# A SYSTEMATIC REVIEW OF K-12 TEACHERS' ADAPTIVE EXPERTISE DEVELOPMENT

## *Una revisión sistemática del desarrollo de la experiencia adaptativa de los docentes de educación infantil, primaria y secundaria*

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**INTRODUCTION.** This systematic review explores the concept of adaptive expertise in the context of kindergarten, primary and secondary education, aiming to identify key characteristics of adaptive expertise as well as how to foster its development. The ability of teachers to adjust their instructional strategies to meet novel and complex classroom situations while striking a balance between routine competency and innovative problem-solving is known as adaptive expertise. **METHOD.** A search of the Web of Science database, with a focus on studies published between 2012 and 2024, identified 112 studies, of which 28 met the inclusion criteria. The CASP (Critical Appraisal Skills Programme) checklist was used, and the review complied with PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) standards to guarantee an open and repeatable procedure for choosing and evaluating the research papers. **RESULTS.** According to the review, reflective practice, student-centered methods, flexibility, and creative problem-solving are traits of adaptive expertise. Practice-based pedagogies, reflective inquiry, mentorship, and creating environments that support experimentation and risk-taking are important approaches to developing adaptive expertise. **DISCUSSION.** According to the findings, teacher education programs should place a strong emphasis on giving instructors the chance to reflect, collaborate, and engage in iterative cycles of practice and feedback. It is also advised to incorporate digital technologies to promote innovation in teaching methods. According to the review's findings, teachers must possess adaptive expertise in order to effectively respond to the diverse and changing students' needs, in particular to support English language learners (ELL), promoting both efficiency in routine tasks and flexibility in new situations. Implications include better hiring procedures, teacher self-efficacy, professional development for subject content teachers teaching ELL students and staff retention.

**Keywords:** *Adaptive expertise, Teacher education, Professional development, English language learners, Reflective teaching.*

## Introduction

While cultivating adaptive expertise among teachers is essential for promoting effective teaching in ever-changing and diverse classrooms, there is a scarcity of empirical research focused on developing adaptive expertise specifically in English Language Learner (ELL) instruction within mainstream educational settings (Von Esch & Kavanagh, 2017; Bowers *et al*., 2019). Preservice mainstream teachers often face challenges in integrating ELL instruction with content teaching, suggesting that conceptualizing teacher learning goals around the development of adaptive expertise could provide valuable insights for designing and implementing structures, pedagogies, and contexts in teacher education. Von Esch and Kavanagh highlight that future research would be greatly enhanced by a well-defined vision of what fully realized adaptive expertise in ELL instruction looks like for mainstream teachers. Such a vision could guide the creation of teacher education models that support instructional flexibility in response to ELL students' needs (Xiang *et al*., 2022). This systematic review is grounded in this premise, seeking to clarify current research on adaptive expertise in order to inform teacher education, recruitment strategies, and ongoing professional development (Serrano *et al*., 2024).

Teacher adaptive expertise is a multifaceted concept that encompasses the ability of educators to transcend routine procedures and effectively tailor their teaching strategies to address novel and complex challenges that arise in the classroom. This skill is crucial for balancing efficiency with innovation, enabling teachers to meet the diverse needs of their students, which include not only academic requirements but also "social, linguistic, cultural, and instructional needs" (Parsons *et al*., 2018; Opre, 2015). Educators who display adaptive expertise are adept at recognizing when standard teaching methods fall short of addressing specific student needs. Effective adaptive experts can efficiently solve familiar problems while innovatively addressing new challenges (Opre, 2015). They actively pursue knowledge to better understand the conditions under which various instructional approaches are effective and employ flexible, creative solutions to overcome obstacles (Von Esch & Kavanagh, 2017; Schwartz *et al*., 2005).

The term "adaptive expertise" was first coined in 1986 by researchers Hatano and Inagaki, who emphasized its relevance to teachers' ability to use context-specific knowledge to make informed decisions. This involves demonstrating case sensitivity and cognitive flexibility by considering multiple hypotheses and remaining open to new information and perspectives (Hatano & Inagaki, 1986; Baldinger & Munson, 2020). Reflective practice and conscious deliberation play a vital role in this process, enabling educators to theorize about their practical knowledge while simultaneously interpreting theoretical frameworks in real-world classroom settings. Through this continual cycle of reflection and adaptation, teachers refine their methods to better cater to the varied needs of their students (Tsui, 2009; Männikkö & Husu, 2019; Soha Zoelfakar & Charles, 2024). Consequently, developing adaptive expertise necessitates a profound understanding of both content knowledge and contextual factors that influence teaching and learning dynamics. This dual understanding allows educators to effectively support student learning in diverse educational environments (Warren & Kersten-Parrish, 2022).

This proposed study aims to explore and identify the characteristics of adaptive expertise, a concept that balances proficiency in routine tasks with the capacity for innovation. This balance is underpinned by continual learning and reflective practice, as highlighted in the works of Schwartz *et al*. (2005), Patel and Groen (1986), Crawford *et al*. (2005), and Von Esch and Kavanagh (2017). The

focus of this research is specifically situated within the context of kindergarten, primary and secondary education, where the dynamics of teaching and learning are crucial.

The concept of "adaptive expertise" is distinctively different from "routine expertise." While routine expertise emphasizes the mastery of established procedures and tasks, adaptive expertise highlights the ability to "read the room" effectively. This ability allows educators to adapt their teaching strategies to meet the diverse needs of learners. It draws from the routine expertise developed over time, which forms a substantial body of procedural knowledge that teachers can modify to fit various educational situations. However, it is essential to note that adaptive expertise is not merely an extension or enhancement of routine expertise; rather, it constitutes a separate set of skills that must be developed concurrently with the construction of routine expertise. Adaptive expertise enables educators to engage in sophisticated problem-solving within novel contexts, while routine expertise remains necessary for educators to function as skilled practitioners. Routine specialists may excel in speed, accuracy, and automated performance; however, they may struggle to adapt to changing circumstances or unexpected challenges. In other words, these specialists are recognized as experts primarily because they can effectively handle typical problems within a stable environment. Yet, this proficiency is limited to their ability to reproduce tasks; when faced with situations where the parameters remain unchanged, the effectiveness of an expert teacher can be significantly constrained, as noted by Hatano and Inagaki (1986) and Lin, Schwartz & Hatano (2005).

According to Hatano and Inagaki, the development of adaptive expertise is more likely to be fostered in environments that are risk-free and encourage experimentation and reflection (Hatano and Inagaki, 1986). Such conditions stand in stark contrast to settings where individuals feel pressured to find immediate correct answers. Teaching is inherently contextual; therefore, there will always be modest correlations between instructor actions and student learning outcomes, as emphasized by Stigler and Miller (2018).

Three factors, according to Hatano and Inagaki (1986), promote the development of adaptive expertise: (1) a random context that compels professionals to modify their skills based on close observation and interaction; (2) a secure setting where rewards are not performance-based; and (3) a work environment that prioritizes quality over efficiency. Accordingly, other researchers have developed strategies for how education might be given to encourage the development of adaptive competence (van Tartwijk *et al*., 2023), albeit the majority of these suggestions have not been empirically tested. The ability to adjust to the needs of English Language Learners (ELLs) while teaching subject-specific curricula, such as science, math, or history, is a critical reason for developing adaptive expertise in education. The systematic review on adaptive expertise is part of the researcher's doctoral studies, aiming to develop secondary school teachers' adaptive expertise characteristics through implementing a participatory action research professional development targeting the needs of English learners.

In summary, this study seeks not only to identify the characteristics of adaptive expertise but also to understand its implications for teaching practices in K-12 education.

## Objective of the Study

The first aim of this review is to synthesize the existing research on adaptive expertise specifically within the contexts of K-12 education. This synthesis seeks to investigate the various characteristics

that define adaptive expertise, as well as how these characteristics can be effectively observed and measured in educational settings. By examining the nuances of adaptive expertise, this review aims to provide a clearer understanding of what it entails and how it manifests in the behaviors and practices of educators.

A second purpose of this study is to identify effective strategies and approaches for supporting the development of adaptive expertise among educators in K-12 education. This involves exploring various pedagogical frameworks, professional development opportunities, and reflective practices that can facilitate the growth of adaptive skills.

Ultimately, this review aspires to bridge the gap between theory and practice by providing actionable recommendations that can be implemented in schools and pre-service programmes. By highlighting both the characteristics of adaptive expertise and the means to develop it, this research will serve as a resource for educators, administrators, and policymakers who are committed to enhancing teaching effectiveness and improving student outcomes in diverse learning environments.

