, Transformational Leadership
C	Study of General Phenomena and Tackling Scaling in it (n=7)	Articles that address broader phenomena related to scaling educational innovations, investigating general principles, models, and frameworks that support scalability in education.	Designing Research to Inform Sustainability and Scalability of Digital Technology Innovations, Effects of ICT, Pedagogical Innovation

Short Description of each case

Below is a table that explains each case, title of the article, focus, challenges, scale, key findings, journal and country.

Table 4

Cases Overview

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Getting to Scale with Moral Education: The Demands of Reproducibility and the Case of the Chicago Manual Training School (1884–1904) (McCamant, 2018)	Integration of industrial training into traditional academics	Reproducibility and measurability of the approach	Not specified	Highlighted the need for clear metrics and reproducibility	Teachers College Record	USA
New Schools in New York City and Singapore (Hatch et al., 2022)	Innovative school models in NYC and Singapore	Governance and professional capacity	111 schools in Singapore, 80 in NYC by 2011	Common challenges in scaling innovative approaches	Journal of Educational Change	USA/Singapore
Bringing a Student-Centered Participatory Pedagogy to Scale in Colombia (Colbert & Arboleda, 2016)	Student-centered learning with Escuela Nueva	Systemic support and teacher involvement	National reach	Success factors include systemic support and teacher engagement	Comparative Education Review	Colombia
Scaling and Sustaining an	Literacy intervention through	Design, data collection,	46,849 students	Importance of well-articulated	Journal of Educational Research	Multiple countries

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Intervention: The Case of Reading Recovery (Rodgers, 2016)	Reading Recovery	and district-level support	across 7 countries	design and support systems		
Diffusing Innovations: Adoption of Serious Educational Games by K-12 Science Teachers (Vallett et al., 2014)	Adoption of educational games in K-12 science education	Teacher perceptions and adaptation	Not specified	Influencing factors include teacher perceptions and engagement	Journal of Science Education and Technology	USA
Dimensions of Scale: Connected Learning Initiative (CLIx)—A Case Study of Educational Technology Initiative in India (Balli & Singla, 2024)	Educational technology through CLIx	Quantity, diffusion, and quality of scale	76,226 students engaged during the intervention	Conceptualized scale as dynamic and multi-dimensional	Journal of Learning Sciences	India
Determinants of the Perceived Usefulness (PU) in the Context of Using Gamification for Classroom-	Gamification for ESL teaching in Dutch higher education	Success factors for gamification	Not specified	Identified success factors and developed monitoring instruments	British Journal of Educational Technology	Netherlands

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Based ESL Teaching (Luo, 2023)						
Design for Scalability: A Case Study of the River City Curriculum (Clarke & Dede, 2009)	Multi-user virtual environment curriculum	Designing for scalability	Scaled to 250 teachers and 15,000 students	Framework for designing scalable educational innovations	Educational Technology Research and Development	USA
Implementing Mobile Learning Curricula in a Grade Level: Empirical Study of Learning Effectiveness at Scale (Looi et al., 2014)	Mobile learning curriculum in primary science	Implementation and effectiveness	1,196 students involved	Effectiveness of mobile learning in primary education	Computers & Education	Singapore
The Singapore Experience: Synergy of National Policy, Classroom Practice and Design Research (Looi et al., 2011)	Systemic education reforms through design research	Synergistic conditions for scaling	Not specified	Strategic planning for scalability at national, school, and classroom levels	Journal of Learning Sciences	Singapore
Continuous Improvement in the Public-	Continuous improvement using	Capacity building and data collection	Not specified	Benefits and challenges of PDSA	Journal of Educational	USA

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
School Context: Understanding How Educators Respond to Plan–Do–Study–Act Cycles (Tichnor-Wagner et al., 2017)	PDSA cycles			cycles in improving outcomes	Administration	
School-Based Management in Marginal Areas: Satisfying the Political Context and Student Needs (Ulfatin et al., 2022)	School-based management in marginal districts	Political context, leadership, and teacher performance	Not specified	Role of teachers and principals in school effectiveness	Educational Management Administration & Leadership	Indonesia
Transformational Leadership for Deeper Learning: Shaping Innovative School Practices for Enhanced Learning (Sliwka et al., 2024)	Transformational leadership for deeper learning	Addressing systemic factors and collaboration	Not specified	Importance of leadership in fostering deeper learning practices	Journal of Educational Change	Multiple countries
Factors Affecting	Differentiated instruction	Teacher beliefs,	Implemented in 18	Factors influencing	Journal of Early	Netherlands

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Intervention Fidelity of Differentiated Instruction in Kindergarten (Dijkstra et al., 2016)	in Dutch kindergartens	principal involvement, and communication	elementary schools	intervention fidelity in differentiated instruction	Childhood Research	
Scaling Up of Continual Professional Development for Mathematics Problem Solving in Singapore Schools (Leong et al., 2021)	Continual professional development for math problem-solving	Readiness of teachers and supporting structures	Not specified	Reflection on CPD strategies and scaling of pedagogical practices	Mathematics Education Research Journal	Singapore
Seamless Learning from Proof-of-Concept to Implementation and Scaling-Up: A Focus on Curriculum Design (Looi & Seow, 2015)	Scaling curricular innovations from research to implementation	Challenges in scaling from initial to broader reach	Initially 38 students, scaled to 600 students	Emphasized curriculum design for scaling up educational innovations	Journal of Computer Assisted Learning	Singapore
Towards a Research Base for Implementation Strategies	Professional development for mathematics teachers	Material, personnel, and systemic strategies	Not specified	Importance of adaptable materials and systemic	International Journal of Science and Mathemati	Germany

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Addressing Mathematics Teachers and Facilitators (Roesken-Winter et al., 2021)				contexts for scaling	cs Education	
Leading from Equity: Changing and Organizing for Deeper Learning (Kim et al., 2023)	Equity leadership and deeper learning in South Korea	Creating inclusive environments and systemic changes	Not specified	Role of equity leadership in scaling deeper learning practices	Journal of Educational Change	South Korea
The Effect of Basic Robotic Coding In-Service Training on Teachers' Acceptance of Technology, Self-Development, and Computational Thinking Skills in Technology Use (Çakır et al., 2021)	Impact of coding instruction on students and teachers	Acceptance of technology and self-development	Not specified	Significant improvements in students' attitudes and skills	Journal of Educational Computing Research	Turkey
Designing for Trust-Building	Trust-building in Networked	Collaborative design and	Not specified	Importance of collaborati	Educational Researcher	USA

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Interactions in the Initiation of a Networked Improvement Community (Kallio & Halverson, 2020)	Improvement Communities	relational trust		ve design activities for scaling NICs		
Designing Rural School Improvement Networks: Aspirations and Actualities (Hargreaves et al., 2015)	Improvement networks for rural schools	Designing and launching school improvement networks	Not specified	Lessons learned about network design and launch	Journal of Educational Change	USA
A Model of Continuous Improvement in High Schools: A Process for Research, Innovation Design, Implementation, and Scale (Cohen-Vogel et al., 2016)	Continuous improvement model for high schools	Prototype development, rapid-cycle testing	Not specified	Emphasized research-practitioner partnerships and prototype development	American Journal of Education	USA
Pedagogical Innovations as Systemic Change: The Challenge of	ICT-based educational change	Sustainability and scalability of ICT innovations	Analyzed 83 case studies	Strategies for systemic change and leadership	Computers & Education	Hong Kong

Case	Focus	Challenges	Scale	Key Findings	Journal	Country
Sustainability and Scalability (Law et al., 2011)				in ICT scaling		
Effects of ICT: Do We Know What We Should Know? (Cox & Marshall, 2007)	Impact of ICT in education	Gaps in research and need for longitudinal studies	Not specified	Importance of rigorous research strategies for scaling ICT innovations	Technology, Pedagogy and Education	UK

Narrative Emergent Themes for the Research Question

Narrative analysis of the articles included in this review resulted in the identification of the four main levels of factors that affect scaling education innovations: designers, teachers, schools and systems. Each level's factors are illustrated in a single mind map. These themes are discussed in the section below:

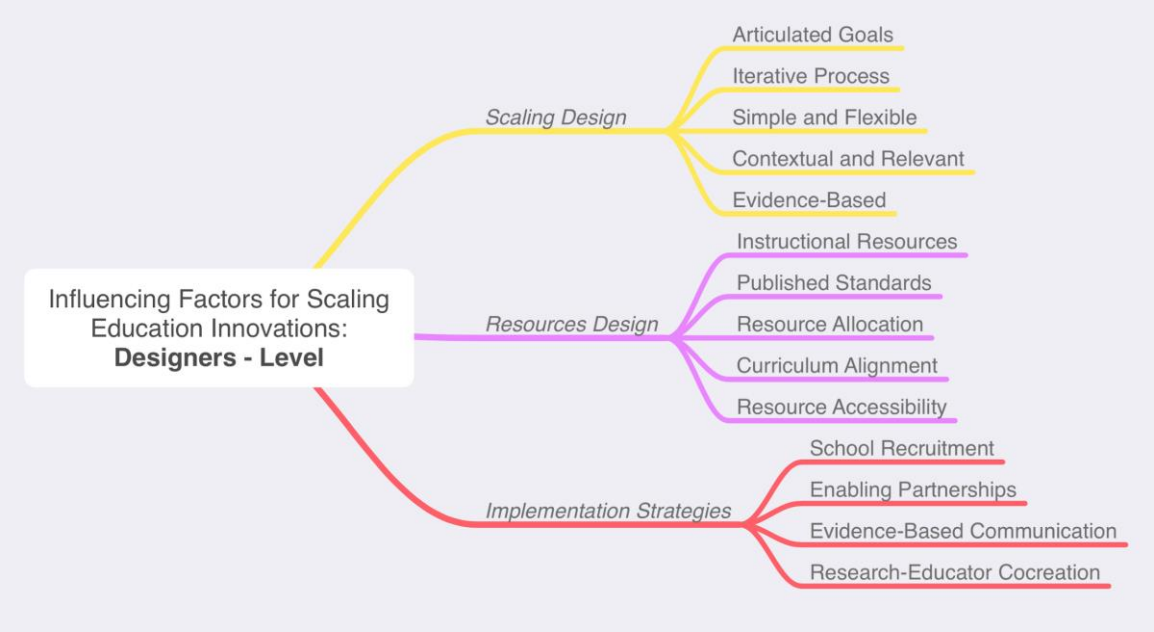
Factors Influencing Scaling-up Education Innovations: Designers Level

In designing scalable educational innovations, several key factors must be considered to ensure success. The design phase encompasses articulated goals, iterative processes for continuous improvement, simple and flexible approaches, contextual and relevant adaptation, and an evidence-based foundation. Resources design is also essential, focusing on high-quality instructional resources, adherence to published implementation standards, effective resource allocation, curriculum alignment, and ensuring resource accessibility. Implementation strategies are critical and include targeted school recruitment, enabling partnerships, evidence-based communication, and research-educator co-creation. These interconnected factors collectively enhance the scalability

and sustainability of educational innovations, fostering environments where effective practices can thrive and adapt to various educational contexts. These interconnected factors will be unpacked in detail below.

Figure 5

Designers influencing factors for scaling education innovations



Scaling Design. Effective scaling design includes the articulation of clear goals, an iterative process, simplicity and flexibility, contextual relevance, and evidence-based practices, all defined below.

Articulate Goals. Having clear design goals is essential to ensure alignment by the broader educational community, facilitating smoother integration and scalability. Ambiguity in goals can leave teachers unsure about the intended outcomes, impeding the effectiveness of scaling innovations, especially at the teacher level (Looi, 2015; Roesken-Winter et al., 2021; Hargreaves et al., 2015; Dijkstra et al., 2016). For instance, Dijkstra et al. (2016) pointed out, "Participants from School A regularly mentioned that the intervention needed to be more specified" (p. 161).

Iterative Process. Iterative design processes that involve continuous feedback and refinement are crucial for developing effective and scalable educational innovations. Design-based research approaches allow for ongoing adjustments based on classroom feedback, ensuring that designs remain practical and relevant (Rodgers, 2016; Looi et al., 2014). However, poorly designed programs can hinder the adoption and scaling of innovations. Challenges such as sustaining the design over time, maintaining the integrity of design principles, and the complexity of the design can hinder easy adoption and adaptation by teachers (Looi and Seow, 2015; Roesken-Winter et al., 2021).

Simple and Flexible. Intensive and complex designs can overwhelm teachers, schools and systems (Rodgers, 2016; Cakir et al., 2021). Flexible and adaptive strategies allow for continuous innovation and adjustment to meet educational needs. Law et al. (2011) described how technology-supported project-based learning innovations were not conducted according to a tightly planned, staged change model, allowing for more adaptability. Clarke and Dede (2009) also highlighted the importance of developing flexible models with variants adapted to different implementation conditions and learning preferences: "In order to design for scale, designers should develop flexible models with variants adapted to a spectrum of implementation conditions and learning preferences" (p. 357). This flexibility enables educators to tailor innovations to their specific contexts and needs, enhancing the likelihood of successful implementation and scaling. On the other hand, emphasizing strict adherence to the materials rather than encouraging flexible use can hinder teachers' ability to integrate new practices into their existing routines. Roesken-Winter et al. (2021) highlighted, "We drew on necessary design elements in TPD materials and manuals, allowing facilitators to make productive adaptations" (p. 1013).

Contextual and Relevant. Designers of the Escuela Nueva innovation understood the specific needs and context of rural schools in Colombia (Colbert and Arboleda, 2016). This knowledge informed the creation of a flexible, child-centered educational model that could be effectively implemented in multi-grade classrooms (Colbert and Arboleda, 2016). Similarly, CLIx innovation resources were adapted to local cultural contexts, making them more relevant and engaging for students in different states. Insufficient support for adaptation further complicates effective implementation. Teachers may struggle to adapt materials without clear guidelines, and robust feedback mechanisms are crucial for measuring the true impact of training that is contextually relevant (Roesken-Winter et al., 2021; Cakir et al., 2021). Limited accessibility to materials and the need for significant training to use them can also limit their impact (Roesken-Winter et al., 2021). Failing to provide practical examples and case studies can leave teachers without clear guidance on how to implement innovations. Dijkstra et al. (2016) highlighted, "Schools wanted more practical advice and real-life examples to follow" (p. 161).

Evidence-Based. Ongoing research-based demonstration of the innovation's effectiveness through continuous data collection and evaluation is essential for supporting its continued implementation and scaling. Looi et al. (2011) emphasized, "Researchers in Singapore schools have capitalized on the nexus between research and practice" (p. 14). Data-driven decision-making ensures solutions are grounded in evidence, guiding design processes (Kallio and Halverson, 2020). Howard et al. (2021) similarly emphasized the use of empirical data: "Artifact analysis of student products, observations of the lessons, interviews with students, guided subsequent iterations of the intervention" (p. 482). Maintaining a balance between theoretical foundations and practical accommodations ensures innovations are both effective and practical (Leong et al., 2021; Looi et al., 2014).

Research-based curriculum design ensures materials are grounded in evidence and effectively support teachers in their instructional practices (Roesken-Winter et al., 2021; Rodgers, 2016; Dijkstra et al., 2016). Innovations grounded in well-established educational theories and frameworks can be more effective and scalable, integrating research and practice (Howard et al., 2021; Hargreaves et al., 2015; Luo, 2023). Teachers valued practical measurement tools that provided quick feedback and facilitated iterative improvement, aligning well with their previous continuous improvement efforts (Howard et al., 2021). However, excessive paperwork and data collection requirements posed significant burdens, limiting the perceived value of scaling these innovations (Ulfatin et al., 2022).

