Strategies That Promote Critical Thinking During K–12 Educators' Professional Development Experiences

Colt Turner

The central aim of this narrative literature review was to develop a deeper understanding of the models and practices that professional development leaders can adopt to support the growth of preservice and practicing K–12 educators' critical thinking skills. The review synthesized core ideas from extant literature at the intersections of adult learning, critical thinking, and K–12 teacher professional development. The review began with a description of the current context and challenges surrounding K–12 educators and those who provide adult learning experiences for teachers. An examination of key terms and primary models of critical thinking were included. Essential practices for developing critical thinking skills in adult learners were explored as well. The review concluded with six implications for facilitators of teacher professional development experiences as well as a discussion of possible areas for further research.

Keywords: adult learning, critical thinking, educator professional development, preservice teacher education, teacher education preparation, teacher learning

According to a 2022 poll of National Education Association members, approximately 55% of educators said they were more likely to leave the K–12 teaching profession earlier than planned. This number is almost double what it was in the months preceding the COVID-19 pandemic. Additionally, these bleak figures were corroborated by the September 2022 report of the National Center for Education Statistics, which included that more than half of U.S. public schools began the 2022–2023 school year understaffed. The most indicated reason (69%) for the staffing shortage was a lack of qualified teacher candidates for available positions (National Center for Education Statistics, 2022). Findings from Nguyen et al. (2022) further provided conservative estimates that over 163,000 U.S. teacher positions for the 2022–2023 school year were occupied by underqualified teachers. Despite the inherent challenges associated with this startling education workforce data, some opportunities exist for adult learning leaders to rethink teacher training and development approaches amid the clear need for increased professional learning and support for preservice and practicing educators. A focus on teacher professional development structures presents a chance for those responsible for organizing learning experiences to consider how they are preparing K–12 educators to maximize their effectiveness in the classroom by regularly applying critical thinking skills as they plan for and facilitate student learning.

In Learning Forward's 2022 revision of its professional learning standards for practicing educators, the association organized its 11 standards into three broad categories: rigorous content for each learner, conditions for success, and transformational processes. The third category—transformational processes—places a spotlight on the characteristics of learning that practitioners

engage in that not only enhance their knowledge and skills but also significantly change their mindsets. Drawing from Mezirow's (1978, 1981, 2003) work, scholars of adult learning understand that shifts in mindsets are a core component of transformative learning, and central to a learner's successful navigation of a transformative experience is the learner's intentional application of critical thinking and reflection (Cranton, 2016; Mezirow, 1990, 1998).

Purpose

Significant previous research efforts have been applied to helping K–12 educators better understand their role in cultivating their students' critical thinking skills (Fair & Fasko, 2021; LaGarde & Hudgins, 2018; Maina et al., 2016; McLean, 2005; Robinson & Knight, 2019; Sezer, 2008; Todd & O'Brien, 2016; Unrau, 2008), and much has been written in the adult learning literature regarding how critical thinking skills can be developed in adult learners (Brookfield, 2012, 2017; Fisher, 2011; Mazer et al., 2008; McGonigal, 2005; McMahon, 2005; Ouellette-Schramm, 2015; Willingham, 2008; Zwiers & Crawford, 2011). A few isolated studies have been conducted to explore how learning facilitators can promote critical thinking as preservice educators engage in program coursework (Cherubini, 2009; Han & Brown, 2013; Low et al., 2017; Qing et al., 2010; Yeh, 2007). However, further clarity is needed to support learning leaders' awareness of how they can cultivate the critical thinking skills of adult learners who teach or are preparing to teach within the K–12 context. The purpose of this review was to synthesize extant literature related to models and strategies that adult learning facilitators can apply to promote the critical thinking skills of the K–12 educators whom they serve. The research question addressed by this review was the following: What models and practices should professional development leaders adopt to support the growth of preservice and practicing K–12 educators' critical thinking skills?

Method and Organizing Structure

A narrative literature review was conducted to identity and analyze previous publications related to the review's research question. Articles and other scholarly publications were identified from the Teachers College, Columbia University digital library database. The citation chaining method was used to develop a robust collection of publications that were used to more deeply understand the research topic. The literature review begins with an overview of the context within which critical thinking was explored for this review. From there, foundational terms such as critical thinking and transformative learning are discussed. Following an exploration of many of the key models through which critical thinking can occur, the literature review examines some of the traditional practices that learning facilitators use to cultivate their learners' critical thinking skills. Further focus is placed on the critical thinking strategies that are applied to the professional development of K–12 preservice and practicing educators. The review concludes with a discussion of the implications for adult learning facilitators within the context of K–12 teacher professional development as well as possible avenues for further research on this topic.

Literature Review Context

Though teacher professional development can take many forms, the context for this review was delimited to the formal professional learning experiences that occur in two settings: K–12 educator

preparation programs and school district-provided professional development opportunities. The word *formal* is included intentionally to differentiate the learning experiences researched within this literature review from the more informal or incidental learning experiences that can occur within professional workspaces. Marsick and Watkins (1990) characterized formal learning as highly structured and organizationally sponsored whereas informal and incidental learning were described as typically occurring outside of a defined classroom setting and as highly controlled by the learner versus by an identified learning facilitator.

Title II of the Higher Education Act categorized educator preparation programs (EPPs), which are sometimes called teacher certification programs, into three types: (a) traditional, (b) alternative based at an institution of higher education, or (c) alternative not based at an institution of higher education (U.S. Department of Education, 2022). According to the National Research Council (2010), traditional EPPs typically occur at institutions of higher education (i.e., colleges and universities) that award bachelor's and graduate degrees. While alternative EPPs often enroll adult learners whose undergraduate degree is outside of the education field, traditional programs typically consist of students who are simultaneously preparing for a state teaching credential as well as pursuing a college degree that will develop their teaching skills. For the purpose of this review, research findings that examined the training of preservice educators were reviewed within the context of traditional EPPs.

District-provided professional development opportunities comprised the second context examined within this literature review. These formal, on-the-job training settings are designed for educators who already have a teaching credential and are currently teaching within a K–12 setting. Teachers participating in district-sponsored professional development may include a mix of first-year and veteran practitioners. Additionally, the literature review represents a variety of course disciplines and student age ranges (i.e., early childhood through high school). For both contexts—preservice and practicing educators—the focus of this review examined how adult learners' critical thinking skills are developed.