The research questions are:

- What are the characteristics of adaptive experts in K-12 education?
- How can adaptive expertise in K-12 education be developed?

## Method

### Information Sources/Search

Searches were conducted using only the Web of Science database because a single researcher performed this comprehensive review. The choice of Web of Science was based on the database's reliability and comprehensive citation tracking (Birkle *et al*., 2020). Including additional databases would have likely generated an overwhelming number of studies, making it impractical for one individual to thoroughly review and synthesize all the relevant literature effectively. By limiting the search to a single database, the researcher aimed to maintain a manageable scope while ensuring a focused and systematic approach to the literature review process.

All records identified through the database searches were managed manually using Microsoft Excel spreadsheets. Titles and abstracts were reviewed by the first author of the paper. In addition to the primary search strategy, some papers were also retrieved using the snowballing technique, commonly referred to as citation searching. This method involves screening the articles identified in the initial search and exploring their reference lists to include papers that have been cited in multiple sources. This approach proved particularly valuable in uncovering influential works that may not have appeared in the initial search results. For instance, one notable example is the "research synthesis" conducted by Parsons and colleagues. Published in 2018, this paper reviewed a substantial body of research literature that focused on different terms associated with adaptive expertise from 1974 to 2014 (Parsons *et al*., 2018).

This foundational paper was instrumental in providing a comprehensive understanding of the historical context surrounding the concept of adaptive expertise. It helped identify the multiplicity of terms used to describe adaptive expertise throughout that extensive period, highlighting how terminology has evolved over time. Indeed, as noted by Parsons *et al*., the variety of terminology employed to describe this phenomenon contributes to a significant lack of clarity within the research landscape. This ambiguity creates challenges in determining how to accurately identify the characteristics of adaptive experts and assess their impact on student learning outcomes (Parsons *et al*., 2018).

Recognizing these complexities, it was our deliberate intention to focus exclusively on research papers that explicitly refer to "adaptive expertise." By doing so, we aimed to avoid any potential ambiguity or confusion regarding definitions and interpretations of related concepts. This focused approach not only enhances clarity but also strengthens the validity of our findings by ensuring that we are examining studies that share a common understanding of what constitutes adaptive expertise.

As part of our review protocol, we first developed and reviewed the inclusion criteria and search query syntax. This step was crucial in ensuring that our search strategy was robust and aligned with our research objectives. By establishing clear inclusion criteria, we aimed to filter out studies that did not meet our specific focus on adaptive expertise in education, thereby streamlining our selection process. The development of an effective search query syntax allowed us to maximize our retrieval of relevant articles while minimizing irrelevant results, ensuring that our review would be both comprehensive and precise.

In summary, by employing a focused search strategy within a single database and utilizing techniques such as citation searching, we aimed to construct a well-rounded literature review that accurately reflects current understanding and developments related to adaptive expertise in education.

**Eligibility Criteria**

The search terms used were:

"Adaptive expertise" AND "teaching"

While refining the search syntax, it was found that adding search terms after "teaching" limited the scope of the research papers and returned few results. Therefore, only the search query "Adaptive expertise" AND "teaching" was kept. Even while searching with these terms, adaptive expertise was frequently associated with healthcare, rather than K-12 education. In this context, it was also usually associated with the adaptive expertise shown by medical students rather than teachers. Therefore, it was an explicit exclusion criterion (see criterion 3 in Table 1) to avoid drawing conclusions not directly related to the development of adaptive expertise in teachers in K-12 settings. Furthermore, any papers that failed to address the concept of teacher adaptive expertise development were systematically excluded (criterion 2 as seen in Table 1). This exclusion criterion was established to maintain a clear focus on teacher adaptive expertise, as opposed to student adaptive expertise.

The timespan for the search was deliberately restricted to the period from 2012 to 2024 (see criterion 1 in Table 1). This decision was made to concentrate on the most recent and relevant research in the field of adaptive expertise, thereby capturing contemporary perspectives and findings that reflect current educational practices and challenges. By focusing on this specific timeframe, the review seeks to provide insights that are not only timely but also pertinent to ongoing discussions and developments within educational research.

As the focus of the review was the development of adaptive expertise, another eligibility criterion was that the study should use qualitative research methods (see criterion 4 in Table 1) to ensure methodological consistency and allow for meaningful synthesis and interpretation of findings (Ghamrawi *et al.*, 2025).

The search for relevant literature was conducted exclusively in English, which reflects both the language proficiency of the researcher and the predominant language of scholarly discourse in this field.

The inclusion and exclusion criteria were applied in a two-stage process following the eligibility criteria described earlier. In the first stage, titles and abstracts were screened for relevance according to the criteria listed below. In the second stage, the full texts of potentially eligible articles were reviewed to confirm their suitability for inclusion. These criteria were designed to ensure that the review remained focused on the target population and phenomenon of interest. For instance, studies that explored adaptive expertise without specific reference to teacher adaptive expertise development were excluded.

**Table 1. Inclusion and exclusion criteria**

| Criteria | Reason for inclusion | Reason for exclusion |
|---|---|---|
| 1. Date of publication | The study must be published from 2012 onwards. | Studies published prior to 2012. |
| 2. Topic of the study | The study must relate to teachers' development of adaptive expertise. | The studies do not relate specifically to teachers' adaptive expertise development (for example: students' adaptive expertise as learners). |
| 3. Context of the study | The study must include Kindergarten, Primary or Secondary (K-12) students in education. | The studies are not related to kindergarten, primary or secondary (K-12) education (for example: healthcare or university setting). |
| 4. Type of research | The study must be a qualitative study to allow a more rigorous comparison of methodologies. | The study was not a qualitative study. |

## Paper Screening and Quality Assessment

The search query returned 112 results on June 6th, 2024. A spreadsheet of the records was generated from Web of Science, which included the abstract to perform a first screening. At this screening stage, the title of the article and the abstract were used to identify whether it should be kept or excluded according to the inclusion and exclusion criteria. Out of the original 112 records, 64 were

excluded according to the exclusion criteria, mainly due to the fact that they were related to healthcare and the development of adaptive expertise in health professionals rather than in teaching, or not related to the development of adaptive expertise in teachers specifically. Out of the remaining papers, 30 were identified as relevant, and 21 as potentially relevant. A second round of exclusion was carried out, and one paper was excluded as it was a replicate of a study already reported in another research paper. Reports were then sought for retrieval. Five papers were not accessible even after attempting to contact the authors. Three papers which had not appeared in the Web of Science search, but were found through a snowball search in the initial search conducted to develop a proposal for this systematic review, were also included, as they met the eligibility criteria.

Full-text articles for all eligible records were retrieved and assessed for inclusion. Each article was then read and reread several times and the SPIDER (Sample group, Phenomenon of interest, Design (specific methodology), Evaluation, Research type) framework for qualitative research summary created to enable the studies to be compared. Originally, the PICO (Population, Intervention, Comparison, Outcome) framework was used, but the limitations in regard to qualitative studies led to adopting the SPIDER framework (Cooke *et al.*, 2012).

The Critical Appraisal Skills Programme (CASP, 2021) checklist for qualitative research was used to assess the quality of the selected papers. The CASP checklist includes 10 guiding questions, which are further broken down into specific sub-questions designed to appraise qualitative studies. The primary aim of these questions is to evaluate whether the results of each study are valid, analyze the rigor of the data analysis process, and critically evaluate whether the study contributes valuable insights to the current body of research in the field.