Resource Design. Effective research design includes instructional resources, adherence to published standards, strategic resource allocation, curriculum alignment, and resource accessibility.

Instructional Resources. High-quality, practical, and well-structured training materials are particularly valued for their effectiveness in helping teachers understand and implement educational innovations (Dijkstra et al., 2016). Moreover, the development of comprehensive instructional packages, including curriculum materials, videos, and lesson plans, is crucial for successful implementation (Leong et al., 2021). Sliwka et al. (2024) highlighted, "Teachers have access to diverse materials and digital platforms to support the creation of innovative learning experiences" (p. 107). Releasing these resources as open educational resources (OERs) under open licenses further promotes widespread adoption and adaptation (Balli and Singla, 2024). Limited access to resources, including time, funding, and technology, significantly hinders the scaling of educational innovations (Howard et al., 2021; Looi et al., 2011; Ulfatin et al., 2022;

Kim et al., 2023; Sliwka et al., 2024; Hargreaves et al., 2015; Hatch et al., 2022; Leong et al., 2021). For example, "Schools in marginal areas often lack access to the necessary resources and infrastructure to fully implement SBM" (Ulfatin et al., 2022, p. 128).

Published Implementation Standards. Adhering to professional standards is essential for maintaining the quality and consistency of educational programs. These standards provide clear implementation guidelines, ensuring effective delivery in diverse settings (Rodgers, 2016). For example, the development of common professional standards for Reading Recovery has been instrumental in its successful adoption (Rodgers, 2016, p. 15).

Resource Allocation. Securing and allocating resources, including funding for travel and release time, is crucial for enabling participation in educational programs (Hargreaves et al., 2015). Resource allocation is often the backbone for districts to participate, with funding secured from various federal and state sources (Hargreaves et al., 2015, p. 317). However, the heavy initial investment required for successful implementation can be challenging to maintain across multiple schools over time (Leong et al., 2021, p. 1295). "The human factors and the need to take into account the contextual givens necessitate this heavy investment approach" (Leong et al., 2021, p. 1295). Moreover, "While close collaboration with one or two schools is not resource-intensive, setting up the same relationship with 20 schools would require considerable time and resources" (Howard et al., 2021).

Curriculum Alignment. Luo (2023) emphasized the importance of curriculum alignment in gamified learning tools, stating, "The content provided by the gamified learning tool is relevant to the curriculum". However, traditional assessment methods often do not align with the innovative design of deeper learning units and collaborative

approaches, undermining the principles of these educational strategies (Sliwka et al., 2024; Looi et al., 2011). “Current testing formats employed in schools essentially undermine the core principles of deeper learning” (Sliwka et al., 2024, p. 113).

Resource Accessibility. Balli and Singla (2024) highlighted the importance of technological flexibility, noting that "These resources can be accessed through three versions of the learning platform: an online platform, a local server-based platform, and an offline standalone version" (p. 13). The ability to adapt technological resources to various contexts significantly enhances their scalability and usability in diverse educational settings. Conversely, limited access to resources poses a significant challenge. Schools, especially those in marginal areas, often lack the necessary infrastructure and financial support to fully implement School-Based Management (SBM) or other innovative practices. Ulfatin et al. (2022) emphasized, "Schools in marginal areas often lack access to the necessary resources and infrastructure to fully implement SBM" (p. 128). This disparity in resource availability highlights the need for equitable distribution of resources to ensure that all schools can participate in and benefit from educational innovations.

Implementation Strategies. Effective implementation strategies include school recruitment, enabling partnerships, evidence-based communication, and researcher-educator co-creation.

School Recruitment. Effective recruitment involves strategically selecting schools for scaling educational innovations. Diversifying the pool of schools can be helpful to test the scalability of the innovation (Rodgers, 2016; Kallio and Halverson, 2020; Hargreaves et al., 2015; Sliwka et al., 2024). Successfully scaling educational programs to varied school settings, such as urban, suburban, and rural areas, demonstrates their

adaptability and broad applicability. This variety showcases the program's robustness and effectiveness in diverse educational environments, as evidenced by the significant increase in the number of schools implementing Reading Recovery, from 12 initially to 3,735 currently (Rodgers, 2016, p. 21). Yet, variations in school contexts may cause participants to perceive others' practices as irrelevant to their own settings. Kallio and Halverson (2020) noted, "The lack of existing ties between educators from different schools and the differences in their school contexts can also produce barriers to collaborative problem-solving" (p. 7). Selecting participants with well-established practices and district leadership support ensures a strong foundation for collaborative efforts (Kallio and Halverson, 2020; Hargreaves et al., 2015). Personal communication and trust-building are essential for successful recruitment, particularly in new networks, as they foster trust and effectively convey the value and requirements of participation (Hargreaves et al., 2015). Additionally, selecting participants with common characteristics and needs helps ensure network activities are relevant and engaging, facilitating smoother collaboration and effective implementation (Hargreaves et al., 2015). Selecting schools with unclear decision structures can result in leadership not arriving at a final decision, leading to significant delays (Howard et al., 2021).

Enabling Partnerships. Different kinds of partnerships provide varying types of support. Three key themes emerged: knowledge partnerships, material partnerships, and funding. Partnerships with universities are essential for professional development and research activities. These collaborations bring expertise, resources, and credibility, enhancing the implementation and sustainability of innovations. Additionally, industry support, such as partnerships providing resources and expertise, enhances the learning environment and facilitates immersive experiences. Hatch et al. (2022) noted, "Beacon

Primary School, working with Singtel, established an immersive laboratory that provided computers whereby students could explore a variety of virtual learning environments" (p. 211). Innovative partnership funding models support the development and implementation of educational innovations. These models ensure that financial resources are available to sustain long-term efforts. Hatch et al. (2022) highlighted, "The Future Schools Programme was jointly funded by the National Research Foundation (NRF), the Ministry of Education, and the Infocomm Development Authority (IDA)" (p. 206). The lack of pre-existing relationships among schools can hinder initial collaborative efforts, impacting the overall success of implementation (Kallio and Halverson, 2020).

Evidence-Based Communication. Communicating solid evidence of positive student outcomes is crucial for gaining support and sustaining the program. Teachers gained more confidence and saw the value in validating their practices while scaling the innovation. Demonstrating significant improvements in student reading skills helps validate the program's effectiveness and justify its continued implementation and scaling. Rodgers (2016) noted, "The WWC's reviews show that Reading Recovery produces the largest impact on student reading skills of any intervention reviewed (WWC, 2013), making it one of the most promising reading interventions available for children" (p. 20).

Researcher-Educator Co-creation. Authentic researcher-practitioner partnerships are crucial for co-developing and refining innovations. This collaborative approach fosters a supportive environment for educators to experiment with and adopt new practices, leading to more effective and sustainable innovations. Collaborative environments where designers can share ideas and co-create learning experiences significantly enhance the scalability of educational innovations. Vogel et al. (2016) highlighted the importance of comprehensive support systems in the success of their

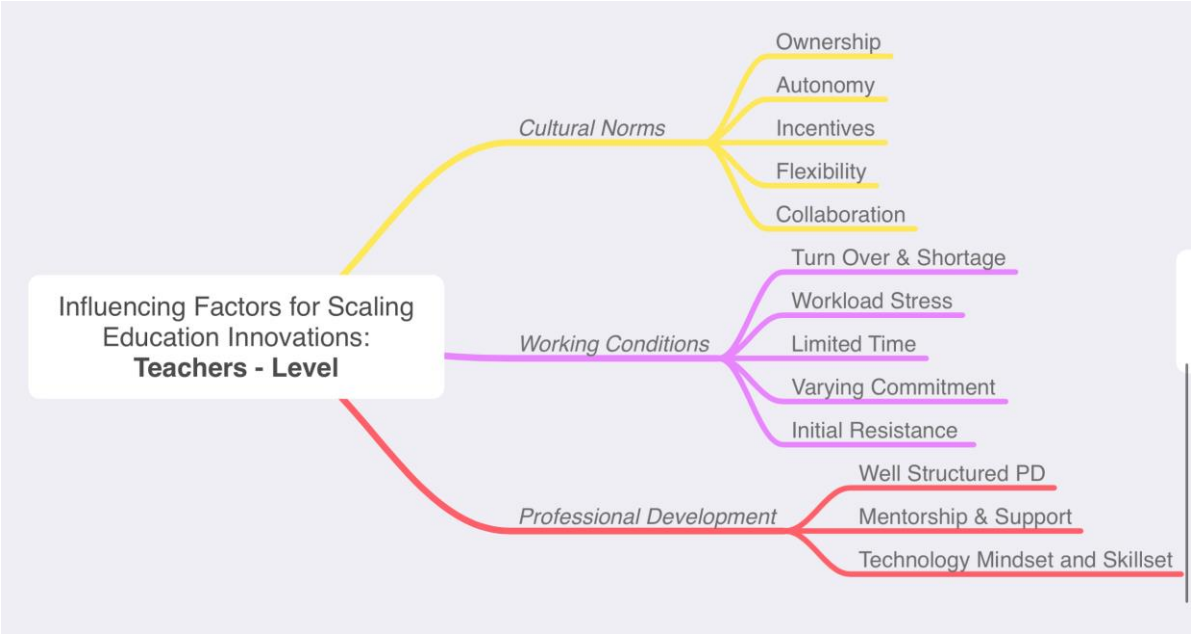
inquiry-based curriculum, noting, "Researchers and teachers discussed, reflected and elaborated the designed lessons for supporting the scaling of the curriculum" (p. 104).

Scaling-up Education Innovations Influencing Factors: Teachers Level

Scaling educational innovations effectively requires a deep understanding of various factors at the teachers' level. These factors encompass cultural norms, working conditions, and professional development, each playing a crucial role in how innovations are adopted and sustained in educational environments. Cultural norms such as ownership, autonomy, incentives, flexibility, and collaboration significantly influence teachers' willingness and ability to embrace new practices. Working conditions, including turnover and shortage, workload stress, limited time, and varying commitment levels, impact the feasibility and consistency of implementing innovations. Professional development, comprising opportunities for growth, mentorship and support, and cultivating a technology mindset and skillset, is essential for equipping teachers with the necessary tools and confidence to integrate and scale innovations successfully. Understanding and addressing these interconnected factors are vital for creating a conducive environment for the sustainable adoption of educational innovations at the teachers' level.

Figure 6

Teachers influencing factors for scaling education innovations



Cultural Norms. Strong enabling school cultural norms for teachers includes ownership, autonomy, incentives, flexibility, and collaboration, all detailed below.

Ownership. The successful implementation and scaling of educational innovations heavily rely on factors such as ownership. When teachers feel a sense of ownership over a program, perceiving it as an internal rather than external initiative, their commitment and engagement significantly increase (Rodgers, 2016; Howard, 2021; Balli and Singla, 2024). As Rodgers (2016) notes, "An innovation is regarded as having scaled if the reform shifts to becoming an internal reform, no longer seen as an external one brought in by someone outside the school" (p. 11). This sense of ownership can be cultivated through teacher involvement in the research and development process, as Howard et al. (2021) highlights, “The teachers decided to use the research as part of their professional learning, specifically how to support students’ learning processes through digital technologies.”

Autonomy. Granting teachers autonomy in decision-making processes and empowering them to design and implement innovative practices further enhances their

involvement and commitment (Ulfatin, 2022; Sliwka et al., 2023; Leong et al., 2021). Ulfatin et al. (2022) points out that "Teachers' involvement in decision-making processes has been key to the success of SBM" (p. 129), emphasizing the importance of giving teachers a microphone to their voice in the process. Sliwka et al. (2023) emphasizes the empowerment aspect, stating, "Empowering teachers by involving them in the co-creation and implementation process of deeper learning units" (p. 112).

Incentives. Recognizing the value of educational innovations through incentives and visible success plays a crucial role in fostering their adoption and sustainability (Calkir, 2021; Leong et al., 2021; Hatch et al., 2022; Dijkstra et al., 2017; Tichnor-Wagner et al., 2017). Calkir (2021) emphasizes that providing incentives encourages educators to engage actively in innovative practices, thereby enhancing motivation and commitment to ongoing improvements (p. 11). Leong et al. (2021) suggests that visible successes and positive outcomes serve as powerful motivators, inspiring teachers to persist in their efforts to innovate within their educational environments (p. 23). Hatch et al. (2022) and others argue that recognizing and rewarding innovative initiatives create a supportive culture that values experimentation and continuous improvement in teaching practices. These approaches not only celebrate achievements but also incentivize further innovation, contributing to sustained educational improvement and growth. Motivation and engagement are key factors in the successful implementation of educational innovations. "High motivation among teachers contributed to successful implementation" (Dijkstra et al., 2017, p. 159).

Flexibility. A flexible curriculum that allows for adaptation to diverse student needs supports innovative teaching practices (Sliwka et al., 2023; Hatch et al., 2022; Looi, 2015). Looi (2015) states, "Teachers need professional development to understand the

intent of the curriculum and the pedagogy needed to enact the lessons" (p. 433). This adaptability is crucial for addressing individual learning styles and promoting deeper engagement and understanding.

Collaboration. Collaborative environments where designers can share ideas and co-create learning experiences significantly enhance the scalability of educational innovations. Vogel et al. (2016) highlighted the importance of comprehensive support systems in the success of their inquiry-based curriculum, noting, "Researchers and teachers discussed, reflected and elaborated the designed lessons for supporting the scaling of the curriculum" (p. 104). The establishment of team and cooperation structures within schools fosters a culture of continuous improvement and collective problem-solving. Sliwka et al. (2024) observed that "Establishment of team and cooperation structures across the school" (p. 113) is crucial for fostering a collaborative environment. Additionally, Kim et al. (2023) pointed out that leveraging professional learning communities makes collaborative networks more meaningful and practical: "Our professional learning communities became more meaningful and practical" (p. 148). This sentiment is echoed by Hargreaves et al. (2015), who emphasized the importance of shared vision and goals: "An effective network has to be owned by the participants themselves. It cannot be borrowed or rented from a single model or exemplar that exists elsewhere and cannot be imposed to implement particular government priorities" (p. 317).

Teacher Working Conditions. Influencing factors include teacher turnover, teacher shortages, workload and stress, limited time and varying teacher commitment.

Teacher Turn Over & Shortages. Rodgers (2016) highlights that high attrition rates among trained teachers can disrupt the continuity and expansion of educational programs, noting that the decision to drop an innovation is often unrelated to its effectiveness.

Colbert and Arboleda (2016) describe high turnover and migration of rural teachers to urban areas as a significant challenge to maintaining consistent implementation and scaling of programs, with approximately 30% of rural teachers in Colombia transferring to urban schools annually in search of better opportunities. Leong et al. (2021) add that a high turnover of teachers can disrupt the continuity and sustained implementation of educational modules, citing an example where four teachers involved in teaching a module left the school. Rodgers (2016) and Colbert and Arboleda (2016) highlight that high turnover disrupts reform efforts and diminishes institutional knowledge, stemming from issues such as burnout and inadequate support systems. Sliwka et al. (2023) discuss teacher shortages, highlighting the insufficient number of teachers to support the implementation of deeper learning. This shortage depletes the strength and power required for effective school development. The cumulative effect of these factors—high attrition, teacher turnover, and shortages—significantly impedes the consistent and sustained implementation of educational innovations and programs. Strategies proposed by Looi (2015) emphasize targeted recruitment and professional development to mitigate these challenges, aiming to bolster educator retention and create a supportive environment conducive to sustained innovation in education.