Critical Thinking Defined

Prior to exploring the various ways in which critical thinking skills can be cultivated, it is first essential to understand how critical thinking has been defined previously in the literature. Over a century ago, Dewey (1910) conceptualized critical thinking as an educational goal aimed at an ongoing practice of reflective thinking. In Dewey's (1910) view, critical thinking involves the development of mental habits through which learners consider beliefs or assumptions from multiple viewpoints. Sternberg (1985) further emphasized mental processes by framing critical thinking as the strategies learners use to solve problems, learn new concepts, and make decisions. Lipman (1988) suggested that critical thinking is "skillful, responsible thinking that facilitates good judgment because it relies upon criteria, is self-correcting, and is sensitive to context" (p. 39). In defining critical thinking, Paul (1993) underscored the technical actions learners take when thinking critically, which include (a) imposing criteria on thinking, (b) taking charge of how thinking is constructed, (c) adjusting thinking toward the predetermined criteria, and (d) assessing the thinking's effectiveness based upon the established criteria. More concisely framed, Paul and Elder (2009) later described critical thinking as "the art of analyzing and evaluating thinking with a view to improving it" (p. 4). In describing the various dimensions of critical thinking, Willingham (2008) suggested that critical thinking can consist of (a) observing multiple sides of an issue, (b) accepting when new evidence contradicts current claims and beliefs, (c) applying reasoning skills,

(d) insisting that claims are backed by evidence, (e) drawing conclusions from presented facts, and (f) solving problems.

Brookfield (1987) extended the act of critical thinking beyond just a function of academic processes by arguing that critical thinking requires learners to question the assumptions that underlie their everyday ways of thinking and behaving. Ennis (1987, 2011, 2016) defined critical thinking as the type of reflective thinking that is centered on what individuals do and believe whereas Halpern (2013) observed that the act of evaluating is what puts the word critical in critical thinking. Beyer (1995) addressed the role of critical thinking as a tool for solving problems, making judgments, and choosing between alternatives. Similarly, Innabi and El Sheikh (2007) noted critical thinking's presence in creative endeavors and in decision making. Speaking to the consequential value of thinking critically in daily life, Brookfield (2012) added that critical thinking is a way of being that helps individuals maintain an internal voice among the many external forces that have only their own interests at heart. Brookfield (2012) also added to this definition by sharing some nonexamples of critical thinking, which include that critical thinking is not (a) a task reserved only for individuals with a college degree or those who reach a certain age, (b) the same as being creative or solving problems, (c) the same as being critical of someone or something such as tearing an idea or person apart, or (d) associated with a person's intelligence quotient or some other measure of intellect.

Though transformative learning is less of a focus of this literature review, its close association with critical reflection within the realm of adult learning merits a brief look at how transformative learning has been defined by a couple of leading voices in the field. Mezirow (1991) described transformative learning as "the process of becoming critically aware of how and why our assumptions have come to constrain the way we perceive, understand, and feel about our world" (p. 167). Cranton (2016) suggested that transformative learning is the product of individuals' efforts to (a) critically consider their usual expectations, (b) make revisions to their perspectives, and then (c) act on their revised perspectives. In both definitions, the role of critical thinking is predominantly situated as a key function of an adult learner's growth and development.

Exploring the concept of critical reflection a bit further, Mezirow (1998) offered a distinction between the terms reflection and critical reflection. Simply stated, reflection may involve only "an awareness of an object, event, or state" (Mezirow, 1998, p. 185). Critical reflection, in contrast, adds a layer of assessment to individuals' reflective processes such that value and merit are attributed to the subjects upon which we reflect. Mezirow (1991) highlighted three different forms of critical reflection: content, process, and premise. Content reflection refers to what we perceive, feel, think, and act. Process reflection includes reflections on "how we perform the functions of perceiving" (Taylor, 2017, p. 78). Premise reflection speaks to why we perceive, feel, think, and act as we do (Mezirow, 1991).

Building on Mezirow's (1991, 1998) examination of critical reflection, Brookfield (2000) conceptualized four traditions of critical reflection. The first tradition is the ideology critique, which as the name implies centers on the way dominant ideologies inherently affect systems. Brookfield's (2000) second tradition is critical reflection on early life traumas, which often involves a self-examination of feelings and relationships. The third tradition, analytic philosophy, leverages logic, judgment, opinion, and evidence when evaluating various perspectives. Finally, the pragmatism tradition highlights how critical reflection supports individuals as they make meaning of experiences and question assumptions.

Key Models of Critical Thinking in Adult Learning

As evidenced by the myriad definitions of critical thinking synthesized above, the literature includes a variety of models through which critical thinking skills can be exercised. While it may be argued that no singular critical thinking model is without fault, Jones and Haydon (2012) suggested that understanding each model's characteristics—including the model's strengths and limitations—is necessary for a few key reasons. First, uniformly adopting a critical thinking model helps learning leaders ensure that professional development experiences across an organization are aligned. An identified model also allows learners to use a common language for communicating about critical thinking from one learning experience to the next. In addition, having an official model for developing critical thinking skills promotes efficiency for those who support learning initiatives within an organization as they work with stakeholders—staff and students—across disciplines. In addition to these compelling reasons, Paul (1995) noted the need for structured processes for critical thinking skill development to combat what Paul termed pseudocritical thinking, which is flawed thinking or reasoning that is presented as sophisticated or intellectual.

Examining Assumptions

Brookfield (1987, 2012) offered a four-faceted approach to thinking critically that includes (a) hunting assumptions (i.e., discovering previously unearthed assumptions that impact individuals' actions and thoughts), (b) checking assumptions (i.e., determining if the assumptions one has are reliable and valid foundations for thinking and behaving), (c) leveraging different viewpoints (i.e., seeing if assumptions make sense from multiple angles), and (d) taking informed action (i.e., analyzing and using evidence to guide the choices and decisions one makes). In brief summary, Brookfield (2012) explained that critical thinking occurs as a product of a person's intentional efforts to evaluate their assumptions and take actions that align with anticipated results.

Brookfield (2017) provided further clarity on the term assumption. In particular, Brookfield (2017) noted three types of assumptions that commonly exist: paradigmatic, prescriptive, and causal. Paradigmatic assumptions influence how a person makes sense of the world. Brookfield (2012) asserted that paradigmatic assumptions are often the most difficult for a person to uncover as they are deeply rooted in individuals' belief systems. Related to paradigmatic assumptions, prescriptive assumptions inform how a person determines the most appropriate outcome of a situation (Brookfield, 2017). The third type of assumptions, causal assumptions, deal with how various aspects of the world work. Brookfield (2012) argued that causal assumptions are the simplest to uncover and the most common to occur.

In addition to the four facets of critical thinking, Brookfield (1987) identified the following five phases of critical thinking: trigger event, appraisal, exploration, developing alternative perspectives, and integration. The trigger event, which is closely aligned with Mezirow's (1978) concept of a disorienting dilemma and McGonigal's (2005) description of an activating event, represents an unexpected occurrence that prompts confusion and discomfort within a person. During the appraisal phase, an individual assesses a situation to determine and clarify the problem (Brookfield, 1987). As McLean (2005) noted, the appraisal phase may involve self-scrutiny as well as the solicited advice of others to help the individual make sense of the disequilibrium caused by the trigger event. During the third phase of exploration, individuals begin considering and testing out alternative ways of addressing the situation. This leads to developing alternative perspectives, which is when Brookfield (1987) argued that individuals identify what they consider

to be the best solution to their dilemma. The final phase involves the integration of new ways of thinking into the person's daily life.