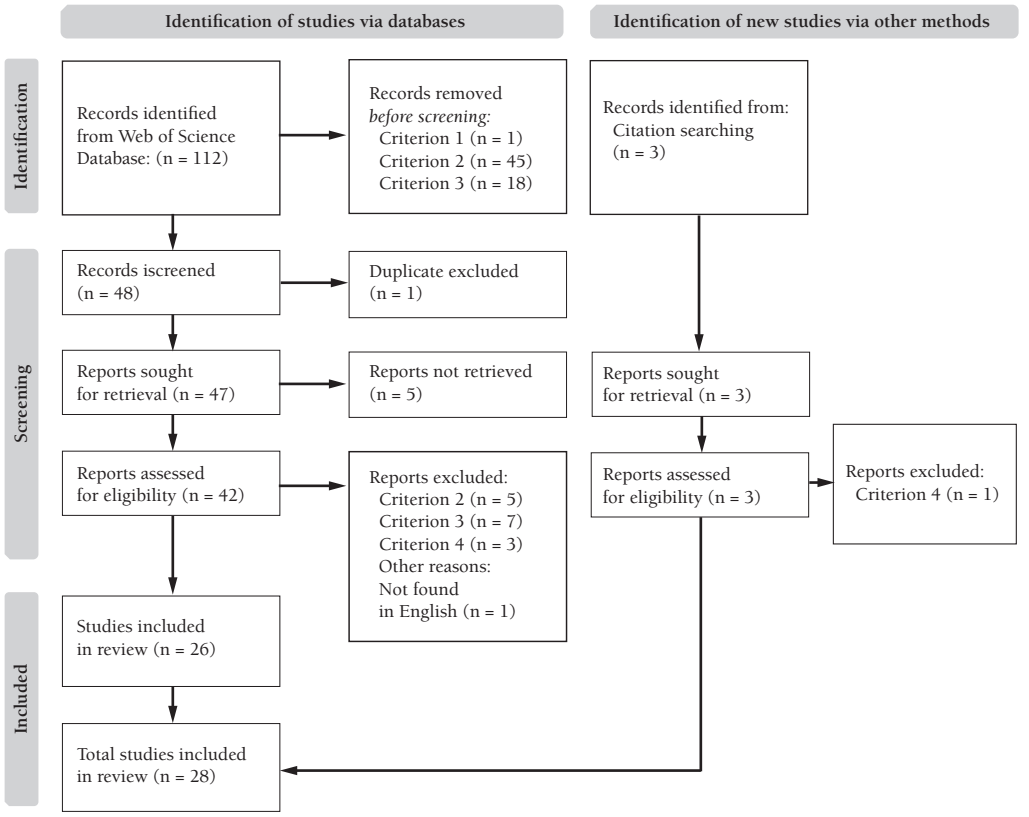
In conjunction with this, the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) flow chart presented in Figure 1 illustrates the detailed process of identifying papers, screening them, and ultimately including eligible studies in the review. This flow chart serves as a visual representation of the systematic review process, ensuring transparency and clarity throughout.

During the initial reading phase, key terms such as "adaptive expertise" were searched throughout the article to ascertain its relevance and to evaluate the references utilized to define adaptive expertise. This enabled the researcher to quickly identify how adaptive expertise was conceptualized within the context of the specific research paper and to determine whether similar authoritative sources were referenced.

The second reading concentrated on examining the interest or phenomenon observed in the research, aiming to establish whether the research effectively addressed the development of adaptive expertise and explored how this development occurred. Subsequent readings were guided by both the SPIDER and CASP checklists, which facilitated a thorough evaluation of the rigor and relevance of the research findings. Sixteen papers were excluded as per the exclusion criteria, one of which because it was not found in English.

To analyze and generate statistics from the studies' characteristics, an open-source software tool known as Jeffrey's Amazing Statistics Program (JASP) was employed. The results from this statistical analysis can be found in Tables 2 through 6, which present an overview of various characteristics derived from the studies included.

**Figure 1. PRISMA flow chart showing papers identified through the search terms (search based on Tetzlaff *et al.*, 2020)**




## Characteristics of the Studies

Each article's characteristics were detailed using the SPIDER framework, as stated earlier. Within this framework, the "Sample" category was further divided into five distinct sub-categories: country, school division, subject area, pre-service or in-service status, and participant demographics. This categorization was implemented to facilitate a comprehensive analysis and generate frequency comparisons based on these specific sub-categories (see screenshot of the table in Figure 2 and the full table in Appendix 1). By breaking down the sample characteristics in this manner, it becomes possible to identify patterns and trends across different contexts and educational settings, thus enriching the overall understanding of adaptive expertise in teaching. Indeed, the development of adaptive expertise among teachers is deeply shaped by the cultural, educational, and policy contexts of each country. For example, Singapore's educational system integrates adaptive expertise through region-specific socio-cultural supports and curricular innovations (Lee & Hung, 2016; Reimann *et al.*, 2009). In Australia, particularly in rural areas, distinct challenges and opportunities arise, prompting teachers to cultivate adaptive expertise via creative practices and local partnerships (McGraw & Walker, 2024). It is

equally important to specify the educational level—primary, secondary, or tertiary—when analyzing adaptive expertise, as students' developmental needs and classroom challenges differ at each stage. Strategies effective for pre-service teachers in elementary settings may not suit those in secondary classrooms (Moran *et al*., 2023; Linda *et al*., 2025). For example, primary teachers in Singapore focus on blending literacy with content instruction (Linda *et al*., 2025), while secondary teachers in rural Australia must adapt to challenges such as professional isolation and limited resources (Reimann *et al*., 2009). In summary, specifying both the country and the school section is essential when analyzing teacher adaptive expertise. This approach ensures that cultural, policy, and developmental differences are taken into account, allowing for more accurate comparisons and an awareness of whether there is an imbalance in the representation of educational contexts.

In addition to the detailed sampling framework, the definitions of adaptive expertise as presented in each article were compiled and organized in a separate spreadsheet. This spreadsheet served as a valuable resource for comparing how adaptive expertise is conceptualized across various studies. Each entry includes specific references to the definitions provided by different authors, allowing for a nuanced understanding of the term as it has evolved over time and across different educational contexts.

The compilation of definitions of adaptive expertise from each article into a separate spreadsheet further underscores the importance of clarity in research terminology. Given that adaptive expertise is a multifaceted concept with varying interpretations across studies, having a centralized reference point allows educators and researchers alike to engage with a more cohesive understanding of what constitutes adaptive expertise in practice. This effort aligns with the broader goal of establishing a more unified framework for discussing and researching adaptive teaching strategies.

**Figure 2. Screenshot of SPIDER framework applied to the studies**

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Preparing Mainstream Classroom Teachers of English Learner Students: Grounding Practice-Based Designs | Von Esch, K., Kavanagh, S. | USA | Primary | Math and English | pre-service | not specified | Pre-service teachers from Seattle University, USA | Investigating how practice-based designs help prepare teachers to teach English Learner students in mainstream classrooms | practice-based learning models; Studio day analysis | Studio days help pre-service teachers integrate content and language instruction for English Learners | Qualitative |
| Developing Adaptive Expertise in the Wake of Rehearsals: An Emergent Model of the Debrief Discussions | Baldinger, E., Munson, J. | USA | Secondary | Math | in-service | 22 | Early-career secondary mathematics teachers, USA | Exploring how post-rehearsal debrief discussions help develop adaptive expertise in non-rehearsing teachers | video recordings and analysis of rehearsal debrief discussions | Debrief discussions provide opportunities for teachers to develop adaptive expertise through reflective dialogue and co-construction of meaning | Qualitative |
| Prospective Teachers' Development of Adaptive Expertise | Anthony, G., Hunter, J., Hunter, R. | NZ | Primary | Math | pre-service | 23 | Prospective teachers from a New Zealand university | Examining the development of adaptive expertise in prospective teachers within a classroom inquiry course | Case study analysis with interviews, reflective journals, and classroom observations | Adaptive expertise was developed through practice-based pedagogies and inquiry, focusing on adaptive teaching shifts | Qualitative |
| Examining Teachers' Adaptive Expertise through Personal Practical Theories | Männikkö, I., Husu, J. | Finland | Primary | Math | in-service | 17 | Finnish primary school teachers | Exploring how teachers' adaptive expertise develops through their personal practical theories | Stimulated recall interviews with video recordings and inductive coding | Teachers' adaptive expertise varied depending on their teaching orientations and classroom observations | Qualitative |
| Learning to Teach Responsively Through Asynchronous Collaborative Discourse Around Video Records of Practice | Caroline B. Ebby, Janine T. Remillard, Lindsay T. Goldsmith-Markey | USA | Primary | Math | in-service | 11 | Early-career teachers (PreK-Grade 1 teachers), 5 first-year teachers, 6 with 1-5 years of experience, mostly from low-income schools. | The study explores how early-career teachers engage in collective deliberation and implement responsive teaching practices through asynchronous video-feedback inquiry groups. | Participants posted teaching videos and feedback on a platform. Feedback was peer-reviewed and tagged to specific moments, with cycles of recording, posting, and commenting. | Findings suggest asynchronous video feedback promotes dialogic conversations that support the growth of responsive teaching, highlighting peer feedback as a key element. | Qualitative |
| Developing pre-service teachers' adaptive expertise through STEM-CT integration | Moran, R.M.R., Robertson, L., Tai, C., Ward, N.A., Price, J. | USA | Primary | not specified | pre-service | 49 | PSTs from public university in southern U.S. with K-5 placements | The development of adaptive expertise in pre-service teachers through STEM-CT integration | Ethnographic study with focus group interviews, observations, and analysis of lesson plans | Adaptive expertise developed through collaboration with mentors and integration of STEM-CT curriculum | Qualitative |
| Developing as a literacy teacher: sense-making and ownership in an online course | Warren, A.N., Kersten-Parrish, S. | USA | Kindergarten to Secondary | literacy | pre-service and in-service | 13 | Participants in an online Master's literacy program, majority female | Investigating how literacy teachers develop sense-making and ownership over word study practice | Analysis of video-mediated discussions, focus groups, reflective journals | Peer collaboration increases ownership of word study practices, helping build adaptive expertise | Qualitative |