Workload Stress. Ulfatin et al. (2022) discuss how increased administrative tasks and stress can negatively impact teachers' performance and willingness to innovate. Dijkstra et al. (2017) add that high workload can prevent teachers from fully engaging with interventions, noting that teachers mentioned the intervention required more workload than expected.

Limited Time. Leong et al. (2021) highlight the challenge of finding regular, dedicated time slots for continuing professional development (CPD) amidst other

teaching responsibilities, noting that the mathematics department found it hard to find a common regular time slot for CPD activities. Sliwka et al. (2023) emphasize the limited time teachers have to plan and implement deeper learning units, with additional hours required for design. Hatch et al. (2022) and Tichnor-Wagner et al. (2017) similarly point out that teachers often have limited time to engage with and implement new tools and practices, struggling to find the time needed for PDSA activities amidst their existing workload. Calkir (2021) also notes that teachers have insufficient time to learn and integrate new technologies into their teaching practices. Kallio and Halverson (2020) discuss the limited availability for engaging in collaborative design activities, hindering participation and progress. Balli and Singla (2024) state that teachers need more time to engage with computer-based activities and complete program modules, while Looi (2015) and Looi (2011) emphasize that teachers often have limited time to plan, implement, and reflect on new curricular innovations, with the additional time required for preparing ICT-enhanced lessons being a significant barrier.

Varying Commitment Level. Leong et al. (2021) point out that differences in commitment levels among teachers can affect the overall consistency and effectiveness of MPS instruction, suggesting a strategic broadening of teacher capacity by including one or two more teachers each year. Balli and Singla (2024) note that engagement variability among teachers with CLIx resources impacted the overall effectiveness of the program, with engagement levels varying based on classroom size and the number of functional computers available.

Initial Resistance to Change. Teachers' attitudes towards innovation being scaled and their initial resistance impact the adoption and scaling of educational innovations were one of the most cited influencing factors with different manifestations in the literature

(Calkir, 2021; Colbert and Arboleda, 2016; Tichnor-Wagner, et al., 2017; Howard, 2021; Ulfatin, 2022; Hatch et al., 2022; Kim, 2023; Dijkstra et al., 2017; Hargreaves et al., 2015; Vallet, 2014; Leong et al., 2021; Balli and Singla, 2024; Roesken-Winter et al., 2021; Looi, 2011). Colbert and Arboleda (2016) discuss the initial resistance to change within the traditional educational system, where both teachers and administrators were skeptical about adopting new methods that deviated from conventional practices, especially due to the additional time required for designing self-instructional learning materials and the perceived threat from reduced teacher numbers. Similarly, Ulfatin et al. (2022) note that some teachers resist changes introduced by SBM due to a preference for traditional methods and Hatch et al. (2022) highlight resistance among teachers to adopt new practices. Tichnor-Wagner et al. (2017) and Kim et al. (2023) report resistance to additional workload, with teachers finding the completion of facilitation guides "laborious," "discouraging," and "redundant." Dijkstra et al. (2017) point out that strong beliefs and resistance to change among teachers can hinder the implementation of new practices, while Vallet (2014) describes how schools that lack a vision for innovation can impede the adoption of SEGs. Leong et al. (2021) describe initial resistance from teachers who were not part of the core group and needed convincing of the value and feasibility of MPS. Balli and Singla (2024) discuss how some teachers revert to traditional instructional methods due to challenges in technology integration, and Roesken-Winter et al. (2021) note that uncertainty about outcomes contributes to resistance. Looi (2011) adds that adherence to traditional, teacher-centered instructional methods can hinder the adoption of collaborative, technology-enhanced learning approaches.

Teacher Professional Development. Influencing factors include well-structured PDs, mentorship and support, and finally, technology mindset and skillset.

Well Structured PD. Various studies converge on the notion that sustained and well-structured PD programs are essential for fostering teacher expertise and supporting the implementation of innovative teaching practices. Rodgers (2016) emphasizes the need for ongoing, tiered PD to create expert teachers, suggesting that a structured approach is vital for maintaining program quality. Howard et al. (2021) highlight the necessity of continuous and robust PD for effectively integrating technological innovations, stressing that treating educators as professionals who can follow their interests is essential. Colbert and Arboleda (2016) illustrate the success of Escuela Nueva, where teachers were trained using the same active learning methods they would apply in their classrooms, helping them understand and embrace the new pedagogy. Ulfatin et al. (2022) and Calkir (2021) highlight that such programs enhance the effectiveness of educational leaders and designers. Continuous training helps educators stay updated with the latest educational practices and technologies, as Sliwka et al. (2023) points out: "Cultivating avenues for professional growth and fostering experimentation" (p. 115). Vallet (2014) adds that integrating technology resources into PD provides hands-on experience and support: "Professional development that does not focus on the ongoing classroom duties of the teacher shows little, if any, impact on teaching practices or student achievement" (p. 253). In contrast, challenges such as inconsistent PD efforts (Howard, 2021) and negative past experiences (Dijkstra et al., 2017) hinder effective skill development and innovation adoption. Some educators also face mismatches between their professional development needs and available resources (Ulfatin, 2022; Kim, 2023; Luo, 2023; Leong et al., 2021), resulting in variability in readiness and inadequate preparation for implementing new

practices (Looi, 2015). Despite these obstacles, targeted efforts to address these issues can enhance educators' capacity to effectively integrate and sustain educational innovations in diverse educational settings.

Mentorship and Support. Mentorship and continuous support play crucial roles in building confidence and refining teaching practices. Issues like assessment constraints and lack of support further exacerbate these challenges (Sliwka et al., 2023; Looi, 2015; Hatch et al., 2022; Calkir, 2021). Looi (2015) adds that pairing less experienced teachers with mentors helps them gain confidence and improve their teaching practices, noting, "Mentors provided support to newer teachers by discussing with their mentees prior to the lesson and providing just-in-time assistance" (p. 427).

Technology Mindset and Skill Set. The lack of technological positive attitude, mindset and skills among educators poses a significant barrier to scaling educational innovations. Howard et al. (2021), Hatch et al. (2022), Calkir (2021), Vallet (2014), Balli and Singla (2024), Looi (2015), and Looi (2011) all highlight various aspects of this issue, from strategies for enhancing teachers' technological competencies to the challenges of bridging skills gaps and the impact of professional development. Vallet (2014) and Balli and Singla (2024) emphasize the importance of sustaining innovations with robust technical skills and integrating these skills into curriculum design. Cultivating a positive attitude towards technology, as noted by Luo (2023), is crucial for innovation adoption. Additionally, Vallet (2014) points out that technical issues and infrastructure challenges can hinder scalability, stressing the need for robust technical support and investment. Integrating technology into teaching practices and promoting digital literacy among teachers supports innovation scalability (Howard et al., 2021; Leong et al., 2021; Roesken-Winter et al., 2021). Roesken-Winter et al. (2021) notes the importance of

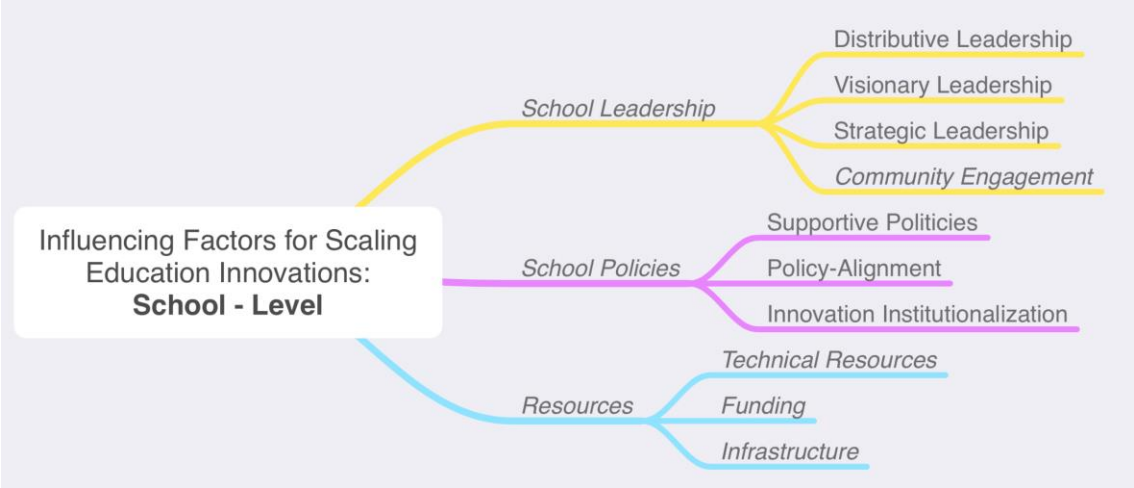
ongoing professional development in digital skills to enhance educational outcomes. However, resistance to technology, driven by attitudes and beliefs about its effectiveness, remains a significant barrier (Howard, 2021; Calkir, 2021; Roesken-Winter, 2021; Kim, 2023). Teachers often feel overwhelmed by the expanded responsibilities and may perceive new technologies as having little educational value. The need for support in integrating technology into teaching practices is highlighted by Howard et al. (2021) and Hatch et al. (2022), who note the lack of expertise and support for teaching in online and hybrid formats. Technological anxiety and inadequate infrastructure further hinder adoption, as noted by Calkir (2021), Vallet (2014), Balli and Singla (2024), Looi (2015), and Looi (2011). Luo (2023) and Vallet (2014) address technological compatibility issues and the need for robust technical support. Overall, the evidence underscores the critical need for adequate technological skills, infrastructure, and support to ensure the effective integration of technology into educational practices, which is essential for teachers to successfully adopt and utilize new technological tools in their classrooms.

Factors Influencing Education Innovations Scaling-up : Schools Level

Scaling education innovations at the school level involves multiple interconnected factors that collectively contribute to sustainable change. Key among these is effective school leadership, which encompasses distributive, visionary, and strategic leadership, as well as engaging the community. School policies play a crucial role, including supportive policies, a school-wide approach, policy alignment, and institutionalizing innovation. Additionally, a long-term commitment that includes vision, culture and capacity is vital for ensuring the longevity and impact of educational innovations. Adequate resources, such as funding and infrastructure, are essential to support these initiatives.

Figure 7

Schools influencing factors for scaling education innovations



School Leadership. Three types of leadership emerged from the literature in connection with scaling education innovation: distributive, visionary and strategic leadership. Along with these 3, community engagement emerged as a common leadership characteristic that enables scaling education innovations.

Distributive Leadership. Rodgers (2016) notes the importance of distributive leadership to ensure scaling education innovations can be successful and not depend on "one hero". School distributive leadership plays a pivotal role in fostering an environment conducive to scaling educational innovations where different types of power are shared. Distributive leadership, characterized by valuing collective continuous improvement and engaging different stakeholders, is crucial. Tichnor-Wagner et al. (2017) emphasize that schools with distributive leadership create environments conducive to PDSA cycles, while Howard et al. (2021) highlight the importance of distributive leadership in fostering a culture of shared vision for change.

Visionary Leadership. Visionary leadership, characterized by forward-thinking and innovative approaches, is critical for driving substantial educational changes. Ulfatin et

al. (2022) underline the importance of visionary leadership in driving educational innovations effectively. Sliwka et al. (2024) and Hatch et al. (2022) highlight the importance of visionary leaders in guiding schools through transformative processes. Additionally, incorporating student voice into decision-making processes is a key aspect of this leadership. Kim et al. (2023) stress that engaging students in the decision-making process fosters a sense of ownership and supports innovation scaling.

Strategic Leadership. Strategic clarity, encompassing clear strategic goals and a well-defined vision and mission, is essential for guiding innovation efforts as competing priorities come into play throughout the academic year (Tichnor-Wagner et al., 2017; Looi, 2015). Looi and Seow (2015) add, "Schools often have multiple priorities, which can divert attention and resources away from new initiatives" (p. 427). Howard et al. (2021) state that clear strategic goals are necessary for aligning school efforts towards innovation, while Ulfatin et al. (2022) and Cakir et al. (2021) emphasize the need for a clear vision and mission. Cohen-Vogel et al. (2016) note that "building a PASL culture by communicating PASL goals, promoting student engagement in school activities, and aligning the school mission to PASL" is crucial (p. 10). However, lack of community and stakeholder support can hinder success, as noted by Dijkstra et al. (2016), Kallio and Halverson (2020), Hargreaves et al. (2015), and Vallett et al. (2014) also underline the importance of strategic clarity in leadership, highlighting how it facilitates coherent and focused efforts towards innovation. As part of the strategic role, Dijkstra et al. (2016) and Rodgers (2016) highlight the impact of inadequate communication and administrative changes on implementation.

Community Engagement. Engagement of various local community members, parents, and students is vital for the success of educational innovations. Sliwka et al.

(2024) highlight the role of parental involvement: “Parents must be consistently brought on board from the beginning” (p. 110). Kim et al. (2023) share the importance of student voice and community engagement. Colbert and Arboleda (2016) and Rodgers (2016) stress the importance of school community involvement and networks of support in maintaining and spreading innovations. Looi and Seow (2015) adds that “engaging the broader school community, including parents, supports the sustainability of the innovation” (p. 433). Ulfatin et al. (2022): “Limited community support can hinder the success of SBM initiatives” (p. 129). These findings suggest that building strong support systems within the community and among stakeholders is crucial for scalability.

Finally, inconsistent leadership, fragmented implementation, lack of understanding and lack of consensus among leaders can significantly hinder progress. Inconsistent leadership practices can lead to fragmented implementation of innovations, as observed by Ulfatin et al. (2022). Howard et al. (2021) further discusse the impact of fragmented implementation due to inconsistent leadership, stating that it hinders the effective scaling of innovations. Additionally, a lack of understanding among leadership regarding innovation processes can be detrimental. Dijkstra et al. (2016) note that leadership's lack of understanding of innovation processes can impede progress. Finally, Kallio and Halverson (2020) emphasize the need for consensus among leadership, stating that a lack of consensus on innovation strategies can obstruct progress.

School Policies. This includes supportive policies, school policy alignment and innovation institutionalization, all explained below.

Supportive Policies. School policies play a critical role in facilitating the scalability of educational innovations. Supportive policies usually address the educational innovation’s requirements and preconditions to be effective within the school

environment. They are essential for fostering an atmosphere conducive to change. Sliwka et al. (2024) note that clear guidelines and supportive frameworks can significantly enhance the implementation and scaling of educational initiatives. For instance, in a case where an innovation requires more time in the school program, supportive policies can address the issue of inflexible schedule (Kim et al., 2023). On another example, frequent administrative changes can disrupt the continuity and consistency needed for scaling innovations while supportive policies can ensure a certain level of continuity due to the power of policies that can systemize a certain workflow (Rodgers, 2016).

Policy Alignment. Aligning school policies with the institution's overall goals is another vital aspect. Looi et al. (2015) emphasize that policies must be closely aligned with the school's strategic objectives to ensure that innovation efforts are not only supported but also integrated into the broader vision of the school (p. 27). This alignment helps in creating a cohesive strategy where every initiative is part of a larger plan, thus enhancing the potential for sustained success by having it documented in policies. Dijkstra et al. (2016) point out that school-wide policies create a unified direction and support system, enabling a coherent and coordinated effort towards innovation. In contrast, inconsistent policies and lack of strategic policy clarity can also impede progress. Luo (2023) discusses the impact of inconsistent policies on the scalability of innovations, highlighting how fragmented and unclear policies can create confusion and hinder effective implementation at the school level. Addressing these issues within the school policy framework is essential for creating a stable and conducive environment for educational innovations to thrive and sustain over time.