A Taxonomy of Critical Thinking

Ennis's (1987) early work contributed to the discussion around critical thinking by developing a taxonomy of critical thinking abilities and dispositions. In particular, Ennis (1987) categorized 12 abilities into four areas of critical thinking. The four basic areas are interaction, inference, basis, and clarity. Each of the four areas include varying amounts of subcomponents, which range from elementary to advanced characteristics. More recently, Ennis (2016) extended this work around critical thinking by organizing considerations into a framework of 12 dispositions and five general abilities. Examples of the dispositions are that critical thinkers are (a) open-minded, (b) well-informed, (c) sensitive to the possibility of alternative explanations of phenomenon, (d) oriented toward the use of credible sources, and (e) prone to take and possibly change positions based upon sufficient evidence and logical reasoning. The five general ability categories suggested by Ennis (2016) are (a) basic clarification (e.g., focusing on a question, asking and answering clarifying questions, and analyzing arguments); (b) bases for decision making (e.g., evaluating the credibility of a source and using existing background knowledge); (c) inference (e.g., offering and evaluating arguments that stem from both inductive and deductive patterns of reasoning); (d) advanced clarification (e.g., addressing and evaluating previously unchecked assumptions); and (e) nonconstitutive (e.g., employing rhetorical strategies).

Informed Judgment

Lipman (1988) offered a different lens into how critical thinking occurs. Emphasizing the connection between the terms criteria and critical, Lipman asserted that a person's capacity to think critically is reliant upon their understanding of clear criteria from which they can make informed judgments. As Mclean (2005) noted, Lipman's focus on criteria is an element that was missing from the taxonomy outlined by Ennis (1987). According to Lipman, examples of criteria include laws, standards, precepts, principles, conventions, objectives, and policies. Lipman also suggested that a central characteristic of critical thinking is that it is self-correcting, meaning that a person's inquiry into assumptions naturally results in the identification and rectification of faulty ways of thinking and behaving. A third component of thinking critically in Lipman's view is that it is sensitive to context. By context, Lipman meant (a) irregular or exceptional conditions or circumstances; (b) constraints, special limitations, or contingencies; (c) general configurations; (d) the possibility that some meanings do not transfer from one domain to another; and (e) the possibility that no patterns in evidence exist.

Halpern (1998) proposed a four-part model for learning and teaching with critical thinking in mind. Part one includes addressing the dispositional characteristics of learners that prepare them for cognitive exercises. Part two of Halpern's (1998) model involves explicit instruction in critical thinking skills. Part three of the model focuses on how arguments and problems are structured. Attention in this third area promotes transfer of critical thinking skills across contexts. Finally, part four of Halpern's (1998) model leverages learners' metacognitive skills as they self-evaluate their progress toward anticipated outcomes.

Reflective Judgment

Grounding their work in earlier foundations of reflective thinking by scholars such as Dewey (1933) and Kohlberg (1969), King and Kitchener (1994) constructed what they termed the reflective judgment model as a way to conceptualize how reflective thinking—an integral component of critical thinking—is developed in adult learners. Love and Guthrie (1999) noted that among its benefits, the reflective judgment model provides opportunities to practice examining issues from multiple, differing perspectives. Similar to Kohlberg's moral development theory, King and Kitchener's reflective judgment model is stage-based and includes a set of descriptive characteristics that define each of the model's seven stages. Also akin to Kohlberg's use of moral dilemma scenarios, King and Kitchener's model employs ill-structured problems—complex issues with unclear outcomes—to illicit participant responses that assist with pinpointing an individual's developmental level.

The first three stages of the reflective judgment model align with what King and Kitchener (1994) called the prereflective thinking level. Individuals who fall within this phase typically do not experience anxiety in responding to ill-structured problems because they do not perceive that the problems have grey areas or complex dimensionality; rather, they perceive that one right answer—whether or not they know that answer—exists for every question or problem. The second level of the model, quasireflective, includes stages four and five. At this level, respondents to ill-structured problems perceive that knowledge is subjective and that they cannot know for certain how best to address given challenges. Stages six and seven comprise King and Kitchener's final level: reflective. Demonstrating a more sophisticated way of thinking, individuals at the reflective level are able to generate well-reasoned claims and defensible conclusions to the ill-structured problems that are presented to them.

Nosich (2009) also leveraged the power of reflective thinking in a four-pronged model of critical thinking. Like Lipman (1988) and Paul and Elder (2009), Nosich (2009) observed that critical thinking involves standards by which thinking can be evaluated. Moreover, Nosich (2009) noted that critical thinking is authentic, is reflective, and requires the use of reason. In addition to advocating for these four characteristics of critical thinking, Nosich (2005) criticized two other common models for engaging students in critical thinking experiences across a college's curriculum: the one-of-many model and the cover-as-much-content-as-possible model. In the one-of-many model, learning facilitators incorporate critical thinking exercises as an instructional delivery approach. As its name implies, the cover-as-much-content-as-possible model includes a host of key topics and concepts but does not delineate which learning elements are central to the course and leaves little room for learners to develop critical thinking skills. According to Nosich (2005), neither model allows students opportunities to substantively engage in critical reflection.

Practices for Cultivating Adult Learners' Critical Thinking Skills

Adult learners' critical thinking skills can be nurtured at various levels and in many ways within a program. From a systems perspective, certain programmatic decisions can be instrumental in fostering a culture of critical thinking for learners. Concrete strategies can be embedded within learning experiences to help adult learners form habits of critical thinking. Moreover, assessment of critical thinking practices is crucial as learning leaders consider what future adjustments can be made to further strengthen learners' critical thinking experiences.

Program-level Decisions that Promote Critical Thinking

A programmatic consideration for cultivating adult learners' critical thinking skills is to naturally embed practice experiences within existing program curricula (Brookfield, 2012; Willingham, 2008). Swartz (2000) argued for critical thinking instruction to be considered within all dimensions of academic programs and represented at the program, course, and lesson plan levels. Similarly, Mazer et al. (2008) highlighted the importance of connecting critical thinking expectations to particular activities within a course or workshop rather than framing them as stand-alone learning events. Thomas et al. (2007) recommended scaffolding learners' thinking complexity over time with organizing frameworks such as Bloom's (1956) taxonomy. Broadbear (2012) highlighted the value of applying criteria for assessing thinking and embedding critical thinking self-assessment opportunities within learning offerings. It is important to note that though the literature concurs that critical thinking is best taught as an integrated part of a wider curricular program, Friedel et al. (2008) and Willingham (2008) concluded that the explicit rather than implicit teaching of critical thinking skills results in learners' greater capacity to apply critical thinking in given scenarios. Among other strategies, Brookfield (2012) suggested the use of critical thinking audits to help learners pause and consider various dimensions of their current learning journey. Example questions asked during a critical thinking audit could be the following: "Which of the assumptions covered so far are primarily paradigmatic? How is power being exercised in this area? What assumptions have been confirmed? What evidence is most open to question? Whose voices are missing from this work?" (Brookfield, 2012, p. 176).