*Note: The full table can be found in Appendix.*

The SPIDER characteristics are summarised below:

***Study Samples (S):***

While the 28 studies represented a diversity of countries throughout the world (12 countries), the majority of studies took place in the Western world, and primarily in the United States of America (54%) (see Table 2). Sample participants represented kindergarten, primary and secondary education in equal numbers (see Table 3). Studies represented both pre-service and in-service teachers, with a small majority focusing on in-service teachers (50% versus 46% for pre-service teachers) (see Table 4). Finally, the subject areas taught by the participants taking part in the studies overwhelmingly represented Math (18%), Science (22%) and English or literacy (18%) (see Table 5). A number of studies, in particular in primary education, did not specify which subject area was the focus.

**Table 2. Frequencies of country in which the studies were undertaken**

| Country | Frequency | Percent |
|---|---|---|
| USA | 15 | 53.571 |
| NZ | 1 | 3.571 |
| Finland | 1 | 3.571 |
| South Africa | 3 | 10.714 |
| Bahrain | 1 | 3.571 |
| Chile | 1 | 3.571 |
| Turkey | 1 | 3.571 |
| Norway | 1 | 3.571 |
| China | 1 | 3.571 |
| Netherlands | 1 | 3.571 |
| US | 2 | 7.143 |
| Missing | 0 | 0.000 |
| Total | 28 | 100.000 |

**Table 3. Frequencies of school division where studies were undertaken**

| School division | Frequency | Percent |
|---|---|---|
| Primary | 11 | 39.286 |
| Secondary | 11 | 39.286 |
| Kindergarten to Secondary | 1 | 3.571 |
| Primary and Secondary | 1 | 3.571 |
| not specified | 4 | 14.286 |
| Missing | 0 | 0.000 |
| Total | 28 | 100.000 |

**Table 4. Frequencies of pre-service and in-service teacher participants in the studies**

| Pre-Service or In-Service | Frequency | Percent |
|---|---|---|
| pre-service | 13 | 46.429 |
| in-service | 14 | 50.000 |
| pre-service and in-service | 1 | 3.571 |
| Missing | 0 | 0.000 |
| Total | 28 | 100.000 |

**Table 5. Frequencies of the subject areas taught by participants**

| Subject Area | Frequency | Percent |
|---|---|---|
| Math and English | 1 | 3.571 |
| Math | 5 | 17.857 |
| not specified | 9 | 32.143 |
| literacy | 3 | 10.714 |
| English | 2 | 7.143 |
| multiple subjects | 1 | 3.571 |
| Science | 5 | 17.857 |
| Special education | 1 | 3.571 |
| Biology | 1 | 3.571 |
| Missing | 0 | 0.000 |
| Total | 28 | 100.000 |

*Phenomenon of Interest (P):*

The central focus in these studies revolves around understanding adaptive expertise in teaching, often in relation to practice-based learning. The studies included in this review explore how teachers develop adaptive expertise through reflective practices, debrief sessions, and feedback mechanisms. A recurring theme is the need for teachers to adapt and improve based on classroom experiences, emphasizing responsive and reflective teaching strategies.

*Design (D):*

One of the criteria for inclusion was that the study should be qualitative, in order to be able to compare the methods employed to gather data (see Table 6). Many studies used more than one type of data collection method, so these were listed separately rather than in relation to each study. As a result, there are more data collection methods listed than the number of studies included in the review. Interviews are one of the most widely used methods in the studies (representing 23% of the methods used across all the studies). Self-reported data, in the form of reflective journals and surveys, also represent 17% of the methods used. Video recordings and classroom observations, combined, represent 28% of the methods used. The designs are frequently based on practice-focused frameworks, incorporating real-life classroom scenarios.

**Table 6. Frequencies of Research Method**

| Method | Frequency | Percent |
|---|---|---|
| reflection | 3 | 5.660 |
| lesson plan analysis | 2 | 3.774 |
| video recordings | 8 | 15.094 |
| reflective journals | 3 | 5.660 |
| interviews | 12 | 22.642 |
| classroom observations | 7 | 13.208 |
| analysis of student performance | 2 | 3.774 |
| field notes | 1 | 1.887 |
| audio recordings | 1 | 1.887 |
| discourse analysis | 2 | 3.774 |
| surveys | 6 | 11.321 |
| qualitative ethnographic descriptions | 1 | 1.887 |
| coding | 1 | 1.887 |
| written analysis | 1 | 1.887 |
| lesson analysis | 1 | 1.887 |
| case studies comparison | 1 | 1.887 |
| Missing | 1 | 1.887 |
| Total | 53 | 100.000 |

*Evaluation (E):*

Conclusions from these studies generally support the efficacy of reflection-based methods in promoting adaptive teaching. For example, video feedback and post-rehearsal debrief sessions are noted for enhancing teachers' responsiveness and integration of theory into practice. Teachers' expertise and adaptability appeared to grow through iterative learning experiences and supportive feedback.

*Research Type (R):*

Twenty-four studies identified in this dataset fit in the qualitative research criterion. Five of the studies used a mixed-method approach. Since this approach includes qualitative methods, they were included in the study.

## Results

**Research Question 1:**

***What are the characteristics of adaptive experts in K-12 education?***

The concept of adaptive expertise in teaching is defined by flexibility, innovation, and the ability to respond effectively to non-routine situations. This differs from routine expertise, which

emphasizes efficiency and mastery of established practices. Adaptive expertise in education involves ongoing reflection, continuous learning, and responsiveness to the diverse and dynamic needs of students.

Several key characteristics of adaptive expertise in K-12 education emerge from the research papers included in the review:

*Student-Centered Focus*: One of the fundamental characteristics of adaptive expertise is a shift from focusing on what the teacher is doing to students' learning (Anthony *et al*., 2015). Teachers consider not only their students' academic progress, but also their overall engagement, their motivation, as well as their well-being (Newberry and Hinchcliff, 2024). Teachers displaying adaptive expertise develop and build on relationships with their students which foster student agency and an environment where learners take responsibility for their own learning (Bowers *et al*., 2019).

*Cognitive flexibility to balance routine with innovation*: Teachers with adaptive expertise are able to adjust their methods and strategies based on the changing needs of their students. This entails that these teachers move beyond routine practices to meet students where they are and guide them toward higher-order thinking. Teachers showing cognitive flexibility in teaching notice when traditional instructional strategies fail and are open to adapting, rethinking, and innovating in the classroom either on the spot or planning forward to better serve students (Baldinger and Munson, 2020; den Hertog *et al*., 2023; Moran *et al*., 2023; Saleh *et al*., 2023; Soslau, 2012; Von Esch and Kavanagh, 2017; Walsh *et al*., 2023).

Adaptive expertise implies teachers are both adept at routine tasks and able to adapt prior knowledge to new situations. Instructional challenges are approached by adaptive experts by questioning familiar solutions and designing creative solutions rather than resting on established routines (Lee *et al*., 2014; Moran *et al*., 2023; Von Esch & Kavanagh, 2017). They engage willingly with the opportunity to experiment and take risks in implementing innovative solutions, motivated by the intention to improve student outcomes (Ebby *et al*., 2023; Wetzel *et al*., 2015). However, this does not negate the need for routine expertise to manage predictable classroom situations. This duality is crucial for maintaining an effective learning environment where both efficiency and creativity are valued. Teachers who are able to combine both procedural knowledge or routine practices, with innovative problem-solving, engineer learning environments where the needs of all learners may be met (Anthony *et al*., 2015; Meneses *et al*., 2023; Moran *et al*., 2023; Walsh *et al*., 2023).

*Metacognitive awareness*: Reflective practice is integral to the development of adaptive expertise. Adaptive experts' reflection on the impact their teaching practices have on student learning is ongoing. Teachers with adaptive expertise display the metacognitive awareness which allows them to constantly fine-tune their teaching strategies and improve the effectiveness of their students' learning experiences (Anthony *et al*., 2015; Von Esch & Kavanagh, 2017; Moran *et al*., 2023). Inquiry is an essential element of this practice, as it allows teachers to evaluate their impact in the classroom in order to make any necessary amendments to meet students' needs (Wetzel *et al*., 2015). Inquiry-based reflection enables educators to assess their effectiveness continually, fostering a culture of improvement within the classroom.