Innovation Institutionalization. Institutionalization of the education innovation within the school policy framework is essential for their longevity and impact. Leong et

al. (2021) highlight the importance of embedding programs within the school's policies to ensure they become a permanent and integral part of the school's operations. This institutionalization process involves formalizing the innovation within the school's policy documents, providing ongoing support, and ensuring that the program is resilient to changes in leadership or external conditions.

Resources. Resources include technical resources, funding and infrastructure as described below.

Technical Resources. The human resources to implement and scale innovations long-term effectively is a significant factor. Tichnor-Wagner et al. (2017) highlight the challenges posed by lack of capacity: “Schools often lacked the necessary expertise to effectively implement, scale and sustain PDSA cycles” (p. 483). Howard et al. (2021) add, “Scaling innovations across diverse school contexts requires careful consideration of local adaptations and fidelity to the original innovation” (p. 110), highlighting the need for school-based local knowledge and skills among the school team. Kallio and Halverson (2020) and Dijkstra et al. (2016) emphasize the importance of structured collaborative activities for effective implementation. Looi and Seow (2015) support this by stating, “Teachers need professional development to understand the intent of the curriculum and understand the pedagogy that is needed to enact the lessons”. Vogel et al. (2016) mention that the internal capacity will ensure the sustainability of the innovation with turnover of staff and continuous need to adapt the innovation to the evolving contextual factors.

Funding. Adequate resources and consistent funding are critical for scaling educational innovations. Howard et al. (2021) and Ulfatin et al. (2022) emphasize the importance of efficient resource allocation and continuous funding. Howard et al. (2021) note that securing consistent funding is essential for sustaining and scaling innovations,

while Ulfatin et al. (2022) stresses the need for efficient allocation of resources to areas of need. Balli and Singla (2024) reinforce this by advising schools to use funds for minor repairs and maintenance of hardware and software. Looi et al. (2014) highlight the necessity of allocating adequate resources for ICT infrastructure, professional development, and ongoing support. However, resource school constraints and high costs present significant barriers. Tichnor-Wagner et al. (2017) observe that schools often lack the necessary resources and expertise to effectively implement and sustain PDSA cycles. Howard et al. (2021) add that scaling up relationships with multiple schools requires considerable time and resources, making system-level scaling difficult. Luo (2023) and Vallett et al. (2014) highlight the impact of limited budgets on technological integration and resource allocation. Looi and Seow (2015) point out that limited financial and technological resources can impede the implementation and scaling of innovations. Clarke and Dede (2009) support this by noting that limited resources and expertise in schools can hinder the successful scaling of innovations.

Infrastructure. Infrastructure plays a pivotal role in both enabling and hindering the scaling of educational innovations. Adequate infrastructure supports the implementation of innovative practices. Conversely, poor infrastructure can significantly impede progress. Ulfatin et al. (2022) highlighted that inadequate facilities can severely limit the effectiveness of School-Based Management (SBM) in marginal areas. The importance of investing in technological infrastructure is highlighted by Cakir et al. (2021), Luo (2023), and Looi et al. (2011), who advocate for equipping schools with necessary technological resources to support innovation. Vogel et al. (2016) further illustrated that investments in WiFi and mobile devices enabled successful implementation. Addressing issues such as high student-to-computer ratios, technology obsolescence, and resource allocation, as

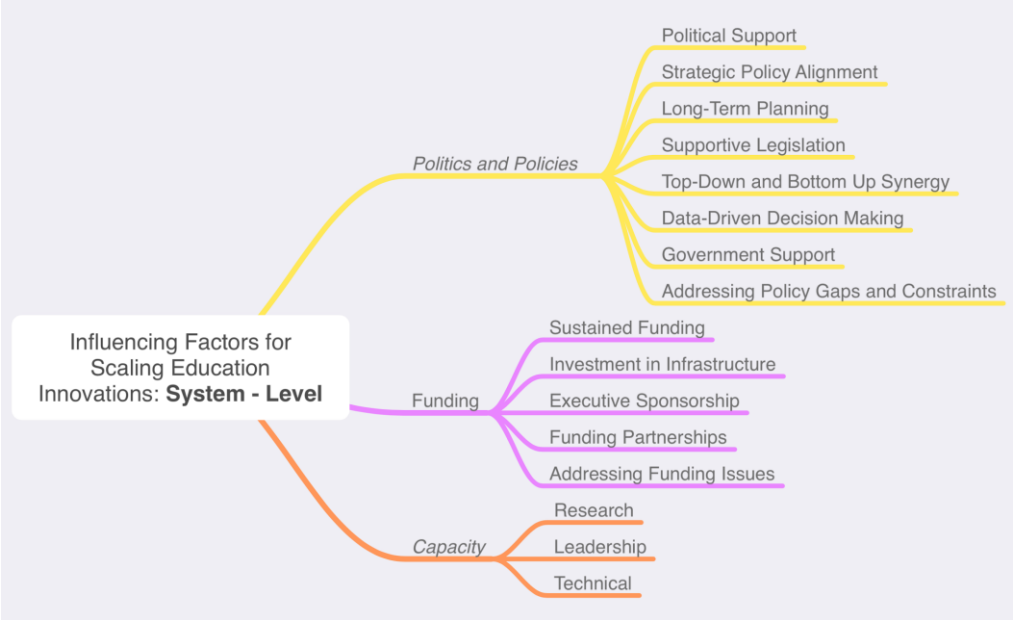
noted by Vallet (2014), Balli and Singla (2024), Roesken-Winter et al. (2021), Hatch et al. (2022), Dijkstra et al. (2017), and Hargreaves et al. (2015), is essential for the scalability of educational innovations. Ensuring adequate infrastructure is thus critical for the effective implementation and sustainability of innovative educational practices.

Factors Influencing Scaling-up Education Innovations: System Level

Scaling educational innovations at the system level involves navigating a complex landscape of politics, policies, funding, and capacity-building efforts. Political support and commitment are crucial, as they influence policy alignment and strategic goals, ensuring that innovations are embedded within a supportive legislative framework. Long-term planning and government backing foster a stable environment where data-driven decision-making and synergy between different stakeholders can thrive, addressing policy gaps and sociopolitical challenges effectively. Sustained funding is another pivotal factor, encompassing not only financial support but also investment in infrastructure and executive sponsorship. Collaborative networks and funding partnerships can mitigate financial barriers and ensure that high costs do not impede progress. Building capacity through research, leadership development, and technical training further strengthens the ability to scale innovations successfully. By addressing these multifaceted elements, educational systems can create an environment conducive to the widespread adoption and sustainability of innovative practices. Below is a presentation of the findings:

Figure 8

System influencing factors for scaling education innovations



Politics and Policies. This section includes multiple factors that primary looks at how policy making take place.

Political Support. The sustained political commitment and support are fundamental for the successful scaling of educational innovations. Colbert and Arboleda (2016) emphasize that political leaders' dedication is essential in driving the alignment of resources, policies, and strategic priorities necessary for long-term educational reform. This commitment ensures that educational innovations receive the necessary backing to thrive. Similarly, Howard et al. (2021) and Kim et al. (2023) highlight the need for comprehensive and adaptive policy frameworks that evolve with educational innovations to provide continuous support and relevance to different contexts. Policies must be flexible enough to accommodate new educational innovations.

Strategic Policy Alignment. Aligning educational innovations with broader strategic goals and national curricula ensures coherence and sustainability, which is pivotal for their success and longevity. Calkir (2021) and Luo (2023) further discuss the significance of integrating innovations into national curricula and providing robust support structures to facilitate their diffusion across different contexts. The alignment of district-level support, as identified by Tichnor-Wagner et al. (2017) and Balli and Singla (2024), with school-level initiatives is crucial for creating a conducive environment for innovation. Such alignment ensures that resources, professional development, and logistical support are systematically provided to foster educational innovations. Tichnor-Wagner et al. (2017) and Hatch et al. (2022) suggest that strategic alignment helps in garnering stakeholder buy-in and facilitates smoother implementation of innovations across various levels of the education system which ensures that innovations support overall educational objectives and are not perceived as isolated efforts. Looi (2015) emphasizes that alignment with strategic goals ensures that educational innovations are integral parts of the overall educational strategy, thereby enhancing their scalability.

***Long-Term Planning*.** Long-term planning and commitment are critical for sustaining educational innovations beyond their initial implementation phases. Kim et al. (2023) and Vallet (2014) stress the importance of continuous support and evaluation to maintain momentum and achieve lasting impact. Leong et al. (2021) and Looi (2011) point out that a long-term vision and planning ensure that innovations are systematically integrated into educational practices and policies.

Supportive Legislation. Supportive legislation plays a crucial role in creating an enabling environment for educational innovations. This refers to adapting law regulations, governmental compliance frameworks, incentives, protection of rights and

accountability. Ulfatin et al. (2022) highlight that legislative support provides the necessary legal and regulatory framework for the adoption and scaling of new practices. Effective legislation can facilitate the implementation and sustainability of innovations, ensuring that they receive the backing needed to thrive in various educational contexts.

Top-Down and Bottom-Up Synergy. A synergistic approach that combines top-down directives with bottom-up initiatives is essential for the successful scaling of educational innovations. Looi (2011) highlights the importance of this synergy in ensuring that innovations are supported by policies while being tailored to local contexts and needs. Centralized support structures, as discussed by Hatch et al. (2022), provide the necessary resources, guidance, and oversight for scaling educational innovations.

Data-Driven Decision Making. Data-driven decision on a national or district level making is also crucial in this process. Kim et al. (2023) emphasize that data can inform policy adjustments and ensure that innovations meet their intended goals. Utilizing data helps make informed decisions that support the scaling process.

Government Support. Government support, highlighted by Dijkstra et al. (2017), is critical for scaling educational innovations, as it provides the necessary resources, legitimacy, and infrastructure to drive large-scale adoption and implementation. Interstate collaboration, as pointed out by Hargreaves et al. (2015), facilitates the sharing of best practices and resources, which is beneficial for scaling educational innovations.

Addressing Policy Gaps and Constraints. *A*ddressing policy gaps and constraints is essential for scaling educational innovations. Ulfatin et al. (2022) and Kim et al. (2023) identify gaps in policies that can hinder scaling efforts, such as a lack of clarity, support, or alignment with educational goals. Effective policy design and implementation can bridge these gaps and support innovation. Similarly, addressing rigid assessment policies,

as discussed by Sliwka et al. (2023) and Looi (2011), is necessary to accommodate innovative practices and support their scalability. Insufficient and inconsistent policies, highlighted by Calkir (2021), Dijkstra et al. (2017), Kallio and Halverson (2020), and Balli and Singla (2024), create confusion and hinder the scaling of educational innovations. Resistance to policy change, as identified by (Colbert and Arboleda, 2016; Sliwka et al., 2023; Kallio and Halverson, 2020; Vallet et al., 2014; Looi, 2011) is another significant barrier that must be overcome for successful implementation mentioning that this resistance often stops initiatives before they can take roots in the system. Moreover, sociopolitical challenges impact the scaling of educational innovations. Balli and Singla (2024) highlight the need for a holistic approach to address these challenges and support the scalability of innovations. Misalignment between policies and practices, as emphasized by Looi (2015) and Roesken-Winter (2021), can hinder the scaling process, making it crucial to ensure that policies support rather than hinder innovative practices.

Funding. High costs at the system level require strategic planning and innovative approaches to tackle funding through sustained funding, investment in infrastructure, executive sponsorship, funding partnerships and strategically addressing funding issues. Below is a description of the factors that emerged from the literature under system level funding.

Sustained Funding. At the system level, sustained funding and resources are essential for scaling educational innovations effectively. Colbert and Arboleda (2016) and Vallet (2014) emphasize that consistent financial support from governmental and institutional sources ensures that innovations can be maintained and scaled over time, providing stability and continuity. Dijkstra et al. (2017) highlight the importance of systemic funding policies that prioritize long-term investment in educational reforms. Similarly,

Howard et al. (2021) and Luo (2023) argue that financial support at the system level is crucial for creating an enabling environment where educational innovations can flourish. System-level funding ensures that schools and educators have the necessary resources to adopt new educational innovations, facilitating widespread implementation.

Investment in Infrastructure. System-level investment in infrastructure is critical for the successful scaling of educational innovations. Hatch et al. (2022) discuss the importance of strategic investments in technology, facilities, and other essential infrastructure to support the widespread adoption of innovative educational practices. These investments enable the creation of a robust framework that can sustain and scale innovations across different regions and contexts.

Executive Sponsorship. Executive sponsorship at the system level, as highlighted by Hargreaves et al. (2015) and Leong et al. (2021), is also vital where high-level leaders within educational systems can champion innovations, provide the strategic direction, resources, and policy support needed to drive long-term success. Their involvement ensures that innovations receive the necessary attention and backing to become integrated into the educational framework.

Collaborative *Funding Partnerships*. System-level funding partnerships and collaborative networks play a significant role in scaling educational innovations. Balli and Singla (2024) and Looi (2015) emphasize the importance of forming strategic partnerships with various stakeholders, including public and private entities, to secure necessary funding and resources. These partnerships facilitate the pooling of resources and expertise, creating a collaborative environment that supports the scaling of innovations. Calkir (2021), Vallet (2014), and Leong et al. (2021) highlight that public-private partnerships at the system level can enhance scalability by leveraging the

strengths of different sectors. Such collaborative networks drive the adoption and implementation of innovative practices across the education system, fostering a culture of continuous improvement and innovation.

***Addressing Funding Issues*.** Insufficient financial resources and unstable funding emerged as the common challenges that can hinder the implementation of new educational practices at the system level according to Rodgers (2016) and Howard et al. (2021). Sliwka et al. (2023) and Kallio and Halverson (2020) emphasize that inadequate system-level funding can prevent schools from adopting and sustaining innovations, leading to fragmented and inconsistent implementation. Roesken-Winter et al. (2021) point out that systemic funding policies must prioritize consistent and adequate financial support to overcome these barriers. Ensuring sufficient and stable funding at the system level is crucial for supporting long-term innovation and scalability in education.

System Capacity. System level capacity includes capacity for research, planning and leadership, as emerged below.

***Research Capacity*.** Building system capacity for scaling educational innovations requires a robust foundation in research and evidence-based practices. Dijkstra et al. (2017), Kallio and Halverson (2020), Hargreaves et al. (2015), Luo (2023), and Vallet (2014) emphasize the importance of integrating research into system-level educational planning for scaling innovations. Howard et al. (2021) point out the dichotomy between a culture of independent initiatives and reliance on evidence, highlighting the need for longitudinal research to validate and sustain innovations. Calkir (2021) and Rodgers (2016) discuss the critical role of system-level monitoring and evaluation (M&E) in ensuring the effectiveness of educational innovations. Effective integration of research

findings into practice, as highlighted by Howard et al. (2021), is essential for evidence-based decision-making and continuous improvement.

Planning Capacity. System-level planning for scaling educational innovations often faces significant challenges due to the complex educational environment. Colbert and Arboleda (2016), Howard et al. (2021), and Leong et al. (2021) highlight that the multifaceted nature of education systems can create substantial barriers to effective innovation. The intricacies of diverse educational contexts require comprehensive, long-term planning, yet many initiatives suffer from a lack of sustained strategic planning. Calkir (2021) and Dijkstra et al. (2017) point out that without a vision for the future, efforts to scale innovations tend to be fragmented and lack coherence. Kallio and Halverson (2020) echo this sentiment, noting that fragmented efforts undermine the potential for widespread impact. Furthermore, Hargreaves et al. (2015) and Looi (2015) underscore that the absence of systematic integration and focus leads to fragmented implementation, further complicating the scaling process. The need for coordinated efforts is critical, but coordination challenges, as discussed by Leong et al. (2021) and Roesken-Winter et al. (2021), often result in conflicting agendas and a lack of cohesion (Dijkstra et al., 2017; Vallet, 2014).