Beyond how experiences are organized within a program, care should be given to the conditions that exist within a learning space to optimize learners' feeling of security as they engage in critical thinking. These conditions should be established early on and can be accomplished by facilitators clearly stating the intent for learning and transparently sharing their own experiences with critical thinking (Brookfield, 2012). Discussion protocols can also help critical conversations maintain focus and efficiency while promoting a culture of inquiry and reflection (Allen et al., 2018). As a way to maintain ideal environments for critical thinking skills to be practiced, facilitators may consider the developmental characteristics of their learners. Drago-Severson and Blum-DeStefano (2016) noted, for example, that it is often helpful to differentiate feedback during discussions to align messages with the characteristics of the intended receivers thereby meeting learners where they are.

Strategies to Promote Critical Thinking

Intentional modeling is among the many practical ways that Brookfield (2012) suggested that learning facilitators can support adult learners' development of critical thinking skills. Modeling can take many forms. One activity that Brookfield (2012) described was speaking in tongues, which involves the learning facilitator explaining a concept through various lenses. Modeling can also occur through the creation of assumption inventories. To compile assumption inventories throughout professional development experiences, learning facilitators periodically pause and think aloud about the assumptions—paradigmatic, prescriptive, or causal—that have informed their instructional approaches up to that point. In coteaching environments, the point-counterpoint method can be used to model critical thinking by demonstrating that there is often more than one correct way to interpret and solve a problem (Boggs & Chatfield, 1995; Brookfield, 2012). During point-counterpoint discussions, instructors demonstrate how to critically analyze another person's

argument through respectful disagreement (Brookfield, 2012). Related to point-counterpoint is the devil's advocate strategy, which allows learning facilitators to individually present multiple sides of an argument, sometimes even physically moving from one side of the room to the next to represent the opposing opinions being shared. The use of critical incident questionnaires also allows instructors to think aloud about their responses to student feedback (Brookfield, 2012).

A foundational strategy instructors can use when supporting learners' critical thinking skills is to call attention to the credibility of sources, claims, and evidence when making arguments. In fact, some researchers such as Willingham (2008), included evidence-backed claims as a defining characteristic of critical thinking. Sometimes, as Fisher (2011) explained and poll data has supported (Anderson & Rainie, 2017), explicit guidance is needed regarding best practices for collecting reliable information from online sources. While misleading and inaccurate information sources may abound, so too do guides for helping leaners determine source credibility. In addition to providing a curated list of lesson plans, tools, and resources that learning facilitators can use to promote media literacy, LaGarde and Hudgins (2018) identified four skill sets that learners should possess today to ensure that they are critical consumers of information. These skills include (a) owning individual biases, (b) detecting and avoiding clickbait, (c) verifying the authority of sources, and (d) making efforts to triangulate evidence (LaGarde & Hudgins, 2018).

Brookfield (2012) argued that "asking questions is at the heart of critical thinking" (p. 195). Monrat et al. (2022) concluded that the use of open-ended questions is a practical means of developing the critical thinking skills of learners at all achievement levels. One reason for this is that carefully constructed questions can help clarify for students the assumptions that may not be evident to them (Brookfield, 2012; McGonigal, 2005). Additionally, questions can help learners evaluate evidence used to support assumptions and can help frame alternate perspectives during discussions (Brookfield, 2012). It is relevant to note, though, that not all questions are created equal. As Santoso et al. (2018) observed in their study findings, learners' regular interactions with questions representing more sophisticated levels of thinking such as those that require predictions, evaluations, and inferences result in more advanced levels of critical skill development. Accordingly, thought should be given to both the formation and timing of questions designed to encourage critical thinking.

In addition to helping learners unearth and evaluate assumptions, well-crafted questions can also encourage critical discourse that can lead to students' sharpened intellectual agility (Brookfield & Preskill, 2005). In a study aimed at better understanding the effects of structured debates on the high-level thinking skills of tertiary students, Spaska et al. (2021) found that students scored higher on domains of analytical thinking after taking part in a debate-centered instructional model. Reznitskaya et al. (2007) recognized oral interaction as a central vessel for helping learners of all ages develop critical thinking skills. Aligned with Vygotsky's (1978) thoughts on the social nature of learning, Zwiers and Crawford (2011) embraced the role that discourse plays in advancing democracy by calling attention to skills such as scrutinizing, validating, and criticizing that are employed when learners participate in critical conversations. Also acknowledging discourse as a key social aspect of transformative learning, McGonigal (2005) listed four ways that adult learners can use conversations to critically reflect: (a) facilitate whole- or small-group discussions to introduce new topics or concepts that help learners consider any previous assumptions that they may bring with them to the learning experience, (b) reserve time toward the end of learning sessions for participants to play devil's advocate to experiment with opposing sides of issues that arise, (c) host online discussion forums to extend conversations that allow learners to continue considering new perspectives and challenging assumptions, and (d)

organize group projects that require learners to engage in critical discussions that are supported by relevant readings and substantive evidence.

Concentrated time for reflection is another critical thinking practice that often appears in the literature. In contrast to the social aspect of discourse (Brookfield, 2012; Taylor, 1998), McGonigal (2005) observed the solitary nature of reflection as a key component of critical thinking and transformative learning. While Zehavi and Mann (2005) more recently argued that there are four components of reflective thinking in mathematics (i.e., techniques, monitoring, insight, and conceptualization), Dewey (1933) provided much of the foundation for how reflective thinking is discussed by education scholars across disciplines. According to Dewey (1933), reflective thought occurs in five phases. Suggestion, the first phase, establishes the basis for thinking deeply as learners define a problem. The second phase, intellectualization, involves analyzing a problem. When forming a hypothesis, the third phase, thinkers examine the core dimensions of a problem and what elements are needed to address it. In the reasoning phase, learners harness their background knowledge (e.g., previous experiences, cultural awareness, and education) as well as scientific understanding to select a possible solution to address a problem. Finally, while testing the hypothesis, learners try out their selected solution and consider how the results inform their future actions, including possibly their reengagement with step one of the reflective thinking method. Beyond the benefits of sound decision-making with scientific models such as the one outlined in Dewey's (1933) approach, Brookfield (2012) suggested that critical reflection is also a necessary habit for learning facilitators to adopt as it helps educators resist the tendency to self-blame in situations that may be out of their control.