**Research Question 2:**

***How can adaptive expertise in K-12 education be developed?***

A non-threatening environment encouraging innovation and reflection has been identified as beneficial to the development of adaptive expertise in teaching. The following specific elements emerge from the literature in determining how to foster adaptive expertise in K-12 education:

*Practice-Based Pedagogies*: In both preservice and in-service settings, teacher education programs benefit from practice-based pedagogies to develop adaptive expertise. This approach allows teachers to go through the process of observing, reflecting and refining their practice (Anthony *et al*., 2015; Von Esch & Kavanagh, 2017). Strategies including micro-teaching and peer-feedback create a supportive environment where teachers feel safe to take risks and implement new strategies, developing a "flexible knowledge base" (Anthony *et al*., 2015) they can start to draw from in dealing with novel situations.

*Reflective Inquiry and Continuous Feedback*: Providing opportunities for inquiry-based reflection is an essential element of developing adaptive expertise. Indeed, it is through inquiry that teachers are led to questioning their routine practices and engage in noticing how their teaching strategies impact student learning (Warren & Kersten-Parrish, 2022; Anthony *et al*., 2015). The social nature of learning, emphasized by Moran and colleagues (2023), is supported by structured training programs including peer-feedback and based on real-time data and student outcomes so teachers learn to adapt and improve their teaching practices (Ebby *et al*., 2023; Moran *et al*., 2023).

*Mentorship and Collaboration*: When approached with structured tools, such as discursive tools specifically designed to frame reflective conversations, the collaboration between novice teachers and their experienced mentors plays a crucial role in supporting the development of adaptive expertise (Hunskaar & Gudmundsdottir, 2023). It is essential for mentors to actively demonstrate qualities such as flexibility, innovation, and student-centered practices. By embodying these characteristics, mentors create an environment where novice teachers feel supported and encouraged to develop these skills themselves. Moreover, peer collaboration serves as a significant booster for adaptive expertise. This collaborative approach creates a dynamic platform for collective problem-solving, where educators can engage in meaningful discussions and share multiple perspectives on various teaching challenges. Such interactions foster a rich exchange of ideas, enabling novice teachers to learn from the experiences of their peers and mentors alike (Gravett *et al*., 2023; Meneses *et al*., 2023; Moran *et al*., 2023; Von Esch & Kavanagh, 2017). Through this collaborative process, novice teachers can refine their practice, adapt to diverse classroom situations, and ultimately enhance their effectiveness as educators.

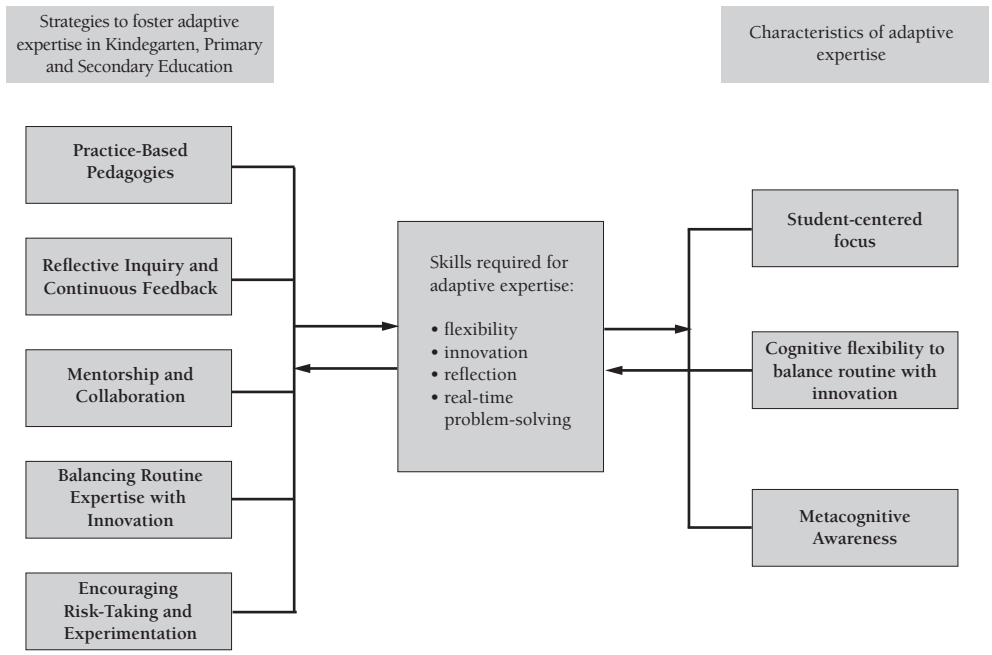
*Balancing Routine Expertise with Innovation*: For teachers to balance the acquisition of routine expertise with opportunities to innovate, teacher professional development must include both. Teacher preparation programs and in-service training that integrate routine tasks, such as lesson planning and classroom management, with more creative and flexible problem-solving tasks encourage teachers to move beyond routine proficiency and embrace adaptability (Anthony *et al*., 2015). This can for instance be fostered through the integration of new technological tools

(Moran *et al*., 2023). Bowers and colleagues also highlight that it is through the tension arising between the structure imposed by a set curriculum and time constraints (requiring routine expertise) and the need to respond to students' needs which leads to creative solutions and thus adaptive expertise (Bowers *et al*., 2019).

*Encouraging Risk-Taking and Experimentation*: Creating and nurturing a professional learning environment where teachers are not only aware but also empathetic to the fact that their colleagues face similar challenges, without any form of judgment, is conducive to educators feeling safe and secure enough to take risks and experiment with innovative teaching approaches. When teachers perceive their environment as supportive, they are more likely to step outside their comfort zones. Professional development programs that emphasize the value of reflective practice and experimentation are instrumental in shaping this positive mindset. These programs encourage teachers to view mistakes not as failures but rather as valuable opportunities for growth and learning. Research conducted by Ebby *et al*. (2023), Gravett *et al*. (2023), and Moran *et al*. (2023) underscores the importance of these principles in professional development. Their findings suggest that when teachers engage in reflective practices, they are better equipped to analyze their experiences critically, leading to more informed decisions in their classrooms. This continuous cycle of reflection and experimentation ultimately enhances the quality of education that students receive.

Figure 3 summarises the findings through a theoretical representation. Strategies to foster adaptive expertise in K-12 education both feed into and are supported by the skills and characteristics needed to demonstrate adaptive expertise.

**Figure 3. Theoretical representation of the results**



## Discussion

While the literature shows in-service teaching training can support the development of adaptive expertise, including explicit expectations in regard to reflective skills for prospective teachers may help schools in hiring teachers who will be better equipped to meet the needs of all students (Gravett *et al*., 2023). It is to be noted that there is some evidence that second-career teachers who had the opportunity to develop these skills in their prior career may bring them to their new classroom setting (den Hertog *et al*., 2023, Lee, 2011).

Non-language teachers teaching subject-specific content to English Language Learners are faced with the challenge of needing to adapt and move beyond their routine expertise. The dual focus on teaching a set curriculum while making the course content accessible to students at different levels of language proficiency implies both being skilled in routine expertise and adaptive expertise (Von Esch & Kavanagh, 2017; Newell *et al*., 2017). In some contexts, where innovation may be hindered by expectations of strict compliance to external assessment objectives, especially in upper High School, teachers may face particular challenges in adapting instruction. Furthermore, the COVID-19 pandemic put to the fore the importance of adaptive expertise (Newberry & Hinchcliff, 2024, Schipper *et al*., 2020). Therefore, the literature clearly emphasizes the need for professional development supporting reflection, inquiry-based learning in real classroom situations and collaborative problem-solving (Anthony *et al*., 2015; Gravett *et al*., 2023). Besides, effective professional development should not only focus on content knowledge but also on pedagogical skills that foster adaptive expertise. For instance, a study by Bowles *et al*. (2023) found that professional development programs that incorporate collaborative learning and reflective practices significantly enhance teachers' ability to adapt their teaching strategies in real-time. This aligns with previous research suggesting that teachers who engage in reflective practice are better equipped to respond to diverse classroom dynamics (Tsui, 2009; Männikkö & Husu, 2019).