Leadership Capacity. Leadership and management play a pivotal role in scaling educational innovations. Leadership commitment, as highlighted by Tichnor-Wagner et al. (2017), is also crucial for driving the vision, resources, and support needed for innovation. Committed leadership can inspire and sustain efforts to scale educational innovations, ensuring that they are systematically integrated into educational practices and policies.

***Technical Capacity*.** Technical capacity, including professional development and supportive networks, is crucial for scaling educational innovations. Tichnor-Wagner et al. (2017) and Calkir (2021) highlight the importance of national training programs and standardized curricula in fostering technical expertise. Howard et al. (2021) and Kallio and Halverson (2020) emphasize the role of supportive and collaborative networks in promoting cultural and contextual adaptation. Ulfatin et al. (2022) and Kim et al. (2023) discuss the benefits of collaborative networks and capacity building efforts, while Sliwka et al. (2023) underscore the significance of leadership training and professional capital. The focus on collaboration with external partners (Hatch et al., 2022) and inter-school collaboration (Kallio and Halverson, 2020) further enhances the technical capacity necessary for scaling innovations. Additionally, Sliwka et al. (2023) highlight the importance of assessment reforms in ensuring that innovations are effectively integrated into the educational system, thereby supporting sustained improvement and scalability.

The above is a summary of all influencing factors for scaling at the level of designers, teachers, schools and systems.

CHAPTER 4

DISCUSSION & CONCLUSION

This section synthesizes and discusses the findings from both descriptive and narrative analyses in light of existing literature asking “so what” question across the findings. It concludes with recommendations for both researchers and practitioners.

Descriptive Analysis Discussion

Descriptive analysis revealed that the literature on scaling education innovations is relatively thick, indicating that this area of research is largely studied, emphasizing a need of more systematic literature reviews to support the continuous development of the knowledge base within the field of scaling education innovations. Yet, this has been contradicted by an imbalance in the geographical distribution of the research on scaling educational innovations, with studies predominantly focusing on the United States and a few other Western countries. While consistent with broader trends in educational research (Hallinger and Hammad, 2017), this imbalance is problematic as it limits our ability to draw comprehensive conclusions and poses a challenge to developing a more balanced and contextually representative knowledge base on the subject.

Descriptive analysis revealed that the majority of sources were journal articles (n=23), with only 2 book chapters, and no master's or PhD dissertations. This absence of dissertations may reflect the current academic orientation of students. Although the field of scaling educational innovations is relatively young, it is gaining significant attention in educational development. In my experience, topics related to scaling and educational innovations were not covered in my classes, and my interest was fueled by involvement in social entrepreneurship and education development sectors. It is crucial to integrate

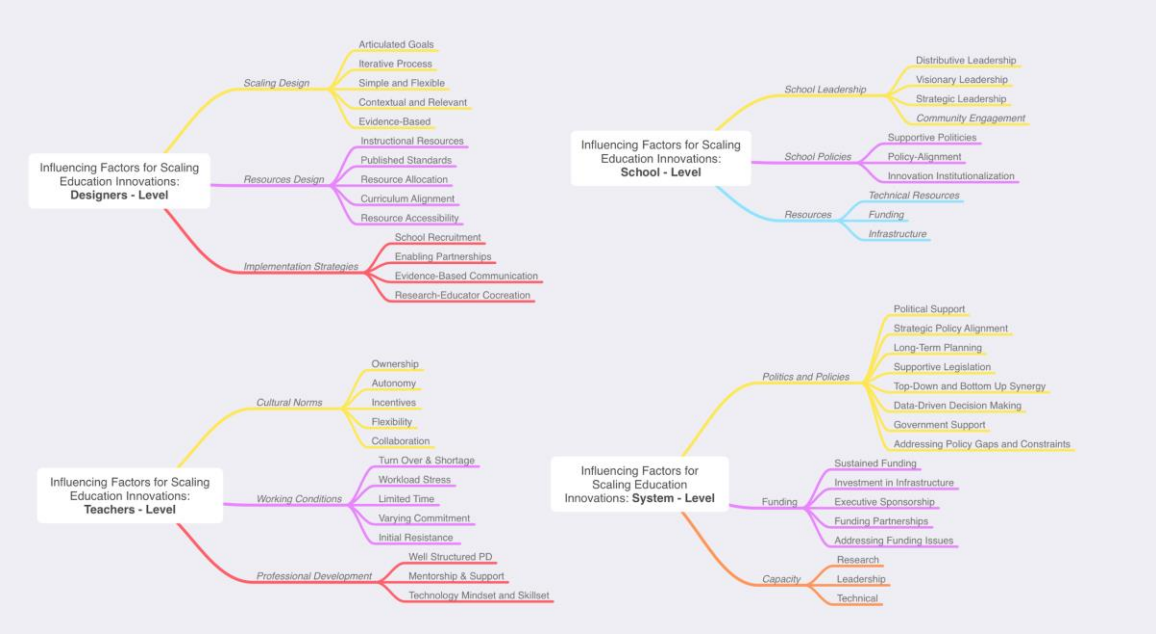
this field into master's and PhD programs, especially for those aiming to work in educational development.

Scale Influencing Factors: Summary and Synthesis of Findings

Through this systematic literature review, diverse factors influencing scaling up education innovations were captured and unpacked. Below is a summary of all factors that were mentioned in the literature surveyed.

Figure 9

Summary of influencing factors for scaling education innovations



Overarching Factors:

Seven (n = 7) overarching factors emerge from this systematic literature review of influencing factors: strategy, resources, capacity building, politics and policies, governance, leadership and culture. Below is a table (table 5) that shows how these overarching factors emerged from the main branches of the emerged influencing factors (Figure 9). This grouping will help in connecting the factors with the scale conceptualizations by the end of this chapter.

Table 5

Overarching Influencing Factors

Strategy	Resources	Capacity Building	Policies & Politics	Governance	Leadership	Culture
Scaling Design	Resources Design	PD (Teachers Level)	Politics and Policies (System Level)	Governance (System Level)	School Leadership (School Level)	Cultural Norms (Teachers Level)
Implementation Strategies	Funding (System Level) School Resources System Capacity		School Policies		System Leadership (System Level)	Working Conditions (Teachers Level)

The 4 Layers of Factors

The 4 Layers of Factors adapted framework from Hung et al. (2015) was instrumental in categorizing the findings within the literature. However, two key issues emerge when looking at the generated findings. Firstly, there is an undue emphasis on the role of the designer. Although the term 'designer' was initially defined to include teachers, school leaders, and system leaders, the literature often portrayed the designer as an elevated researcher, academic or NGO worker or development practitioner. This portrayal has significant implications for the role of teachers. Despite 'ownership' being highlighted as a design dimension, it often seemed tokenistic, more like a tactic to integrate certain innovations into the system, using teachers merely as instruments to

achieve this. It is argued that authentic ownership begins at the design stage, and teachers should be at the forefront of this process. Designers and development practitioners should authentically partner with teachers, facilitating a collaborative process to create innovations that meet their specific needs.

Additionally, the framework noticeably lacks a focus on students' roles. This oversight may stem from the nature of the innovations studied and age group they target. To address this gap, a fifth layer focusing on students should be incorporated into the framework. This layer would explore how to represent and support students in adopting, developing and nurturing educational innovations that address their needs and are driven by them.

Interconnected Factors Require Collective Leadership

As mentioned previously, scaling up has been described as a complex phenomenon for educational reform due to its dependency on multiple factors to produce better outcomes (Crawford et al., 2020; Horner et al., 2014; Krainer et al., 2019; Tan and Hung, 2020). Through RQ#1, some of the findings evident in the literature were captured. However, the nature and relationship of different factors elements are complicated and there is no silver bullet to ensure scaling can be effective.

Morel et al. (2019) explain that scaling in education is dynamic, meaning it evolves over time as innovations are implemented and adapted. For instance, what begins as an initiative to improve teaching practices in a small number of schools may expand to include broader systemic changes as it gains traction and demonstrates success. Designers referred as “reformers” may adjust their strategies and redefine their objectives as they learn from initial implementations and respond to emerging challenges and opportunities. Furthermore, scaling is “polysemic” (Coburn et al., 2021; Morel et al.,

2019), indicating that it has multiple meanings and can be interpreted in various ways depending on the context. Different stakeholders might understand and prioritize different aspects of scaling. For example, policymakers might focus on quantitative growth and reaching a larger number of schools, while educators might emphasize the qualitative aspects, such as changes in teaching practices and student outcomes. Researchers might be interested in how deeply an innovation is embedded in the daily practices of schools and how it influences the broader educational ecosystem. With this diversification of motives and interests, there should be a shared purpose and vision at all levels to ensure an innovation whose objective is to solve a certain education problem with the aim to enhance student outcomes can effectively make its impact.

Collective leadership is a collaborative approach where diverse stakeholders across different levels of the education system—teachers, school leaders, researchers, policymakers, and community members—work together to drive systemic change. This form of leadership emphasizes that no single entity or individual holds the key to resolving complex challenges (Teach For All, 2024). Instead, it promotes shared responsibility, mutual trust, and continuous learning, making it a critical factor for achieving meaningful and sustainable educational improvements.

Teach For All's insights underscore that systemic change requires shifts in goals, beliefs, values, and power structures. These changes are only possible through a collective leadership approach that encompasses all levels of the education system, driving a shared commitment to transforming education to better serve all students through education innovations. Such leadership fosters a culture of mutual trust, shared responsibility, and continuous learning, which are essential for overcoming the inertia that often impedes systemic change in education. Collective leadership is the "missing piece" that can ensure

these elements—design principles, cultural norms, working conditions, professional development, school policies, community engagement, political support, strategic alignment, and capacity building—are effectively integrated and sustained, leading to meaningful and lasting improvements in educational outcomes.

A Strategy Model to Implement Scaling Education Innovations

As previously explained, there is an implementation strategy model for scaling health innovations but not one available for education found in the initial literature review. The Milat et al. (2014) scalability framework offers a comprehensive guide for scaling up health policies and programs and argues that the same principles for health are highly applicable to educational innovations. Designed for practitioners, policymakers, and researchers, the framework provides a structured approach to assess, plan, prepare, and execute the scaling process. It begins with a scalability assessment to determine the suitability of an intervention for scaling, considering its effectiveness, potential reach, alignment with strategic goals, and feasibility. The next step involves developing a detailed scaling-up plan, including documenting the rationale, describing the intervention, conducting stakeholder analysis, and outlining key functions and resources needed. Preparation for scaling includes consulting stakeholders, legitimizing change, building a constituency, and mobilizing resources. Finally, the execution phase focuses on modifying and strengthening organizations, coordinating actions, monitoring performance, and ensuring sustainability. By emphasizing continuous evaluation and adaptability, the Milat et al. (year) framework ensures that scaling efforts are dynamic and responsive to changing conditions, fostering the successful expansion and enduring impact of innovative practices.

The Milat et al. (2014b) scalability framework offers a structured approach to scaling up health policies and programs, which can be effectively adapted to educational interventions. Researchers argue that both health and education sectors face similar challenges in scaling interventions, such as ensuring effectiveness, managing fidelity and adaptation, and addressing contextual factors. By applying Milat et al.'s (year) framework, educational policymakers, practitioners, and researchers can adopt a systematic method to facilitate the widespread adoption and maintenance of educational programs that tackle the issue of reactiveness in the design and implementation of scaling education innovations. However, it is not grounded in empirical research. This framework can be effectively applied to scaling educational innovations by aligning its steps with the identified evidence-based factors across the designer, teacher, school, and system levels emerged from this systematic literature review. Below is an attempt on how the influencing factors emerged connect to the implementation strategy:

Step 1: Scalability Assessment. Assessment includes assessing effectiveness, potential reach and adoption, alignment with the strategic context and accessibility and feasibility.

Assess Effectiveness. Assess how well the intervention achieves its intended outcomes in its current context.

- Designer Level: Evaluating the articulated goals, iterative processes, and evidence-based foundation to ensure the innovation's effectiveness.
- Teachers Level: Assessing how cultural norms, such as ownership and collaboration, impact the effectiveness of the innovation.
- School Level: Reviewing the effectiveness of distributive and visionary leadership and supportive policies.

- System Level: Analyzing political support and policy alignment to determine the innovation's overall effectiveness.

Assess Potential Reach and Adoption. Determine the likelihood of the intervention being accepted and implemented across different settings.

- Designer Level: Considering the simplicity, flexibility, and contextual relevance of the innovation for broad adoption.
- Teachers Level. Evaluating the potential for widespread teacher engagement through professional development and improved working conditions.
- School Level: Assessing the potential for school-wide adoption through strategic leadership and supportive policies.
- System Level: Reviewing the systemic support and capacity for broad adoption, including funding and infrastructure.

Assess Alignment with Strategic Content: Check that the intervention fits with broader organizational or system-level goals.

- Designer Level: Ensuring the innovation aligns with curricular goals and implementation standards.
- Teachers Level: Aligning the innovation with teachers' professional development needs and classroom practices.
- School Level: Aligning with school-wide strategic goals and vision.
- System Level: Ensuring alignment with national and regional educational policies and strategic goals.

Assess Acceptability and Feasibility. Evaluate whether the intervention is both acceptable to stakeholders and feasible to implement at scale.

- Designer Level: Evaluating the feasibility of high-quality instructional resources and resource accessibility.
- Teachers Level: Assessing the acceptability among teachers based on cultural norms and professional development support.
- School Level: Reviewing the feasibility of implementation through supportive school leadership and policies.
- System Level: Considering the feasibility at the systemic level, including funding, infrastructure, and political support.

Step 2: Develop a Scaling-Up Plan. This plan is often a document including the rationale, description of the intervention, stakeholder analysis, determining who could perform key functions, selecting an approach for scaling up, considering monitoring and evaluation, and an estimation of resources.

Document a Rationale for Scaling Up. Justify why the intervention should be scaled based on evidence of its success and potential impact.

- Designer Level: Articulating the goals and iterative processes that justify the need for scaling up.
- Teachers Level: Highlighting the benefits for teachers.
- School Level: Emphasizing the strategic leadership and community engagement that support scaling.
- System Level: Justifying the scaling with political and strategic alignment and support.

Describe the Intervention. Provide a comprehensive description of the intervention, including how it works and what makes it effective.

- Designer Level: Providing detailed descriptions of the instructional resources, implementation standards, and alignment with curricular goals.
- Teachers Level: Describing professional development programs and collaborative practices.
- School Level: Detailing school policies, leadership approaches, and community engagement strategies.
- System Level: Outlining systemic support, funding mechanisms, and policy alignment.

Complete a Stakeholder Analysis. Analyze which stakeholders are critical for scaling, their interests, and how to engage them.

- Designer Level: Identifying key stakeholders involved in the design and implementation of the innovation.
- Teachers Level: Analyzing the roles of teachers, professional development providers, and support networks.
- School Level: Identifying school leaders, community members, and policy influencers.
- System Level: Mapping policymakers, funders, and other systemic stakeholders.