Assessment of Critical Thinking

Following an increased focus on best practices for developing adult learners' critical thinking skills, energy has been devoted to the creation of assessments that help measure learners' critical thinking growth over time. Commissioned by the U.S. Department of Education, Paul and Nosich (1992) outlined a model for assessing higher order thinking skills. Their model includes guidance for assessing higher order thinking as well as criteria for evaluating assessments used to measure critical thinking. The Foundation for Critical Thinking offers both online and print as well as essay-based and multiple-choice versions of assessments that provide indicators of learners' critical thinking skills aligned with criteria such as assumptions and points of view. Additionally, the foundation provides a list of critical thinking tests currently available for public use.

Critical Thinking Strategies and K–12 Teacher Professional Development

Prior to identifying particular strategies that learning leaders can apply in their facilitation of K–12 teacher professional development, it is first important to understand the key components of a professional development program that is committed to developing the critical thinking skills of its learners. Elder (2022) identified the following 13 core actions that program leaders can take to ensure a robust professional development program: (a) identify gaps between the real and the ideal; (b) foster a climate of critical thinking; (c) ensure administration is committed to critical thinking; (d) establish a team to advise and guide professional development efforts; (e) approach plans with an eye for long-term results; (f) facilitate ongoing workshops in which first-year content is required for all stakeholders and focused on foundations of critical thinking; (g) organize professional development cycles so that participants can learn skills, implement practices, reflect on their

implementation, and report out about their learning; (h) provide experiences throughout the year where participants can engage in critical thinking; (i) link professional development experiences to anticipated student achievement outcomes and the broader organizational mission; (j) fund the professional development program; (k) avoid political challenges that will derail professional development efforts; (l) be sensitive to intellectual arrogance; and (m) be intentionally inclusive to avoid elitism among professional development participants.

A few studies involving preservice teachers have helped to shed light on the conditions that promote the development of critical thinking skills for learners engaging in educator preparation programs. Han and Brown (2013) researched the effects of critical thinking interventions for prospective teachers in early childhood education programs. In addition to observing an increase in educators' abilities to apply critical thinking skills in their work, Han and Brown found that after receiving critical thinking interventions, study participants were also able to articulate in more detail what it means to think critically. In agreement with other critical thinking scholars (Brookfield, 2012; Friedel et al., 2008; Willingham, 2008), Han and Brown concluded that it is important to embed critical thinking instruction into existing programming while still providing direct training on how to think critically.

Stemming from their work with preservice teacher candidates, Harn and Meline (2019) discussed the value of developing educators' critical thinking and reflection skills within educator preparation programs. In particular, the researchers stressed how critical thinking skills can be strengthened through lesson studies, microteaching, video-case instruction, and case-based instruction. Moreover, Harn and Meline explained how critical thinking skills can be further developed through performance feedback, performance-based assessments, and video analysis reflections. In another study, Qing et al. (2010) found that programs that applied an inquiry-based instructional model yielded measurable improvements in preservice teachers' critical thinking skills. In particular, statistical differences in scores between the control group and experimental group were noticed in assessed subareas related to analysis and evaluation (Qing et al., 2010).

Low et al. (2017) examined how mentor educators influence the critical thinking skills and values of their student teachers. Contending that critical thinking is the vehicle whereby teachers select and implement the most effective instructional strategies to support their students, Low et al. determined that mentor educator practices could positively influence the learning and thinking habits of their student teachers. These findings expanded on knowledge from previous work (Brookfield, 2012; Ennis, 1987, 2016; Halpern, 1998) that focused on frameworks and models for developing critical thinking by examining how the beliefs and actions of supervising teachers can influence the values and critical thinking proficiencies of their colleagues in training.

Conclusions from a study by Grosser and Lombard (2008) illuminated the role that cultural backgrounds play in exercising critical thinking skills. In their study of preservice teachers in South Africa, the researchers sought to better understand how critical thinking skills of a mixed cultural group of over 100 student teachers differed according to the preservice educators' backgrounds. Among the findings from Grosser and Lombard's work were a discrepancy between the higher critical thinking skill development of western-heritage student teachers and the lower skill development of student teachers whose backgrounds were representative of African culture.

Yeh (2007) grounded a study in Halpern's (1998) model for teaching and learning critical thinking skills. For example, Yeh's early efforts to form a collegial online community aligned with Halpern's (1998) recommendation to attend to the dispositional needs of learners. Additionally, Yeh's inclusion of situational-based tests mirrored Halpern's (1998) guidance on ways to promote transference of critical thinking skills across contexts. Findings from Yeh's study revealed that the

integration of cooperative learning, online discussions, regular reflection, learner interactions, and a scaffolded-based instructional approach enhanced preservice educators' critical thinking skills.

Implications of the Literature on K–12 Educators' Professional Development Experiences

From the definitions, models, and practices related to critical thinking that were represented in the literature, some key implications emerged. Below are six areas of consideration that, for the purposes of this review, are framed as recommendations for professional development leaders of either K–12 educator preparation programs or school districts.

- Professional development programs should identify, articulate, implement, and evaluate a model for explicit critical thinking skills instruction. Even if the selected model is a blend of models that currently exist in the literature (Brookfield, 1987, 2012; Ennis, 1987; Halpern, 1998; King & Kitchener, 1994; Lipman, 1988; Nosich, 2009), a documented model for the professional development program's approach to critical thinking skill development will provide clarity to stakeholders of the program's intended outcomes, help ensure that the model is implemented with fidelity, and provide structure for the evaluation of the program goals that pertain to critical thinking.

- Professional development programs should reserve and preserve time for critical reflection. The power of regular reflection was a common theme expressed in the literature (Brookfield, 2012; Cranton, 2016; Ennis, 2011; Harn & Meline, 2019; McGonigal, 2005; Mezirow, 1990, 1998; Nosich, 2005; Zehavi & Mann, 2005). University programs and K–12 school districts have many competing priorities that all require dedicated time and attention. Accordingly, structured opportunities for reflection should be established as a central component of professional development programs that aim to strengthen learners' critical thinking skills.

- Professional development programs should incorporate meaningful discourse as a regular instructional activity. The literature highlighted many benefits of discourse as a vehicle for advancing students' critical thinking skills, and references provided guidance on how discussions can be structured to maximize students' higher-level thinking (Allen et al., 2018; Brookfield, 2012; Brookfield & Preskill, 2005; McGonigal, 2005; Reznitskaya et al., 2007; Spaska et al., 2021; Zwiers & Crawford, 2011). As with critical reflection practices, structured discourse should be systematically incorporated into learning opportunities across professional development offerings.