## Conclusion and Limitations

Adaptive expertise in teaching is defined by flexibility, innovation, and responsiveness to non-routine situations, setting it apart from routine expertise, which focuses on efficiency and established practices. Adaptive teachers prioritize student learning and well-being (Anthony *et al*., 2015; Newberry and Hinchcliff, 2024; Bowers *et al*., 2019), adapt their methods to meet changing needs (Baldinger and Munson, 2020; den Hertog *et al*., 2023; Moran *et al*., 2023; Saleh *et al*., 2023; Soslau, 2012; Von Esch and Kavanagh, 2017; Walsh *et al*., 2023), and creatively solve instructional challenges (Lee *et al*., 2014; Moran *et al*., 2023; Von Esch & Kavanagh, 2017; Ebby *et al*., 2023; Wetzel *et al*., 2015). They balance routine expertise with innovation to address all learners' needs (Anthony *et al*., 2015; Meneses *et al*., 2023; Moran *et al*., 2023; Walsh *et al*., 2023), and engage in ongoing reflective practice characterized by metacognitive awareness to continually improve their teaching (Anthony *et al*., 2015; Von Esch & Kavanagh, 2017; Moran *et al*., 2023; Wetzel *et al*., 2015).

Adaptive expertise in K-12 education is developed by fostering a supportive, reflective environment where teachers feel safe to innovate and take risks. Key strategies include practice-based

pedagogies like micro-teaching and peer feedback (Anthony *et al*., 2015; Von Esch & Kavanagh, 2017), opportunities for inquiry-based reflection and continuous feedback (Warren & Kersten-Parrish, 2022; Anthony *et al*., 2015; Ebby *et al*., 2023; Moran *et al*., 2023), and structured mentorship and collaboration (Hunskaar & Gudmundsdottir, 2023; Gravett *et al*., 2023; Meneses *et al*., 2023; Moran *et al*., 2023; Von Esch & Kavanagh, 2017). Balancing routine expertise with innovation, often supported by new technologies, and encouraging risk-taking and experimentation are also essential for developing adaptive expertise (Anthony *et al*., 2015; Moran *et al*., 2023; Bowers *et al*., 2019; Ebby *et al*., 2023; Gravett *et al*., 2023).

In the review published by Parsons and colleagues, focusing on diverse ways of referring to adaptive teaching from 1975 to 2014, it was noted that the field was fragmented due to the varied terminology and methodologies. This systematic review endeavored to provide a more homogeneous picture of research, focusing specifically on the phenomenon referred to as adaptive expertise, and concentrating solely on qualitative research. Nevertheless, the same findings come to the fore, with an acknowledgment of the importance of metacognition and professional development to support the development of adaptive expertise.

While this review included studies involving both preservice and in-service participants, Moran and colleagues highlight a need to explore the long-term impact of preservice training aimed at developing adaptive expertise. Also, the scarcity of articles focused on ELL instruction reinforces the need for further research in developing adaptive expertise in this particular context, as mentioned at the beginning of this article.

This study has potential limitations. Firstly, a number of the studies included in this review were conducted on small samples, which may impact on the validity of their findings. Furthermore, there is a lack of balance in the representation of different regions, with the majority of studies having been carried out in the US. This has implications for the environment in which participants are observed, with some countries being less flexible with how curricula are taught and assessed. Hanushek (2021) warns against comparisons between research outcomes stemming from different educational systems, noting that cultural and systemic differences can significantly influence teaching practices and their effectiveness.

Another limitation lies in the fact that this review was researched by one person and only one database was explored. While this was mitigated by justifying the choice of Web of Science and the use of transparent frameworks such as PRISMA and SPIDER, as stated earlier in this paper, the reliance on a single researcher may introduce biases in interpretation and analysis, while utilizing only one database limits the scope of literature reviewed. Future systematic reviews should consider incorporating multiple databases and diverse perspectives to provide a more comprehensive understanding of adaptive expertise across various educational contexts.

In conclusion, while this systematic review contributes valuable insights into the characteristics and development of adaptive expertise among educators, it also highlights significant gaps in current research. The need for longitudinal studies examining the long-term impacts of preservice training on adaptive expertise is critical for informing teacher education programs. Additionally, further exploration into how contextual factors influence adaptive teaching practices will enhance our understanding of effective instructional strategies for diverse learners, particularly ELLs.

As education continues to evolve in response to societal changes and increasing diversity within classrooms, fostering adaptive expertise among teachers will be essential for meeting students' varied needs. Ongoing professional development that emphasizes reflective practice, collaboration, and innovation will be key components in preparing educators for the complexities of modern teaching environments. By addressing these gaps and limitations identified in this review, future research can contribute to a more robust framework for understanding and enhancing adaptive expertise within educational settings.