Determine Who Could Perform Key Functions. Clarify the roles, responsibilities, and tasks necessary for the scaling process.

- Designer Level: Assigning roles for designing, testing, and refining the innovation.

- Teachers Level: Identifying teacher leaders and PD facilitators.
- School Level: Delegating responsibilities to school leaders and community liaisons.
- System Level: Assigning roles to policymakers, funders, and systemic leaders.

Select an Approach to Scaling Up. Select the most suitable strategy or model for scaling, whether it's replication, expansion, or another method.

- Designer Level: Choosing scalable design strategies, such as flexible and adaptive approaches.
- Teachers Level: Selecting PD models that promote widespread teacher engagement.
- School Level: Adopting school-wide strategies that align with strategic goals.
- System Level: Developing systemic approaches that ensure alignment with broader educational policies.

Consider Options for Evaluation and Monitoring. Build in a plan to continuously evaluate the effectiveness and progress of the scaling efforts.

- Designer Level: Establishing metrics to monitor the effectiveness of instructional resources and implementation standards.
- Teachers Level: Setting up mechanisms to evaluate PD programs and teacher engagement.
- School Level: Creating school-wide evaluation frameworks to monitor implementation progress.

- System Level: Developing systemic evaluation tools to track policy alignment, funding, and overall impact.

Estimate Resources Required for Scale-Up. Calculate the financial, human, and material resources required to execute the scale-up.

- Designer Level: Calculating resources needed for developing and distributing instructional materials.
- Teachers Level: Estimating costs for professional development and support.
- School Level: Allocating resources for school-wide implementation and leadership training.
- System Level: Budgeting for systemic support, infrastructure, and long-term funding.

Write Up the Plan. Develop a detailed roadmap that includes all components of the scaling process.

- All Levels: Documenting detailed plans that incorporate the considerations above, ensuring a comprehensive and cohesive strategy for scaling up.

Step 3: Prepare for Scale-Up. This includes consulting with stakeholders, legitimizing change, building constituency and realigning and mobilizing resources.

Consult with Stakeholders. Engaging stakeholders at all levels to gather input, build support, and ensure alignment with the scaling plan.

Legitimize Change. Securing buy-in from key stakeholders to legitimize and support the scaling efforts.

Build a Constituency. Develop a coalition of supporters, advocates, and champions who will help drive the scaling process forward.

Realign and Mobilize Resources. Secure and reorganize resources (financial, human, technical) to support the successful scale-up of the intervention.

Step 4: Scale Up the Intervention. This includes modifying and strengthening organizations, coordinating action and governance, monitoring performance and efficiency and finally ensuring sustainability.

Modify and Strengthen Organizations. Adapt or restructure organizations to support the increased scale and demands of the intervention.

Coordinate Action and Governance. Ensure all stakeholders and organizations involved are aligned and that there is clear governance to manage the scale-up.

Monitor Performance and Efficiency. Continuously track the implementation process to ensure the intervention is achieving its goals efficiently at scale.

Ensure Sustainability: Plan for the intervention to be sustainable over time by securing ongoing resources and institutional support.

By connecting the factors across designer, teacher, school, and system levels with the steps of the Milat et al. (2014b) scalability framework, we can create a comprehensive and dynamic strategy for effectively scaling educational innovations. This integrated approach ensures that all aspects of the innovation are considered, adapted, and supported throughout the scaling process.

Scaling Education Innovations in a Fragile State: Lebanon's Context and Challenges

Scaling educational innovations in fragile states like Lebanon is a complex and challenging endeavor, deeply affected by instability and systemic issues. While scholars have emphasized the context-dependent nature of scaling (Coburn, 2003; McDonald et

al., 2007), there remains a lack of critical analysis, often treating the context as a technical variable and assuming political and economic stability. This assumption is largely based on studies from the Global North collected through this SLR. However, the Global South faces unique systemic issues that complicate the scaling of educational innovations. Lebanon, often described as an Education in Emergencies (EiE) context, grapples with challenges such as war and conflict, mass displacements, natural disasters, political instability, explosions, assassinations, government corruption, economic recessions, and funding limitations.

Khaddit Beirut (2021) explains that amid the repercussions of COVID-19, the Beirut Blast, and ongoing socio-political and economic collapse, initiatives aimed at reforming the education system in Lebanon often encounter cycles of dysfunction and dependency. Past efforts have been characterized by piecemeal support, lacking proper coordination and sustainability with a chronic dependency on external aid (Khaddit Beirut, 2021). Schools in Lebanon need to be supported and enabled to make informed decisions and take ownership of their development and be self-reliant.(Khaddit Beirut, 2021).

A clear example of this can be seen in the various school improvement programs (SIPs) implemented over the past decade, designed to foster school-based innovations and self-renewal. Through conversations with practitioners in the field, it has become apparent that while these SIPs have led to valuable innovations, they remain largely disconnected and lack institutionalization at the government level. Despite the success and positive impact of these programs, there has been no concerted effort from the government to systematically scale and leverage these bottom-up innovations across the educational system.

Each program operates independently, funded by different donors and managed by various stakeholders, without converging into a centralized, government-led initiative for school-based reform. The absence of government support has resulted in inconsistency, vague documentation, and a lack of strategic direction, preventing these innovations from reaching their full potential. Programs such as Qitabi, and Dirasati, nafda, and others, which have engaged numerous schools, are valuable but operate in silos, limiting their broader impact. This fragmentation highlights the need for a coordinated, equity-focused approach to scaling educational innovations, moving beyond isolated efforts to foster systemic change across the educational landscape.

Without institutional backing, these innovations risk remaining confined to pockets of success, rather than driving the widespread transformation needed to address deeper issues within the system. The failure to integrate and scale such programs reflects the broader challenge of scaling educational innovations in contexts where government support is lacking, and systemic barriers persist. For scaling to be effective, there must be a clear strategy that not only enhances innovation but also addresses the root causes of educational inequity, ensuring that reform efforts are both sustainable and equitable.

TAMAM is a research and development project that turned into a movement in the Arab world that promotes transforming schools into self-renewing institutions through School Improvement Programs. The TAMAM model is the only university and research based program that has pioneered a contextual School Improvement Plan (SIP) influencing many of the initiatives above.

In parallel, nafda Lebanon has innovated the peer-to-peer scaling-up model explained above. However, these programs in Lebanon operate within a dysfunctional

Ministry of Education, resulting in funders driving the education development agenda disconnecting results rather than fostering a systematic, interconnected reform strategy to scale school-based innovations.

Education development in crisis-affected contexts requires system leaders that look beyond immediate relief to sustainable development, focusing on long-term planning to scale education innovations system-wide, similar to Singapore's strategic vision (Kitt et al., 2019). Given that most reform projects are donor-driven and funding issues persist in fragile states like Lebanon, innovative financing should be utilized to explore non-traditional methods to raise new funds and use existing funds more efficiently and effectively (Norrag, 2020).

Scaling Education Innovations Research in the Arab World

Despite the absence of articles on scaling education innovations in the Arab region from my systematic literature review, it is crucial to recognize that the discourse around this topic is both present and evolving. The lack of identified studies may be attributed to several factors, including the possibility that relevant research is published in Arabic and hence was not captured in my review. However, this does not imply a void in awareness or discussion.

In various platforms across the Arab region, the conversation around scaling educational innovations is gaining momentum. Educational conferences, policy forums, and social media discussions reveal a growing interest and engagement with the topic. Stakeholders ranging from policymakers, education development practitioners to educators and social entrepreneurs are increasingly acknowledging the importance of scaling successful educational interventions to achieve broader systemic impact.

Back to Positionality: Rethinking of Premise of Scaling Education Innovation

Education innovations are often framed as targeted solutions to specific practice problems within schools and educational systems. However, addressing these

challenges effectively requires more than just immediate fixes; it necessitates a deeper understanding of the historical, social, and systemic factors that have contributed to these issues in the first place. Without this broader perspective, attempts to scale these innovations risk oversimplifying complex problems and may unintentionally reinforce existing inequities, perpetuating the very injustices they seek to eliminate. For instance, scaling an innovation without critically examining its broader impact may lead to the reproduction of structural inequalities, marginalizing underserved communities further. Therefore, rather than viewing scaling as an automatic pathway to success, it is essential to interrogate the underlying assumptions driving such efforts, particularly through a neoliberal lens that often prioritizes efficiency and expansion over equity and justice. To ensure that education innovations truly foster transformative change, we must prioritize equity at every stage of scaling and remain vigilant about the potential unintended consequences of expansion.

Reflection on nafda Lebanon Model on Scaling Education Innovations

In this subsection, I aim to give an overview of nafda's model and then share implications for practice.

nafda adopts a "Peer-to-Peer" or "Cascade" scaling model, where schools that have successfully created and implemented a solution or innovation become the drivers of spreading that innovation across 3 other schools each - often referred to as "mentor" who scale the innovation to 3 other "mentee schools". This model ensures local ownership, adaptability, sustainability, and rapid expansion. Schools are more likely to embrace innovations promoted by their peers, allowing for contextual adaptation and building a sustainable network of schools that can continue supporting each other after the initial project ends. However, maintaining quality control, ensuring consistent support, and addressing potential resistance to change are challenges that require effective coordination, training, and ongoing monitoring.

The model focuses on scaling both the innovation process and its content. The process involves a project management model characterized by distributed, inclusive, and value-based leadership, while the content includes educational innovations expected to become the new normal in learning schools, reinforcing educational best practices

The implementation strategy begins with a validation of the mentor's schools readiness to scale, followed by identifying and engaging mentor schools, providing capacity building for these schools to prepare their innovations for being scaled up and finally, facilitating community visioning processes to match available innovations with mentee's schools needs. Finally, a confirmation process ensures successful implementation, where the council and expert groups review and validate the outcomes, creating a cascade effect of expertise and adoption across schools.

Implications for Practice

When considering the practical aspects of scaling educational innovations, two critical factors come into play: the underlying philosophy and objectives guiding the effort, and the tension between funder expectations and the necessary timeline for sustainable growth.

Underlying Philosophy and Objectives of Scaling. One of the most critical factors influencing the success of scaling efforts is the philosophy of the designer and the objectives they set. These foundational elements shape key decisions around the depth versus breadth of impact, the number of schools to be reached, and the timeline for achieving scaling outcomes. In practice, I have observed initiatives that expanded from 2 to 6 schools, as well as those that grew from 20 to 60 schools. The central question remains: what are designers willing to prioritize or compromise on to achieve their scaling objectives? The philosophy behind the effort will determine whether a more concentrated, in-depth approach is preferable to a broader, less intensive

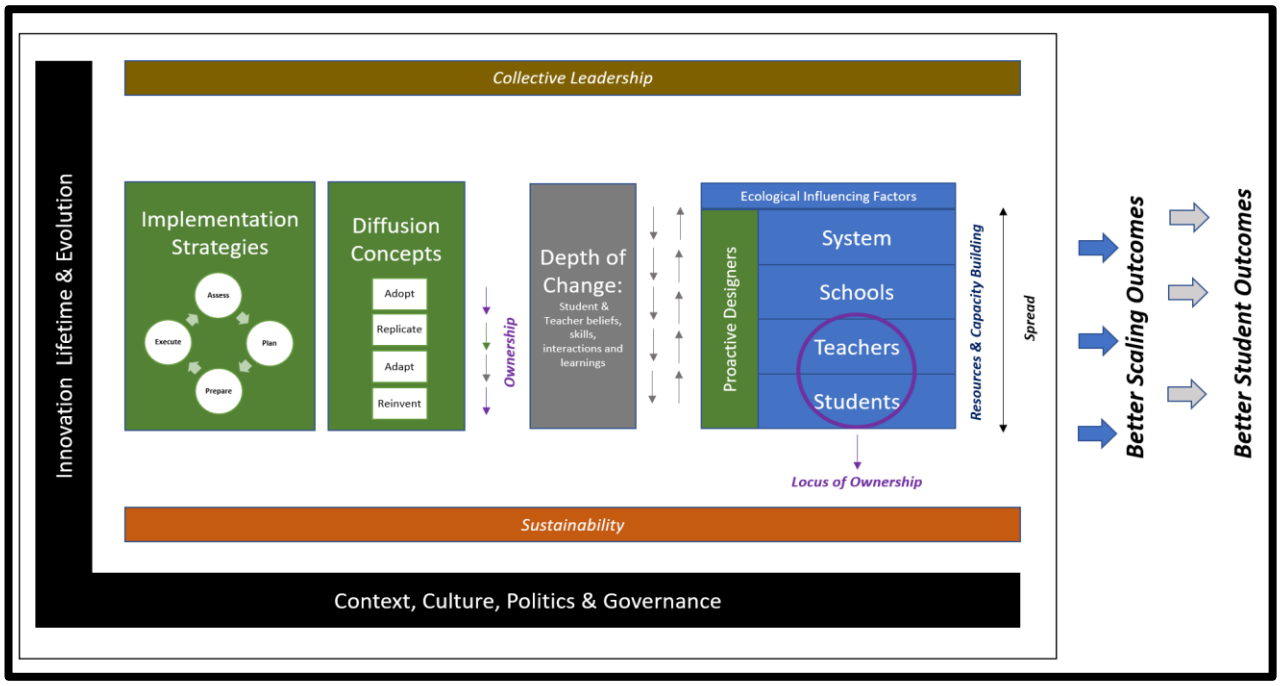
expansion, making it essential for designers to be clear about their values and goals from the outset.

Scaling Timeline and Funder Pressure. A persistent challenge in educational development is the tension between funders and practitioners over the pace of scaling. Funders often push for quicker outcomes, driven by timelines and return on investment, while practitioners understand that scaling educational innovations is a complex, time-intensive process. From experience, we have seen that funders almost always aim to shorten timelines, even when more time is needed to ensure the quality and sustainability of the intervention. It is therefore crucial for researchers and designers to stand firm, advocating for the necessary time to thoughtfully plan and assess the scaling process. Clearly communicating the underlying philosophy and objectives of the scaling effort to funders can help manage expectations and protect the integrity of the initiative, ensuring that scaling is done at the right pace rather than at a rushed one that may compromise impact.

A Framework for Scaling Education Innovation Across Systems for System Change: A Conceptual Model

Figure 10

Conceptual Framework



To achieve the present gap highlighted above, an attempt was made to consolidate all findings into a single conceptual model that visualizes the interconnectedness of various concepts and influencing factors, providing a comprehensive and cohesive framework for scaling educational innovations across systems. Below is a presentation of the model.

Implementation Strategies

The implementation strategies block, positioned at the start, emphasizes the systematic, proactive and structured approach essential for initiating scaling educational innovations. Its cyclical process (assess, prepare, plan, execute) as per Mitlat et al. (2015) framework to ensures continuous improvement and reflection. This foundational

placement highlights the importance of a well-thought-out plan before proceeding with diffusion and deeper changes.

Diffusion Concepts

Colored with the same green color of the implementation, the diffusion concepts block outlines the different concepts of diffusion to ensure while planning for the implementation, designers are intentional and conscious on which concept they are using (adoption, replication, adaptation, and reinvention) while designing for scaling-up.

Depth of Change

Centrally located, depth of change bridges initial implementation and ecological influencing factors. Positioned next to the diffusion concepts, the arrows illustrate that each concept going downwards leads to deeper change for teachers and students, fostering greater ownership at their level. For instance, having reinventing the innovation will lead to greater ownership at the level of student and teachers than adopting an innovation; thus, greater depth. The alternating arrows between depth of change and the ecological model emphasize the synergy needed for top-down and bottom-up strategies. This underscores that the depth of change in learning should be a focus across the entire system. It highlights that not only designers or schools, with their traditional power and authority, but even students, teachers and system leaders should understand and communicate the importance of depth of change for a particular innovation. Its central position emphasizes the critical nature of profound, meaningful changes that educational innovations intend to transform at the teaching and learning technical level.