- Professional development programs should leverage high-quality questioning techniques with a focus on questions that represent complex levels of Bloom's (1956) thinking. The use of thoughtful and well-positioned questions surfaced as a powerful instructional approach for learning leaders (Brookfield, 2012; Ennis, 2016; McGonigal, 2005; Monrat et al., 2022; Santoso et al., 2018). While not all questions are created equal, questions that require learners to analyze, synthesize, and evaluate concepts can serve as catalysts for transformative learning experiences. In addition, questions can be used to help learners unearth assumptions, present alternative views on topics, and aid in critical reflection.

- Professional development programs should articulate critical thinking skill development in its list of intended outcomes and then implement programmatic ways to measure learners' critical thinking skills. Both parts of this recommendation were observed in the literature (Broadbear, 2012; Elder, 2022; Harn & Meline, 2019; Paul, 1993; Paul & Nosich, 1992). The value of expressing critical thinking skill development as an outcome helps to communicate its importance to stakeholders. In addition, collecting measurements of learners' critical thinking skill development over time helps program leaders make informed decisions as they create future program plans.

- Professional development programs should embed critical thinking skill development into existing program content and not isolate critical thinking skill practice as stand-alone professional development offerings. Attention to the organization of skill development opportunities was well-articulated in the literature (Broadbear, 2012; Brookfield, 2012; Friedel et al., 2008; Mazer et al., 2008; Swartz, 2000; Thomas et al., 2007; Willingham, 2008). Focus should be given to all levels of programming, including overall program outcomes as well as individual activities within professional development offerings. Efforts should also be made to incorporate explicit critical thinking skill instruction within existing professional development content.

Discussion

The purpose of this review was to synthesize existing literature related to models and strategies that adult learning facilitators can apply to promote the critical thinking skills of the K–12 educators whom they serve. The research question addressed by this review was the following: What models and practices should professional development leaders adopt to support the growth of preservice and practicing K–12 educators' critical thinking skills? This research question was answered via the wide range of articles, books, and other scholarly resources that were collected and synthesized in this literature review. However, as with almost all areas of inquiry, more could be known about the review's topic. Additionally, certain components of the information reviewed merit further consideration and scrutiny as follows.

One consideration is the need for more recent studies that address models for critical thinking. Much of the current research on how critical thinking skills are developed in preservice educators is grounded in models of critical thinking from a few decades ago. Given the dramatic technological advances of the past 20 years, including in the fields of artificial intelligence and neuroscience, it is suggested that models for critical thinking be revisited to consider their current relevance in today's educational landscape. Further research is also needed to better understand how the knowledge around critical thinking skill development that has been gained from previous studies has been used to improve program curriculum and instruction. A few questions that might be asked of future research studies include the following: What role does critical thinking play for adult learners in the age of artificial intelligence? How can the brains of contemporary educators be trained to think more critically? What has been the impact of three decades of critical thinking research on the current state of teacher training programs?

As was established in the first few sections of this review, the context for this literature review included two focus areas: (a) preservice educators studying in EPPs and (b) practicing educators serving in K–12 school districts. Concerning context, an area for further research is the extent to which critical thinking practices currently exist within and have an impact on the

professional development experiences of practicing K–12 educators. This need surfaced after reflecting on the imbalance of studies for currently practicing educators versus those for preservice teachers in EPPs (Grosser & Lombard, 2008; Han & Brown, 2013; Low et al., 2017; Qing et al., 2010; Yeh, 2007). It is understandable that researchers would have more convenient access to preservice teachers in multiyear EPPs; however, this imbalance in studies is unfortunate given that educators who are currently serving in K–12 schools are the ones having the most immediate impact on student learning. Two questions for further research could include the following: How can critical thinking skill development be incorporated into K–12 school districts' year-long or multiyear-long teacher professional development programs? How do educators' years of teaching experience impact their professional development needs regarding critical thinking skills?

An unexpected consideration that surfaced while synthesizing the literature was the Western orientation toward critical thinking that was assumed by many of the researchers. In particular, the Grosser and Lombard (2008) article, which described a study of preservice teachers in South Africa, helped to capture the reality that cultural differences in educator groups can account for variances in teacher preparedness for and general disposition around developing their critical thinking skills. This realization was especially significant to me given my background as a director of professional development in an international school setting (i.e., The People's Republic of China). From lived professional experiences, one way that the researcher could envision cultural differences impacting critical thinking skill development is in how adult learners interact with one another in discourse activities. For example, in a mixed group of educators from both Eastern and Western backgrounds, it is possible that the amount of speaking time may not be shared evenly by members of both traditions. Accordingly, two considerations surface. First, Brookfield's (2012) suggestion of discourse protocols may prove especially helpful in mitigating speaking imbalances. Second, further research may be needed to better understand how any gaps in critical thinking skill development can be minimized in groups where multiple cultural backgrounds are represented. Research questions aligned to this need could be as follows: What differences in critical thinking skill development experiences exist in educator preparation programs where adult learners from many cultural backgrounds are enrolled? How can professional development leaders in K–12 school districts equitably address the critical thinking skill development needs of a culturally diverse educator population?

A final thought related to the role of critical thinking professional development and the current state of the education field is connected to the review's introductory remarks regarding the relevance of this topic in today's education landscape. As was established, the teacher retention rate is a topic of serious concern for educational leaders. The impact of COVID-19 and news headlines about issues such as literary censorship and gun violence have certainly not helped this reality. This brings to mind a few important questions: What place do schools have in promoting critical thinking for today's youth? What skills are necessary for educators to support their students' critical thinking development?

Given the numerous resources and raft of previous research available today, both the capacity and need for K–12 educators to practice critical thinking seems greater than ever before. While additional research will further support practitioners' understanding of critical thinking skill development, the synthesis of literature generated by this review helped to unearth some of the essential models and practices professional development leaders can adopt to support the growth of preservice and practicing K–12 educators' critical thinking skills.

References

Allen, D., Blythe, T., Dichter, A., & Lynch, T. (2018). *Protocols in the classroom: Tools to help students read, write, think, and collaborate.* Teachers College Press.

Anderson, J., & Rainie, L. (2017). *The future of truth and misinformation online*. Pew Research Center. https://www.pewresearch.org/internet/2017/10/19/the-future-of-truth-and-misinformation-online

Beyer, B. (1995). *Critical thinking*. Phi Delta Kappa Educational Foundation.

Bloom, B. (1956). *Taxonomy of educational objectives, handbook I: The cognitive domain.* David McKay Company.

Boggs, J., & Chatfield, J. (1995). Point counterpoint: A method for teaching critical thinking. *Journal of Extension, 33*(4). https://commons.joe.org/cgi/viewcontent.cgi?article=7428&context=joe

Broadbear, J. (2012). Essential elements of lessons designed to promote critical thinking. *Journal of the Scholarship of Teaching and Learning*, *3*(3), 1–14. https://scholarworks.iu.edu/journals/index.php/josotl/article/view/1603

Brookfield, S. (1987). *Developing critical thinkers: Challenging adults to explore alternative ways of thinking and acting.* Jossey-Bass.