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# Appendix

**SPIDER framework applied to the studies**

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Preparing Mainstream Classroom Teachers of English Learner Students: Grounding Practice-Based Designs | Von Esch, K., Kavanagh, S. | USA | Primary | Math and English | pre-service | not specified | Pre-service teachers from Seattle University, USA. | Investigating how practice-based designs help prepare teachers to teach English Learner students in mainstream classrooms. | practice-based learning models; Studio day analysis. | Studio days help pre-service teachers integrate content and language instruction for English Learners. | Qualitative |
| Developing Adaptive Expertise in the Wake of Rehearsals: An Emergent Model of the Debrief Discussions | Baldinger, E., Munson, J. | USA | Secondary | Math | in-service | 22 | Early-career secondary mathematics teachers, USA. | Exploring how post-rehearsal debrief discussions help develop adaptive expertise in non-rehearsing teachers. | video recordings and analysis of rehearsal debrief discussions. | Debrief discussions provide opportunities for teachers to develop adaptive expertise through reflective dialogue and co-construction of meaning. | Qualitative |
| Prospective Teachers' Development of Adaptive Expertise | Anthony, G., Hunter, J., Hunter, R. | NZ | Primary | Math | pre-service | 23 | Prospective teachers from a New Zealand university. | Examining the development of adaptive expertise in prospective teachers within a classroom inquiry course. | Case study analysis with interviews, reflective journals, and classroom observations. | Adaptive expertise was developed through practice-based pedagogies and inquiry, focusing on adaptive teaching shifts. | Qualitative |
| Examining Teachers' Adaptive Expertise through Personal Practical Theories | Männikkö, I., Husu, J. | Finland | Primary | Math | in-service | 17 | Finnish primary school teachers. | Exploring how teachers' adaptive expertise develops through their personal practical theories. | Stimulated recall interviews with video recordings and inductive coding. | Teachers' adaptive expertise varied depending on their teaching orientations and classroom observations. | Qualitative |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Learning to Teach Responsively Through Asynchronous Collaborative Discourse Around Video Records of Practice | Caroline B. Ebby, Janine T. Remillard, Lindsay T. Goldsmith-Markey. | USA | Primary | Math | in-service | 11 Early-career teachers (PreK-Grade 1 teachers), 5 first-year teachers, 6 with 1-5 years of experience, mostly from low-income schools. | The study explores how early-career teachers engage in collective deliberation and implement responsive teaching practices through asynchronous video-feedback inquiry groups. | Participants posted teaching videos and feedback on a platform. Feedback was peer-reviewed and tagged to specific moments, with cycles of recording, posting, and commenting. | Findings suggest asynchronous video feedback promotes dialogic conversations that support the growth of responsive teaching, highlighting peer feedback as a key element. | Qualitative |
| Developing pre-service teachers' adaptive expertise through STEM-CT integration | Moran, R.M.R., Robertson, L., Tai, C., Ward, N.A., Price, J. | USA | Primary | not specified | pre-service | 49 PSTs from public university in southern U.S. with K-5 placements. | The development of adaptive expertise in pre-service teachers through STEM-CT integration. | Ethnographic study with focus group interviews, observations, and analysis of lesson plans. | Adaptive expertise developed through collaboration with mentors and integration of STEM-CT curriculum. | Qualitative |
| Developing as a literacy teacher: sense-making and ownership in an online course | Warren, A.N., Kersten-Parrish, S. | USA | Kindergarten to Secondary | literacy | pre-service and in-service | 13 Participants in an online Master's literacy program, majority female. | Investigating how literacy teachers develop sense-making and ownership over word study practice. | Analysis of video-mediated discussions, focus groups, reflective journals. | Peer collaboration increases ownership of word study practices, helping build adaptive expertise. | Qualitative |
| Adaptive Expertise in the Teaching and Learning of Literary Argumentation in High School Language Arts | George E. Newell, Brent Goff, Eileen Buescher, Larkin Weyand, Theresa Thanos, SuBeom Kwak. | USA | Secondary | English | in-service | 1 High school English Language Arts (ELA) teacher and students (11th grade IB, 26 students; 16 White, 10 of other ethnicities). | Investigating how adaptive expertise in teaching literary argumentation unfolds in ELA classrooms over time. | Ethnographic-oriented methods, including interviews with teachers and students, video recordings of classroom observations, field notes, and analysis of classroom work. | Adaptive teaching of argumentation shifted from structural concerns (Toulmin model) to focusing on using argumentation as a tool for deeper literary analysis and understanding. | Qualitative |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Neuroscience Foundations In Teacher Professional Development Delivers Unexpected Adaptive Expertise Outcomes | Timothy Kieran O'Mahony, Conn McQuinn, Jenny Williamson, Nathan Abe, Helen Buckland, Susanna Cunningham. | USA | Secondary | multiple subjects | in-service | 125 Middle school teachers from the Puget Sound Educational Service District in Washington. Participants were teams of teachers, including science, mathematics, English, and other educators from Title 1 schools (low-income). | To investigate the impact of neuroscience knowledge on teaching practices and adolescent learning, focusing on adaptive expertise among teachers. | Mixed-methods design including pre- and post-surveys, qualitative ethnographic descriptions, video and audio recordings, observations, and discourse analysis. | The study found that teachers who gained neuroscience knowledge showed improvements in adaptive expertise and applied brain-centric models to improve classroom practices. They experienced shifts in mindset and teaching capacity. | Mixed methods (both quantitative and qualitative) |
| Validating a model for assessing science teacher's adaptive expertise | Yoon, S.A., Evans, C., Miller, K., Anderson, E. | USA | Secondary | Science | in-service | 10 High school science teachers and 351 students from diverse U.S. classrooms. | Validating a model of adaptive expertise in science teachers using computer-supported systems. | Mixed methods: Classroom observations, teacher interviews, coding, and regression analysis of student performance. | Adaptive expertise linked to better student learning in complex systems. | Mixed methods |
| Learning to become a teacher: student teachers' experiences and perceptions of a one-year initial teacher education programme | Sarah Gravett & Rika Kroon. | South Africa | Secondary | not specified | pre-service | 210 Student teachers enrolled in a PGCE program at a metropolitan university in South Africa. 15 graduates participated 18 months after completing the program. | Explore how a one-year ITE program equips prospective teachers for local challenges and a fast-changing world. | Data were collected via focus-group interviews, reflective journals, individual interviews, WhatsApp messages, and questionnaires. | The study found that student teachers developed basic knowledge for practice and reflective practice but felt unprepared for classroom management and lacked practical pedagogical skills. | Qualitative and quantitative (mixed methods). |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Exploring the Relationship Between Attitudes of Preservice Primary Science Teachers Toward Integrated STEM Teaching and Their Adaptive Expertise in Science Teaching | Mounir R. Saleh, Bashirah Ibrahimm & Ernest Afari. | Bahrain | Primary | Science | pre-service | 91 PSTs in their fourth year of the primary science teaching program. Fourth-year PSTs were purposely sampled to ensure minimal domain expertise. | Adaptive expertise in science teaching is a potential factor that is positively related to teachers' attitudes toward iSTEM teaching. | Surveys. | Adaptive expertise in science teaching is a potential factor that is positively related to teachers' attitudes toward iSTEM teaching. | Qualitative |
| Practice-based 21st-century teacher education: Design principles for adaptive expertise | Alejandra Meneses, Miguel Nussbaum, María Graciela Veas, Silvana Arriagada. | Chile | Primary | literacy | pre-service | 51 Prospective teachers from an elementary education program at a university in Santiago, Chile. 14 participants were analyzed in depth. | To explore the design principles for adaptive expertise in practice-based 21st-century teacher education, focusing on core practices and pedagogical reasoning. | Design-Based Research (DBR) approach. Data was collected through instructional activities (enactment task) and post-teaching reports (written analysis). | The study proposes a framework integrating core practices, pedagogical reasoning, and 21st-century skills. The participants showed progress in core practices, but critical thinking skills were less developed. | Qualitative |
| Learning-centered lesson design and learning about teaching in a pre-service teacher education course | Sarah Gravett, Dean van der Merwe. | South Africa | Primary | not specified | pre-service | 27 Student teachers. | Investigates how lesson design based on the science of learning impacts student teachers' understanding. | Semi-structured interviews, lesson analysis. | Lesson design based on the science of learning fosters adaptive expertise and deep reflection in student teachers. | Qualitative |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Surviving uncertainty: the impact of COVID-19 policies on the teaching practicum in Turkey | Gülden Taner, F. Gümüşok, G. Balıkçı, B. Ç. Başaran Uysal. | Turkey | Primary and Secondary | not specified | pre-service | 35 | 9 supervisors, 11 mentors, 35 pre-service teachers. | Examines how pandemic policies impacted teaching practicum. | Interviews, qualitative surveys. | Pandemic caused workload stress, adaptive expertise crucial for teacher learning. | Qualitative |
| Tool-based mentoring conversations in teacher education: new structures, opportunities and the role of adaptive expertise | Tove Seiness Hunskaar, Greta Bjork Gudmundsdottir. | Norway | not specified | not specified | pre-service | 7 | 5 mentors and 7 preservice teachers. | Explores mentoring conversations when applying digital and discursive tools to improve adaptive expertise. | 12 interviews. Thematic analysis of interviews. | Mentoring tools enhanced reflective mentoring conversations and developed adaptive expertise. | Qualitative |
| Navigating teacher-student relationships during and beyond the pandemic | Melissa Newberry, Elizabeth Hinchcliff. | USA | Secondary | not specified | in-service | 2 | Two teachers. | Explores teacher-student relationship-building during COVID-19. | Multiple interviews over the school year. | Teachers adapted relationship-building strategies despite pandemic constraints. | Qualitative |
| Opportunities to develop adaptive teaching expertise during supervisory conferences | Elizabeth Soslau. | USA | not specified | not specified | pre-service | 3 | 3 supervisors, 3 student teachers. | Investigates how supervisory conferences develop adaptive teaching expertise. | Case study, discourse analysis of conferences. | Supervisory discourse can foster adaptive teaching expertise if it challenges reflection and decision-making. | Qualitative |
| Teachers learning from analysis of other teachers' reading lessons | Cheryl L. Rosaen, Joanne F. Carlisle, Emily Mihocko, Andrea Melnick, Jodi Johnson. | USA | Primary | literacy | in-service | 18 | 18 teachers. | Investigates how analyzing other teachers' reading lessons develops adaptive expertise in teachers. | Interviews, video case analysis, surveys. | Teachers appreciated video analysis, but had mixed views on guided questions; some made changes in their practices. | Qualitative |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Retooling Asian-Pacific teachers to promote creativity, innovation and problem solving in science classrooms | Kar-Tin Lee, Christina Chalmers, Vinesh Chandra, Andy Yeh, Rod Nason. | China | Primary | Science | in-service | 100 primary school teachers. | Development of adaptive expertise in using technology for innovative science teaching. | Professional learning programme with workshops and reflection sessions. | Teachers developed adaptive expertise, improving pedagogical content knowledge and confidence. | Mixed-methods |
| Using an Adaptive Expertise Lens to Understand the Quality of Teachers' Classroom Implementation of Computer-Supported Reform Curricula in High School Science | Susan A. Yoon, Jessica Koehler, Joyce Wang, Emma Anderson. | USA | Secondary | Science | in-service | 3 Three high school science teachers. | Examines how adaptive expertise influences teachers' implementation of computer-supported complex systems curricula. | Case studies, classroom observations, interviews, surveys. | Teachers' levels of adaptive expertise were found to affect student engagement and curriculum implementation success. | Case study |
| Utilising previous professional expertise by second-career teachers: Analysing case studies using the lens of transfer and adaptive expertise | Gerard den Hertog * , Monika Louws, Martine van Rijswijk, Jan van Tartwijk. | Netherlands | Secondary | not specified | in-service | N/A 41 case studies from a total of 1591 articles, focusing on SCTs working in secondary education. | To understand the beneficial or hindering utilisation of previous professional expertise (PPE) by second-career teachers. | Qualitative literature study analyzing 41 case studies using concepts of transfer and adaptive expertise. | Adaptive expertise developed during the previous career impacts the beneficial use of PPE, but support for utilizing PPE is often insufficient. | Qualitative |
| Exploring Teacher Adaptive Expertise in the Context of Elementary School Science Reforms | Bowers, Nicole; Merritt, Eileen; Rimm-Kaufman, Sara. | US | Primary | Science | in-service | 5 Five fourth-grade teachers. | To analyze NGSS classroom enactments in elementary schools and to develop a model of teacher adaptive expertise in elementary science education. | Qualitative content analysis of five fourth-grade teachers enacting the same NGSS lesson. | Teacher adaptive expertise aligns with NGSS shifts and reflects student-centered science discourse. | Qualitative |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
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| Building teacher candidates' adaptive expertise: engaging experienced teachers in prompting reflection. | Wetzel, A. P., De Arment, S. T., & Reed, E. (2015). | US | not specified | Special education | pre-service | 7 ECSE and SEGE graduate programs at a southeast research university. They represented diverse roles and educational settings, including early interventionist, special educators, and school psychologists. | To explore the credibility of a reflection prompt protocol designed to elicit adaptive skills and dispositions from teacher candidates. | Engaging teacher candidates in dialogue with experienced teachers and using reflection prompts. | Reflection protocol is credible in prompting adaptive expertise in both experienced teachers and teacher candidates. | Qualitative |
| Adaptive Teaching for English Language Arts: Following the Pathway of Classroom Data in Preservice Teacher Inquiry | Athanases, Steven Z.; Bennett, Lisa H.; Wahleithner, Juliet Michelsen | USA | Secondary | English | pre-service | 96 Preservice teachers in grades 7-12 English language arts placements in mostly high poverty, highly diverse schools. | To examine how a data-based model of teacher inquiry fosters adaptive teaching in preservice teachers. | Analysis of 96 preservice teacher inquiries collected over seven years, along with questionnaires and discussions. | Data-based inquiry supports preservice teachers in making complex adaptations in literacy teaching. | Qualitative |
| Characterizing adaptive teaching expertise: Teacher profiles based on epistemic orientation and knowledge of epistemic tools | Suh, Jee K.; Hand, Brian; Dursun, Jale E.; Lammert, Catherine; Fulmer, Gavin | USA | Secondary | Biology | in-service | 12 11 experienced and 1 novice Biology teachers. | To characterize adaptive expertise in science teaching. | Empirical research studying science teaching practices and teacher adaptive expertise. | Adaptive expertise in science teaching is characterized by the ability to adapt practices to different contexts. | Empirical |