Ecological Influencing Factors

Ecological influencing factors, placed to the right, encompass system, school, teacher, and student levels, representing the broader environment affecting innovation scaling and sustainability. This is an additional iteration of Balli and Singla (2024); visualizing the different layers rather than just putting it as "scalability: internal and external factors of an innovation that influence its spread and diffusion" in their conceptual model. This vertical arrangement reflects the hierarchical and organizational influence necessary for alignment across all levels.

Designers are named "proactive", highlighting the important role for being proactive, intentional, forward-thinking, anticipatory. Proactive designers are positioned in a vertical manner, clarifying that the designers could be any of the layers (students, teachers, schools or system) or can be a layer itself on its own. Situated between depth of change and inside the ecological influencing factors, proactive designers strategize how to deepen the change while scaling.

Resources and capacity building are needed across the whole ecological model as highlighted in the influencing factors. It is a common factor across all the layers.

Spread is positioned by the end of the main model and next to the ecological model to illustrate that spread goes across the different layers; and even can spread across different educational systems (districts or countries) as highlighted in the systematic literature review.

Collective Leadership

Collective leadership spans the entire process, providing vision, shared "why", shared goals and support at every stage. This overarching placement signifies the importance of shared leadership in guiding and sustaining innovations through

collaboration and continuous improvement. It highlights that effective scaling of innovations cannot be achieved by a single player or layer, but must be a collective effort to achieve system scaling and system change.

Sustainability

Positioned at the bottom, sustainability underpins all components, symbolizing its foundational role in ensuring the long-term viability of innovations. Sustainability cannot be achieved by a single operation or design iteration. It requires a lot of ongoing support and it is one of the most challenging dimensions of scale. This base layer stresses the necessity for ongoing support and capacity building to achieve enduring positive outcomes whether in the implementing strategies, diffusing concepts, depth of change or ecological model. Different factors highlighted in the ecological model are connected to sustainability.

Context, Culture, Politics and Governance

At the very base, context, culture, politics and governance highlights the fundamental influence of societal factors on educational innovations as they don't scale in vacuum as thoroughly described in the influencing factors section of the findings. Stability cannot be assumed; context is extremely sensitive when scaling innovation as argued by researchers. Politics include all the influencing factors is needed at different levels for buy-in along with the need for political support needed for system scaling. Governance includes the long-term strategic planning needed, top-down and bottom-up synergy and data driven decision making.

Innovation Lifetime and Evolution

The innovation lifetime and evolution layer, running vertically along the left side, indicates that the entire process is dynamic and evolves over time and over the lifetime

of the innovation. Evolution, as described by Clarke and Dede (2009), refers to the iterations of the design since its inception. However, the analysis of the sample showed that there is no thorough description of the lifetime of the innovation. Key questions raised include: when is an innovation at its peak of usefulness and relevance, particularly when it has support from different ecological layers? When does the innovation become obsolete? How can researchers and designers locate where the innovation is in its lifetime? Was the research conducted during this peak period or during the initial pilot phase? How critical is the research produced when emphasizing an innovation that has been scaled for decades?

Better Scaling Outcomes and Better Student Outcomes

Depicted at the far right, the whole framework leads to better scaling outcomes and thus better student outcomes, given that the innovation aims to enhance student outcomes. Better scaling and student outcomes represent the ultimate goals of the model. Their positioning illustrates the logical flow, where each step builds towards achieving these end objectives, reflecting the model's comprehensive approach to educational reform.

Recommendations for Researchers

For researchers, conducting more systematic literature reviews is paramount. Given the relatively thick literature on scaling educational innovations, systematic reviews will synthesize existing knowledge and identify gaps, supporting the continuous development of the field. Addressing geographical imbalances by prioritizing research in underrepresented regions can provide a more comprehensive global perspective on scaling educational innovations, helping to understand contextual nuances and creating more effective and inclusive scaling strategies.

Expanding research methodologies to include master's and PhD dissertations alongside journal articles and book chapters can enrich the academic discourse and bring fresh perspectives from emerging scholars. Researchers should also explore and adapt existing conceptual frameworks, such as Coburn's (2003) model, to address emerging complexities in scaling educational innovations. Engaging in theory development by integrating new dimensions and evolving frameworks can better capture the dynamic nature of scaling.

Interdisciplinary collaborations are crucial for drawing insights from fields such as health, social sciences, and technology. Applying frameworks like Milat et al.'s (2014b) scalability framework from health to education can provide structured approaches and enhance the effectiveness of scaling educational innovations.

In closing, I am optimistic that the coming decades will be fruitful in building a more diverse and comprehensive global knowledge base in scaling educational innovations. Scholars working across various contexts have a crucial role to play in this global effort. Indeed, based on the data presented in this review, I am confident that scholars from diverse regions will significantly increase their contributions to global scholarship in this field. I hope that the recommendations offered in this review will enhance the quality and utility of those contributions, much like previous reviews have done for other fields.

This review will be concluded with recommendations designed to enhance future efforts in building the knowledge base for scaling educational innovations. First, given the assessment of the current state of the literature, one could not expect to find a solid foundation of knowledge within the existing research on scaling educational innovations. This mirrors attempts to synthesize findings from early studies in

educational reform. Due to the nascent stage of the knowledge base and the lack of a critical mass of studies on common topics, substantive reviews must be regarded as exploratory rather than explanatory in nature.

Nonetheless, this research recommends extending the scope of this review in the region to encompass a broader set of sources. The scope could be expanded to include all relevant journals rather than a limited selection of core journals. Alternatively, the review could be extended to include graduate theses, conference papers, and published journal articles. There is no single correct approach in determining the scope of a research review; rather, the decision should depend on practical considerations such as the size of the database and the resources available to the reviewer.

This study also recommends that scholars in the field of educational innovation work towards developing informal networks with the dual goals of sharing knowledge and establishing common research priorities. While the research enterprise in higher education will continue to be 'loosely coupled', some coordination of research efforts is desirable to advance the field. In the current global higher education environment, universities will continue to press individual scholars to publish without regard to a broader agenda. Intellectual leadership is needed within the community of scholars to forge a meaningful research agenda that leads to productive outcomes. In the absence of intellectual leadership, little will change in the patterns of knowledge production highlighted in this review.

Networking among scholars within specific regions or disciplines may not, by itself, be enough. Although some regions are producing more knowledge in educational innovation than others no 'centers of excellence' in scaling educational innovations were identified. This implies that networks of scholars will need to link up with productive

scholars and research networks from outside their regions to build capacity. Therefore, the development of a research agenda, loose coordination and collaboration among scholars, and strengthened research capacity are prerequisites for making sustainable progress toward building a robust and useful knowledge base in scaling educational innovations.

Recommendations for Education Development Practitioners

For education development practitioners, it is essential to encourage country-specific research to actively support and initiate studies focusing on the unique challenges and opportunities of scaling educational innovations in diverse contexts. This can help build a more balanced and contextually relevant knowledge base. Moreover, integrating the principles and practices of scaling educational innovations into teacher training and professional development programs will ensure that educators are well-equipped to adapt and implement scalable solutions in their classrooms. Practitioners should also foster a collaborative leadership approach that involves teachers, school leaders, policymakers, and community members to ensure that educational innovations are co-created, widely supported, and sustainable.

Developing a structured scaling plan is crucial. Utilizing frameworks like the Milat et al. (2014b) scalability framework to systematically plan and execute the scaling of educational innovations can provide a comprehensive approach. This includes assessing scalability, developing a detailed scaling-up plan, preparing for scaling, and ensuring sustainability. Practitioners should focus on continuous improvement by establishing iterative processes for feedback and refinement of educational innovations, engaging stakeholders at all levels to adapt interventions based on practical insights and evolving educational contexts

APPENDIX

CASES

- Cases under Category A (n=10): Case Study of Scaling a Specific Innovation

1. Getting to Scale with Moral Education: The Demands of Reproducibility and the Case of the Chicago Manual Training School, 1884–1904 (McCamant, 2018): This study explores the historical case of the Chicago Manual Training School (CMTS), which integrated industrial training into traditional academics to develop students holistically. Despite its innovative approach, CMTS's educational philosophy faced challenges in reproducibility, highlighting the importance of intelligibility and measurability in scaling educational reforms.
2. New Schools in New York City and Singapore (Hatch et al., 2022): This paper compares the evolution of innovative school models in New York City's iZone and Singapore's Future Schools initiatives. Despite different governance and professional capacities, both initiatives faced common challenges in scaling innovative approaches, impacting over 111 schools in Singapore and more than 80 new iZone schools by 2011 in New York City.
3. Bringing a Student-Centered Participatory Pedagogy to Scale in Colombia (Colbert & Arboleda, 2016): This paper discusses the scaling of the "Escuela Nueva" educational innovation, which emphasizes student-centered learning and participatory pedagogy. The study highlights key factors for success and challenges in scaling, emphasizing the need for systemic support and teacher involvement.
4. Scaling and Sustaining an Intervention: The Case of Reading Recovery (Rodgers, 2016): This article reviews the challenges and barriers to scaling educational

innovations using Reading Recovery as a case example. The program has reached 46,849 students across 7 countries, highlighting the importance of well-articulated design, data collection, and district-level support in sustaining and scaling literacy interventions.

5. Diffusing Innovations: Adoption of Serious Educational Games by K-12 Science Teachers (Vallett et al., 2014): This mixed-methods study examines the adoption of educational gaming in K-12 science education, using the diffusion of innovation theory. The findings highlight factors influencing teachers' perceptions and the potential for scaling educational games as innovative pedagogical tools.
6. Dimensions of Scale: Connected Learning Initiative (CLIx)—A Case Study of Educational Technology Initiative in India (Balli & Singla, 2024): This paper conceptualizes scale as a dynamic process involving quantity, diffusion, and quality through the Connected Learning Initiative (CLIx) in India. Approximately 76,226 students engaged with CLIx resources during the intervention period.
7. Determinants of the Perceived Usefulness (PU) in the Context of Using Gamification for Classroom-Based ESL Teaching: A Scale Development Study (Luo, 2023): This study investigates the success factors of large-scale educational innovation projects in Dutch higher education, focusing on the use of gamification for ESL teaching. The research identifies potential success factors and develops instruments for selecting and monitoring innovative educational projects.
8. Design for Scalability: A Case Study of the River City Curriculum (Clarke & Dede, 2009): This paper presents a framework for designing educational innovations for scalability, using the River City multi-user virtual environment (MUVE) as a case study. The curriculum, designed to enhance middle school

science engagement, has scaled to over 250 teachers and 15,000 students across the U.S. and Canada.

9. Implementing Mobile Learning Curricula in a Grade Level: Empirical Study of Learning Effectiveness at Scale (Looi et al., 2014): This paper presents a study of scaling a primary science curriculum integrating mobile technology in a Singapore school. The innovation was scaled to all classes in the pilot school, involving a total of 1,196 students across the years 2010 to 2013.
10. The Singapore Experience: Synergy of National Policy, Classroom Practice and Design Research (Looi et al., 2011): This paper critically examines the impact of systemic education reforms in Singapore through design research on CSCL (computer-supported collaborative learning). The study highlights the synergistic conditions for scaling CSCL practices, guided by strategic planning for scalability at national, school, and classroom levels.

- Cases under Category B (n=8): Case Study of Scaling a Single Professional Practice (n=8)

1. Continuous Improvement in the Public-School Context: Understanding How Educators Respond to Plan–Do–Study–Act Cycles (Tichnor-Wagner et al., 2017): This study examines the application of continuous improvement research (CIR) using plan-do-study-act (PDSA) cycles in two urban school districts. The findings reveal the benefits and challenges of PDSA in improving high school student outcomes, emphasizing the need for capacity building and data collection in scaling such innovations.
2. School-Based Management in Marginal Areas: Satisfying the Political Context and Student Needs (Ulfatin et al., 2022): This study investigates the implementation of

school-based management (SBM) in secondary public schools in a marginal district, focusing on the political context, principal leadership, and teacher performance. The findings highlight the critical role of teachers in improving school effectiveness and student achievement through SBM.

3. Transformational Leadership for Deeper Learning: Shaping Innovative School Practices for Enhanced Learning (Sliwka et al., 2024): This research explores how transformational leadership can foster deeper learning by addressing systemic factors such as teacher collaboration, assessment regulations, and the utilization of time and space. The study emphasizes the need for transformational leaders to achieve widespread adoption of deeper learning across schools.
4. Factors Affecting Intervention Fidelity of Differentiated Instruction in Kindergarten (Dijkstra et al., 2016): This design-based research project in Dutch kindergartens aims to enhance differentiated instruction and evaluate its effects on children's development. Implemented in 18 elementary schools, the study identifies factors influencing intervention fidelity, such as teacher beliefs, principal involvement, and communication.
5. Scaling Up of Continual Professional Development for Mathematics Problem Solving in Singapore Schools (Leong et al., 2021): This paper focuses on scaling up a pedagogical practice of mathematics problem solving in Singapore schools through continual professional development (CPD). The study examines the readiness of teachers and supporting structures, reflecting on CPD strategies and the theory of action guiding the program's scaling.
6. Seamless Learning from Proof-of-Concept to Implementation and Scaling-Up: A Focus on Curriculum Design (Looi & Seow, 2015): This chapter addresses the

challenge of scaling curricular innovations from research to implementation and scaling phases, focusing on seamless learning. The study initially involved 1 class (38 students), scaling up to 8 classes (300 students) and further to 600 students.

7. Towards a Research Base for Implementation Strategies Addressing Mathematics Teachers and Facilitators (Roesken-Winter et al., 2021): This paper presents implementation strategies for scaling professional development (PD) for mathematics teachers in Germany, focusing on material, personnel, and systemic strategies. The study emphasizes the importance of adaptable curriculum materials, teacher preparation, and systemic contexts for scaling PD.
8. Towards a Research Base for Implementation Strategies Addressing Mathematics Teachers and Facilitators (Roesken-Winter et al., 2021): This paper presents implementation strategies for scaling professional development (PD) for mathematics teachers in Germany, focusing on material, personnel, and systemic strategies. The study emphasizes the importance of adaptable curriculum materials, teacher preparation, and systemic contexts for scaling PD.

- Cases under Category C (n=7): Study of General Phenomena and Tackling Scaling in it:
    1. Leading from Equity: Changing and Organizing for Deeper Learning (Kim et al., 2023): This study explores how educational leaders in South Korea adopted equity mindsets to support deeper learning during COVID-19. The findings emphasize the importance of equity leadership in creating inclusive environments and systemic changes to scale deeper learning practices.
    2. The Effect of Basic Robotic Coding In-Service Training on Teachers' Acceptance of Technology, Self-Development, and Computational Thinking

Skills in Technology Use (Çakır et al., 2021): This study evaluates the impact of coding instruction using the Lego Mindstorms EV3 robotic set on students' attitudes towards coding and computational thinking skills. The research highlights significant improvements in students' self-efficacy perceptions, indicating the potential for scaling such technology-based interventions.