Brookfield, S. (2000). The concept of critically reflective practice. In A. L. Wilson & E. R. Hayes (Eds.), *Handbook of adult and continuing education* (pp. 110–126). Jossey-Bass.

Brookfield, S. (2012). *Teaching for critical thinking: Tools and techniques to help students question their assumptions*. Jossey-Bass.

Brookfield, S. (2017). *Becoming a critically reflective teacher* (2nd ed.). Jossey-Bass.

Brookfield, S., & Preskill, S. (2005). *Discussion as a way of teaching: Tools and techniques for democratic classrooms* (2nd ed.). Jossey-Bass.

Cherubini, L. (2009). Exploring prospective teachers' critical thinking: Case-based pedagogy and the standards of professional practice. *Teaching and Teacher Education*, *25*(2), 228–234. https://doi.org/10.1016/j.tate.2008.10.007

Cranton, P. (2016). *Understanding and promoting transformative learning: A guide to theory and practice*. Stylus Publishing.

Dewey, J. (1910). *How we think*. Heath and Company.

Dewey, J. (1933). *How we think: A restatement of the relation of reflective thinking to the educative process.* Heath and Company.

Drago-Severson, E., & Blum-DeStefano, J. (2016). *Tell me so I can hear you: A developmental approach to feedback for educators.* Harvard Education Press.

Elder, L. (2022). *Professional development model for K–12*. The Foundation for Critical Thinking. https://www.criticalthinking.org/pages/professional-development-model-for-K-12/436

Ennis, R. (1987). A taxonomy of critical thinking dispositions and abilities. In J. Baron and R. Sternberg (Eds.), *Teaching thinking skills: Theory and practice* (pp. 9–26). W. H. Freeman and Company.

Ennis, R. (2011). Reflection and perspective: Part one. *Inquiry*, *26*(1), 4–18. https://doi.org/10.5840/inquiryctnews20112613

Ennis, R. (2016). Critical thinking across the curriculum: A vision. *Topoi*, *37*(1), 165–184. https://doi.org/10.1007/s11245-016-9401-4

Fair, F., & Fasko, D. (2021). *Critical thinking and reasoning: Theory, development, instruction, and assessment.* Sense Publication.

Fisher, A. (2011). *Critical thinking: An introduction* (2nd ed.). Cambridge University Press.

Friedel, C., Irani, T., Rudd, R., Gallo, M., Eckhardt, E., & Ricketts, J. (2008). Overtly teaching critical thinking and inquiry-based learning: A comparison of two undergraduate biotechnology classes. *Journal of Agricultural Education*, *49*(1), 72–84. https://files.eric.ed.gov/fulltext/EJ839873.pdf

Grosser, M., & Lombard, B. (2008). The relationship between culture and the development of critical thinking abilities of prospective teachers. *Teacher and Teacher Education*, *24*(5), 1364–1375. https://doi.org/10.1016/j.tate.2007.10.001

Halpern, D. (1998). Teaching critical thinking for transfer across domains: Dispositions, skills, structure training, and metacognitive monitoring. *American Psychologist*, *53*(4), 449–455. https://doi.org/10.1037/0003-066X.53.4.449

Halpern, D. (2013). *Thought and knowledge: An introduction to critical thinking* (5th ed.). Psychology Press.

Han, H., & Brown, E. (2013). Effects of critical thinking intervention for early childhood teaching candidates. *The Teacher Educator*, *48*(1), 110–127. https://doi.org/10.1080/08878730.2012.760699

Harn, B., & Meline, M. (2019). Developing critical thinking and reflection in teachers within teacher preparation. In G. Mariano and F. Figliano (Eds.), *The handbook of research on critical thinking strategies in pre-service learning environments* (pp. 126–145). IGI Global.

Innabi, H., & El Sheikh, O. (2007). The change in mathematics teachers' perceptions of critical thinking after 15 years of educational reform in Jordan. *Educational Studies in Mathematics*, *64*(1), 45–68. https://doi.org/10.1007/s10649-005-9017-x

Jones, P., & Haydon, D. (2012). *Putting it into practice: Developing student critical thinking skills in teacher education: The models, methods, experience, and results*. Information Age Publishing.

King, P., & Kitchener, K. (1994). *Developing reflective judgment: Understanding and promoting intellectual growth and critical thinking in adolescents and adults*. Jossey-Bass.

Kohlberg, L. (1969). Stage and sequence: The cognitive developmental approach to socialization. In D. Goslin (Ed.), *Handbook on socialization theory and research* (pp. 347–480). Rand McNally.

LaGarde, J., & Hudgins, D. (2018). *Fact vs. fiction: Teaching critical thinking skills in the age of fake news.* International Society for Technology in Education.

Learning Forward. (2022). *Standards for professional learning.* https://standards.learningforward.org/?_ga=2.12886967.1602137141.1672076219-1589097389.1671728066

Lipman, M. (1988). Critical thinking: What can it be? *Educational Leadership*, *46*(1), 38–43.

Love, P., & Guthrie, V. (1999). King and Kitchener's reflective judgment model. *New Directions for Student Services*, *1999*(88), 41–51. https://doi.org/10.1002/ss.8804

Low, E., Hui, C., & Cai, L. (2017). Developing student teachers' critical thinking and professional values: A case study of a teacher educator in Singapore. *Asia Pacific Journal of Education*, *37*(4), 535–551. https://doi.org/10.1080/02188791.2017.1386093

Maina, M., Maina, J., & Hunt, K. (2016). Interactive games in physical education: A practical approach for teaching critical thinking skills—Part II. *Strategies*, *29*(4), 8–14. https://doi.org/10.1080/08924562.2016.1181588

Marsick, V., & Watkins, K. (1990). *Informal and incidental learning in the workplace*. Routledge.

Mazer, J., Hunt, S., & Kuznekoff, J. (2008). Revising general education: Assessing a critical thinking instructional model in the basic communication course. *The Journal of General Education*, *56*(3), 173–199. https://doi.org/10.2307/jgeneeduc.56.3.0173

McGonigal, K. (2005). Teaching for transformation: From learning theory to teaching strategies. *Newsletter on Teaching: Stanford University*, *14*(2), 1–4.

McLean, C. (2005). Evaluating critical thinking skills: Two conceptualizations. *Journal of Distance Education*, *20*(2), 1–20.

McMahon, C. (2005). *Critical thinking: Unfinished business*. Jossey-Bass.