| Title of Article | Authors | Country | School division | Subject area | pre-service or in-service | participants | Phenomenon of Interest (aims) | Design | Evaluation (conclusions) | Research Type |
|---|---|---|---|---|---|---|---|---|---|---|
| Mental simulations to facilitate teacher learning of ambitious mathematics instruction in coaching interactions | Walsh, Marguerite E.; Witherspoon, Eben B.; Schunn, Christian D.; Matsumura, Lindsay Clare | USA | Secondary | Math | in-service | 8 | Four coach–teacher pairs from a larger dataset. | Use Mental Simulations for Teacher Reflection (MSTR), for advancing robust teacher learning in the context of one mathematics-focused instructional coaching intervention. | The study uses a large dataset to compare coach-teacher pairs with similar baseline instructional quality but varying improvement levels. Qualitative coding and quantitative analyses assess the difference in instructional growth and mental simulation talk quality. | Engaging teachers' in-depth pedagogical reasoning to connect specific teaching moves to conceptual learning goals in mental simulations is a key distinction of the high-growth coaches. | Qualitative and quantitative (mixed methods). |
| Mixed-Reality Simulation to Support Practice Learning of Preservice Teachers | Gravett, Sarah; Van der Merwe, Dean; Ramsaroop, Sarita; Tshabalala, Pamela; Bremner, Casey; Mello, Pumzile | South Africa | not specified | not specified | pre-service | 14 | 14 final-year preservice teachers at random within the 2022 student cohort who were pursuing a four-year Bachelor of Education degree (N = 224). | To explore the potential of mixed-reality simulation (MRS) to strengthen the practice learning experiences of preservice teachers. | focus group interviews, stimulated- recall interviews, observations, and video analysis. | MRS provides a low-risk learning environment that preservice teachers perceive as authentic. The findings also highlight the importance of coaching for maximizing MRS advantages. | Qualitative |

## Resumen

*Una revisión sistemática del desarrollo de la experiencia adaptativa de los docentes de educación infantil, primaria y secundaria*

**INTRODUCCIÓN.** Esta revisión sistemática explora el concepto de pericia adaptativa en la educación preescolar, primaria y secundaria, buscando identificar sus características clave y cómo fomentar su desarrollo. La capacidad de los docentes para ajustar sus estrategias a situaciones novedosas y complejas, equilibrando competencia rutinaria e innovación, se conoce como pericia adaptativa. **MÉTODO.** Una búsqueda en Web of Science, centrada en estudios publicados entre 2012 y 2024, identificó 112 estudios, de los cuales 28 cumplieron con los criterios de inclusión. Se empleó la lista CASP (Critical Appraisal Skills Programme) y se siguieron las normas PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) para garantizar un proceso transparente en la selección y evaluación de los artículos. **RESULTADOS.** La revisión indica que la práctica reflexiva, los métodos centrados en el estudiante, la flexibilidad y la resolución creativa de problemas son características de la pericia adaptativa. Las pedagogías prácticas, la indagación reflexiva, la mentoría y los entornos que fomenten la experimentación y el riesgo son enfoques clave para su desarrollo. **DISCUSIÓN.** Los hallazgos sugieren que los programas de formación docente deben priorizar la reflexión, la colaboración y ciclos iterativos de práctica y retroalimentación. También se recomienda incorporar tecnologías digitales para fomentar la innovación en métodos de enseñanza. Según la revisión, los docentes deben poseer pericia adaptativa para responder eficazmente a las diversas y cambiantes necesidades de los estudiantes, especialmente de los estudiantes de inglés (ELL), promoviendo eficiencia en tareas rutinarias y flexibilidad ante nuevas situaciones. Las implicaciones incluyen mejoras en la selección de personal, autoeficacia docente, desarrollo profesional para instructores de contenido que enseñan a estudiantes ELL y retención de personal.


**Palabras clave:** *Pericia adaptativa, Formación docente, Desarrollo profesional, Estudiantes de inglés, Enseñanza reflexiva.*


## Résumé

*Une Revue Systématique du Développement de l'Expertise Adaptative des Enseignants de la Maternelle, Premier et Seconde degrés*

**INTRODUCTION.** Cette revue systématique explore le concept d'expertise adaptative dans le contexte de l'éducation préscolaire, primaire et secondaire en cherchant à identifier ses caractéristiques clés ainsi que les moyens de favoriser son développement. La capacité des enseignants à ajuster leurs stratégies pédagogiques face à des situations nouvelles et complexes, en équilibrant compétence de routine et résolution innovante de problèmes, est connue sous le nom d'expertise adaptative. **MÉTHODE.** Une recherche dans la base de données Web of Science, centrée sur les études publiées entre 2012 et 2024 a identifié 112 études, dont 28 répondaient aux critères d'inclusion. La liste de vérification CASP (Critical Appraisal Skills Programme) a été utilisée et les normes PRISMA (Preferred Reporting Items for Systematic Reviews and Meta-Analyses) ont été suivies afin de garantir un processus transparent et

**reproductible de sélection et d'évaluation des articles. RÉSULTATS. La revue indique que la pratique réflexive, les méthodes centrées sur l'élève, la flexibilité et la résolution créative de problèmes sont des caractéristiques de l'expertise adaptative. Les pédagogies basées sur la pratique, l'enquête réflexive, le mentorat et les environnements qui encouragent l'expérimentation et la prise de risques sont des approches clés pour favoriser ce type d'expertise. DISCUSSION. Les résultats suggèrent que les programmes de formation des enseignants doivent accorder la priorité à la réflexion, à la collaboration et à des cycles itératifs de pratique et de rétroaction. L'intégration des technologies numériques est également recommandée pour stimuler l'innovation dans les méthodes d'enseignement. Selon la revue, les enseignants doivent posséder une compétence adaptative afin de répondre efficacement aux besoins divers et changeants des élèves, notamment ceux des apprenants de l'anglais, en promouvant à la fois l'efficacité dans les tâches routinières et la flexibilité face à de nouvelles situations. Les implications incluent des améliorations dans le recrutement du personnel, l'auto-efficacité des enseignants, le développement professionnel des enseignants de matières travaillant avec des élèves ELL, ainsi que la rétention du personnel.**

**Mots-clés :** *Expertise adaptative, Formation des enseignants, Développement professionnel, Apprenants de l'anglais, Enseignement réflexif.*

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