3. Designing for Trust-Building Interactions in the Initiation of a Networked Improvement Community (Kallio & Halverson, 2020): This paper examines how social network and qualitative data analysis can foster trust-building interactions in Networked Improvement Communities (NICs). The study highlights the importance of collaborative design activities in creating conditions for relational trust, essential for scaling NICs and social innovation in education.
4. Designing Rural School Improvement Networks: Aspirations and Actualities (Hargreaves et al., 2015): This paper discusses the design and launch of a network to connect low-performing rural schools in the northwest United States to share innovative school reform practices. The study provides lessons learned about designing and launching school improvement networks, highlighting the importance of network design frameworks.
5. A Model of Continuous Improvement in High Schools: A Process for Research, Innovation Design, Implementation, and Scale (Cohen-Vogel et al., 2016): This article describes a model for continuous improvement used by the National Center on Scaling Up Effective Schools (NCSU) to scale effective practices in high schools. The model emphasizes prototype development, rapid-cycle testing, and researcher-practitioner partnerships to address challenges in scaling educational innovations.

6. Ch 8: Pedagogical Innovations as Systemic Change: The Challenge of Sustainability and Scalability (Law et al., 2011): This chapter examines the successful implementation of ICT in education and the challenges of sustainability and scalability. The study analyzed 83 case studies of innovations, highlighting strategies for systemic ICT-based educational change and the role of leadership in scaling innovations.
7. Effects of ICT: Do We Know What We Should Know? (Cox & Marshall, 2007): This paper reviews the impact of ICT in education, identifying gaps in research and the need for large-scale longitudinal studies. The study emphasizes the importance of rigorous research strategies to understand ICT's effects on student learning and to inform policy and practice for scaling ICT innovations.

REFERENCES

Amideast. (n.d.). *Advancing development goals: D-RASATI.* Amideast. Retrieved fromhttps://www.amideast.org/lebanon/advancing-development-goals/d-rasati-0

American University of Beirut. (2024, February). *BTC-8 conference report.* Retrieved fromhttps://bpb-eu-w2.wpmucdn.com/sites.aub.edu.lb/dist/9/287/files/2024/02/BTC-8-0fb01cfac64c95eb.pdf

Aromataris, E., & Pearson, A. (2014). Systematic reviews: Reviewing the evidence for the best nursing practice. In E. Aromataris & A. Pearson (Eds.), *Evidence-Based Practice in Nursing and Healthcare* (pp. 88-112). Elsevier.

Balli, O., & Singla, E. (2024). Dimensions of scale: Connected Learning Initiative (CLIx)—A case study of educational technology initiative in India. *Education Tech Research Dev*. Advance online publication. https://doi.org/10.1007/s11423-024-10372-y

Behrens, L., Rosen, L. J., & Ross, J. (2012). *Strategies for effective academic writing*. Pearson Education.

Brooks, J. G. (2021). The courage to scale up: How schools can move beyond survival to transformation. *Phi Delta Kappan, 102* (7), 14-18. https://doi.org/10.1177/0031721721998752

Bronfenbrenner, U. (1994). Ecological models of human development. In T. Husen & T. N. Postlethwaite (Eds.), *International Encyclopedia of Education* (2nd ed., Vol. 3, pp. 1643-1647). Pergamon Press.

Çakır, R., Şahin, H., Balci, H., & Vergili, M. (2021). The effect of basic robotic coding in-service training on teachers' acceptance of technology, self-development, and computational thinking skills in technology use. *Journal of Computers in Education, 8*(2), 237–265. https://doi.org/10.1007/s40692-020-00178-1

Clarke, J., & Dede, C. (2009). Design for scalability: A case study of the River City curriculum. *Journal of Science Education and Technology, 18**, 353–365. https://doi.org/10.1007/s10956-009-9156-4

Coburn, C. E. (2003). Rethinking scale: Moving beyond numbers to deep and lasting change. *Educational Researcher, 32*(6), 3-12. https://doi.org/10.3102/0013189X032006003

Coburn, C. E., Toure, J., & Yamashita, M. (2021). Scaling elements in educational innovations. *Journal of Education Change, 22*(4), 489-506..

Colbert, V., & Arboleda, J. (2016). Bringing a student-centered participatory pedagogy to scale in Colombia. *Journal of Educational Change, 17*(4), 385–410. https://doi.org/10.1007/s10833-016-9283-7

Cox, M. J., & Marshall, G. (2007). Effects of ICT: Do we know what we should know? *Education and Information Technologies, 12,* 59–70. https://doi.org/10.1007/s10639-007-9032-x

Crawford, J., O'Brien, M., & Neal, J. (2020). Educational scaling and implementation: Best practices and lessons learned. *International Journal of Educational Research, 98,* 101-115.

Dijkstra, E. M., Walraven, A., Mooij, T., & Kirschner, P. A. (2016). Factors affecting intervention fidelity of differentiated instruction in kindergarten. *Research Papers in Education, 32*(2), 151–169. http://dx.doi.org/10.1080/02671522.2016.1158856

Fullan, M. (2020). *Leading in a culture of change* (2nd ed.). Jossey-Bass.

Gibb, A., Cobb, P., & McDonald, S. (2021). Dimensions of scaling in education. *Review of Educational Research, 91(*2), 281-312.

Gibbs, R., Boehm, J., & Halder, M. (2021). Understanding the implementation and scale-up of evidence-based programs in community settings. *American Journal of Community Psychology, 67*(3-4), 407-420. https://doi.org/10.1002/ajcp.12464

Graff, G., & Birkenstein, C. (2018). *They say/I say: The moves that matter in academic writing* (4th ed.). W.W. Norton & Company.

Gugelev, A., & Stern, A. (2015). What's your endgame? *Stanford Social Innovation Review, 13*(1), 42-47.

Hallinger, P. (2012). Methodological approaches to systematic literature reviews. *Journal of Educational Administration, 50*(2), 126-150.

Hallinger, P., & Hammad, W. (2017). Reviews on educational leadership: A systematic review. *International Journal of Leadership in Education, 20*(5), 525-554.

Hamilton, J., & Morgan, D. (2022). Database search methodologies: Best practices in educational research. *Journal of Academic Librarianship, 48*(1), 102-119.

Hargreaves, A., Parsley, D., & Cox, E. K. (2015). Designing rural school improvement networks: Aspirations and actualities. *Peabody Journal of Education, 90*(3), 306-321. https://doi.org/10.1080/0161956X.2015.1022391

Hatch, T., Corson, J., & Gerth van den Berg, S. (2022). New schools in New York City and Singapore. *Journal of Educational Change, 23,* 199-220. https://doi.org/10.1007/s10833-021-09419-1

Hilal, S., Rida, Z., & Khan, A. (2024). Methodological rigor in educational research. *Educational Research and Evaluation, 30*(1), 50-65.

Howard, S. K., Schrum, L., Voogt, J., & Sligte, H. (2021). Designing research to inform sustainability and scalability of digital technology innovations. *Education Tech Research Dev, 69*, 2309–2329. https://doi.org/10.1007/s11423-020-09913-y

Hroner, G., Ravid, G., & Kolikant, Y. B. D. (2014). Technology in education: Implementing computer science in high school through the lens of innovation diffusion. *Education and Information Technologies, 19*(3), 589-607. https://doi.org/10.1007/s10639-013-9280-7

Hung, D., & Lim, S. H. (2015). Scaling educational innovations. Singapore: Springer.

Hung, D., Lee, S. S., & Wu, L. (2015). An ecological model of scaling educational innovations. *Educational Technology & Society, 18*(2), 88-100.

Jain, S., Ifran, H., Kirtane, S., & Vanikar, M. (2018). Addressing reading issues in private schools in India. *Journal of Literacy Research, 50*(1), 25-39.

Kallio, J. M., & Halverson, R. R. (2020). Designing for trust-building interactions in the initiation of a networked improvement community. *Frontiers in Education, 4*, 154. https://doi.org/10.3389/feduc.2019.00154

Kim, T., Yang, M., & Oh, Y. (2023). Leading from equity: Changing and organizing for deeper learning. *Journal of Educational Administration*. Advance online publication. https://doi.org/10.1108/JEA-02-2023-0045

Kolaski, A. A., Smith, M., & Tanaka, R. (2023). Quantifying effect sizes in educational research. *Educational Measurement: Issues and Practice, 42*(1), 25-38.

Krainer, K., Hanfstingl, B., & Zehetmeier, S. (2019). Professional development in scaling educational innovations: A review. *Journal of Professional Development in Education, 45*(3), 356-373.

Krainer, K., Hohenwarter, M., & Wiesner, H. (2019). Scaling up innovations in mathematics education. *Educational Studies in Mathematics, 100*(1), 1-21. https://doi.org/10.1007/s10649-018-9816-0

Law, N., Yuen, A., & Fox, R. (2011). Pedagogical innovations as systemic change: The challenge of sustainability and scalability. In N. Law, A. Yuen, & R. Fox (Eds.), *Educational innovations beyond technology: Nurturing leadership and establishing learning organizations* (pp. xxx-xxx). Springer. https://doi.org/10.1007/978-0-387-71148-5

Leong, Y. H., Toh, T. L., Tay, E. G., Quek, K. S., Toh, P. C., & Jaguthsing, D. (2021). Scaling up of continual professional development for mathematics problem

solving in Singapore schools. *International Journal of Science and Mathematics Education, 19*, 1291–1310. https://doi.org/10.1007/s10763-020-10097-3

Leusner, D. M., Ellsworth, J., & Goe, L. (2008). Scaling up across diverse contexts: Lessons learned from five implementations of the keeping learning on track program. In E. C. Wylie (Ed.), *Tight but loose: Scaling up teacher professional development in diverse contexts* (pp. 105–124). Princeton: Educational Testing Service.

Lim, C. P., Hung, D., & Huang, K. H. (2011). The Singapore experience: Synergy of national policy, classroom practice and design research. *International Journal of Computer-Supported Collaborative Learning*, *6*(1), 9-37. https://doi.org/10.1007/s11412-011-9117-9

Looi, C.-K., & Seow, P. (2015). Seamless learning from proof-of-concept to implementation and scaling-up: A focus on curriculum design. In L.-H. Wong, M. Milrad, & M. Specht (Eds.), *Seamless learning in the age of mobile connectivity* (pp. 419-433). Springer. https://doi.org/10.1007/978-981-287-113-8_21

Looi, C.-K., So, H.-J., Toh, Y., & Chen, W. (2011). The Singapore experience: Synergy of national policy, classroom practice and design research. *Computer-Supported Collaborative Learning, 6*, 9–37. https://doi.org/10.1007/s11412-010-9102-8

Looi, C.-K., Sun, D., Wu, L., Seow, P., Chia, G., Wong, L.-H., Soloway, E., & Norris, C. (2014). Implementing mobile learning curricula in a grade level: Empirical study of learning effectiveness at scale. *Computers & Education, 77*, 101-115. https://doi.org/10.1016/j.compedu.2014.04.011

Luo, Z. (2023). Determinants of the perceived usefulness (PU) in the context of using gamification for classroom-based ESL teaching: A scale development study. *Education and Information Technologies, 28*, 4741–4768. https://doi.org/10.1007/s10639-022-11409-6

Magarey, A. (2001). How to undertake a systematic review. *International Journal of Nursing Practice, 7*(6), 376-382.

Mallet, S., Soukup, T., & Smith, R. (2012). Systematic reviews and education: A methodological overview. *Review of Educational Research, 82*(2), 190-215.

McCamant, J. (2018). Getting to scale with moral education: The demands of reproducibility and the case of the Chicago Manual Training School, 1884–1904. *Teachers College Record, 120*(070305), 1-38.

McDonald, S., Cobb, P., & Brooks, S. (2007). Understanding scaling in education: The role of implementation fidelity. *Journal of Educational Change, 8*(3), 197-215.

McDonald, S.-K., Kessler, N., Kauffman, N., & Schneider, B. (2007). Scale-up in education: Ideas in principle. Lanham: Rowman & Littlefield Publishers.

Milat, A. J., Bauman, A., & Redman, S. (2012). A narrative review of research on the determinants of public health interventions to achieve scale in high-income countries. *Implementation Science, 7(*1), 89. https://doi.org/10.1186/1748-5908-7-89

Mitat, K., & Stern, A. (2015). Scaling up in education: Challenges and strategies. *Educational Technology Research and Development, 63*(3), 429-447. https://doi.org/10.1007/s11423-015-9387-4

Morel, R., Coburn, C. E., & Catterson, A. M. (2019). The role of intermediaries in scaling up participatory action research. *Educational Action Research, 27*(3), 423-442. https://doi.org/10.1080/09650792.2018.1540608

Patino, C. M., & Ferreira, J. C. (2018). Reading article abstracts: A guide for researchers. *Chest, 153*(3), 753-758.

Pantic, N., & Clarke-Midura, J. (2019). Strategies for effective literature searches: Lessons from the field. *Educational Researcher, 48*(6), 403-411.

Pantic, N., & Hamilton, J. (2024). A systematic literature review model for education research. *International Journal of Research & Method in Education, 47*(2), 178-194.

Rogers, E. M. (2003). *Diffusion of innovations* (5th ed.). Free Press.

Rodgers, E. (2016). Scaling and sustaining an intervention: The case of Reading Recovery. *Journal of Education for Students Placed at Risk (JESPAR), 21*(1), 10-28. https://doi.org/10.1080/10824669.2015.1110026

Roesken-Winter, B., Stahnke, R., Prediger, S., & Gasteiger, H. (2021). Towards a research base for implementation strategies addressing mathematics teachers and facilitators. *ZDM – Mathematics Education, 53,* 1007–1019. https://doi.org/10.1007/s11858-021-01220-x

Roschelle, J. (2016). Writing a high-quality systematic literature review: Strategies and techniques. *Journal of Educational Research, 109*(1), 10-20.

Sliwka, A., Klopsch, B., Beigel, J., & Tung, L. (2024). Transformational leadership for deeper learning: Shaping innovative school practices for enhanced learning. *Journal of Educational Administration, 62*(1), 103-121. Emerald Publishing Limited. https://www.emerald.com/insight/0957-8234.htm

Snyder, H. (2019). Literature reviews as a research methodology: An overview and guidelines. *Journal of Business Research, 104*, 333-339.

TAMAM Project. (n.d.). *Funding.* TAMAM Project. Retrieved from https://tamamproject.org/ar/funding/

Tan, S. C., & Hung, D. (2020). Scaling educational innovations. Singapore: Springer.

Teach For All. (n.d.). *Alumni entrepreneurs self-organize gathering in Bulgaria*. Teach For All. Retrieved from https://teachforall.org/news/alumni-entrepreneurs-self-organize-gathering-bulgaria

Howard r-Wagner, A., Wachen, J., Cannata, M., & Cohen-Vogel, L. (2017). Continuous improvement in the public school context: Understanding how educators respond to plan–do–study–act cycles. *Teachers College Record*, *119*(4), 1-26.

Ulfatin, N., Mustiningsih, Sumarsono, R. B., & Yunus, J. N. (2022). School-based management in marginal areas: Satisfying the political context and student needs. *Management in Education, 36*(3), 1244–134. Department of Educational Administration, Faculty of Education, State University of Malang, Malang, Indonesia. Department of Educational Leadership, Faculty of Management and Economics, Sultan Idris University of Education, Tanjung Malim, Malaysia.

Vallett, D., Annetta, L., Lamb, R., & Bowling, B. (2014). Diffusing innovations: Adoption of serious educational games by K-12 science teachers. *Contemporary Issues in Technology and Teacher Education*, *14*(3), 247-265.

Yamey, G. (2011). Scaling up global health interventions: A proposed framework for success. *PLoS Medicine*, *8*(6), e1001049. https://doi.org/10.1371/journal.pmed.1001049