Mezirow, J. (1978). Perspective transformation. *Adult Education*, *28*(2), 100–110. https://doi.org/10.1177/074171367802800202

Mezirow, J. (1981). A critical theory of adult learning and education. *Adult Education Quarterly*, *32*(1), 3–24. https://doi.org/10.1177/074171368103200101

Mezirow, J. (1990). *Fostering critical reflection in adulthood: A guide to transformative and emancipatory learning*. Jossey-Bass.

Mezirow, J. (1991). *Transformative dimensions of adult learning*. Jossey-Bass.

Mezirow, J. (1998). On critical reflection. *Adult Education Quarterly*, *48*(3), 185–199. https://doi.org/10.1177/074171369804800305

Mezirow, J. (2003). Transformative learning as discourse. *Journal of Transformative Education*, *1*(1), 58–63. https://doi.org/10.1177/1541344603252172

Monrat, N., Phaksunchai, M., & Chonchaiya, R. (2022). Developing students' mathematical critical thinking skills using open-ended questions and activities based on student learning preferences. *Education Research International*, *2022*, 1–11. https://doi.org/10.1155/2022/3300363

National Center for Education Statistics. (2022). *Too few candidates applying for teaching jobs the primary hiring challenge for more than two-thirds of public schools entering the 2022–23 school year.* https://www.prnewswire.com/news-releases/too-few-candidates-applying-for-teaching-jobs-the-primary-hiring-challenge-for-more-than-two-thirds-of-public-schools-entering-the-202223-school-year-301633685.html

National Education Association. (2022). Survey: Alarming number of educators may soon leave the profession. *National Education Association Today*. https://www.nea.org/advocating-for-change/new-from-nea/survey-alarming-number-educators-may-soon-leave-profession

National Research Council. (2010). Preparing teachers: Building evidence for sound policy. *The National Academies Press*. https://doi.org/10.17226/12882

Nguyen, T., Lam, C., & Bruno, P. (2022). Is there a national teacher shortage? A systematic examination of reports of teacher shortages in the United States. *EdWorking Papers*. https://doi.org/10.26300/76eq-hj32

Nosich, G. (2005). Problems with two standard models for teaching critical thinking. *New Directions for Community Colleges*, *2005*(130), 59–67. https://doi.org/10.1002/cc.196

Nosich, G. (2009). *Learning to think things through: A guide to critical thinking cross the curriculum.* Pearson Education.

Ouellette-Schramm, J. (2015). Epistemological development and critical thinking in post-secondary. *Australian Journal of Adult Learning*, *55*(1), 114–134.

Paul, R. (1993). *Critical thinking: What every person needs to survive in a rapidly changing world* (3rd ed.). Center for Critical Thinking and Moral Critique, Sonoma State University.

Paul, R. (1995). *Critical thinking: How to prepare students for a rapidly changing world*. Foundation for Critical Thinking.

Paul, R., & Elder, L. (2009). *The miniature guide to critical thinking concepts and tools.* Foundation for Critical Thinking. https://www.criticalthinking.org/files/Concepts_Tools.pdf

Paul, R., & Nosich, G. (1992). *A model for the national assessment of higher order thinking*. Foundation for Critical Thinking. https://www.criticalthinking.org/pages/a-model-for-the-national-assessment-of-higher-order-thinking/591

Qing, Z., Jing, G., & Yan, W. (2010). Promoting pre-service teachers' critical thinking skills by inquiry-based chemical experiment. *Procedia – Social and Behavioral Sciences*, *2*(2), 4597–4603. https://doi.org/10.1016/j.sbspro.2010.03.737

Reznitskaya, A., Anderson, R., & Luo, L. (2007). Teaching and learning argumentation. *Elementary School Journal*, *107*(5), 449–472. https://doi.org/10.1086/518623

Robinson, S., & Knight, V. (2019). *Handbook of research on critical thinking and teacher education pedagogy.* IGI Global.

Santoso, T., Yanita, L., & Erman, E. (2018). The role of student's critical asking question in developing student's critical thinking skills. *Journal of Physics: Conference Series*, *953*(1), 120–142. https://doi.org/10.1088/1742-6596/953/1/012042

Sezer, R. (2008). Integration of critical thinking skills into elementary school teacher education courses in mathematics. *Education*, *128*(3), 349–362.

Spaska, A., Savishchenko, V., Komar, O., Hritchenko, T., & Maidanyk, O. (2021). Enhancing analytical thinking in tertiary students using debates. *European Journal of Educational Research*, *10*(2), 879–889. https://doi.org/10.12973/eu-jer.10.2.879

Sternberg, R. (1985). Critical thinking: Its nature, measurement, and improvement. In F. Link (Ed.), *Essays in intellect* (pp. 45–66). Association for Supervision and Curriculum Development.

Swartz, R. (2000). *Towards developing and implementing a thinking curriculum*. Keynote address presented at the First Annual Thinking Qualities Initiative Conference. Hong Kong.

Taylor, E. (1998). *The theory and practice of transformative learning: A critical review* (ED423422). ERIC. https://files.eric.ed.gov/fulltext/ED423422.pdf

Taylor, E. (2017). Critical reflection and transformative learning: A critical review. PAACE *Journal of Lifelong Learning*, *26*, 77–95. https://www.iup.edu/pse/files/programs/graduate_programs_r/instructional_design_and_technology_ma/paace_journal_of_lifelong_learning/volume_26,_2017/taylor.pdf

Thomas, T., Davis, T., & Kazlauskas, A. (2007). Embedding critical thinking in IS curricula. *Journal of Information Technology Education*, *6*, 327–346. https://doi.org/10.28945/219

Todd, C., & O'Brien, K. (2016). Teaching anthropogenic climate change through interdisciplinary collaboration: Helping students think critically about science and ethics in dialogue. *Journal of Geoscience Education*, *64*(1), 52–59. https://doi.org/10.5408/12-331.1

Unrau, N. (2008). *Thoughtful teachers, thoughtful learners: Helping students think critically* (2nd ed.). Pippin Publications.

U.S. Department of Education. (2022). *Preparing and credentialing the nation's teachers: The Secretary's report on the teacher workforce*. Office of Postsecondary Education. https://title2.ed.gov/Public/OPE%20Annual%20Report.pdf

Vygotsky, L. (1978). *Mind in society: The development of higher psychological processes*. Harvard University Press.

Willingham, D. (2008). Critical thinking: Why is it so hard to teach? *Arts Education Policy Review*, *109*(4), 21–32. https://doi.org/10.3200/AEPR.109.4.21-32

Yeh, Y. (2007). Integrating e-learning into the direct-instruction model to enhance the effectiveness of critical-thinking instruction. *Instructional Science*, *37*(2), 185–203. https://doi.org/10.1007/s11251-007-9048-z

Zehavi, N., & Mann, G. (2005). Instrumented techniques and reflective thinking in analytic geometry. *The Montana Mathematics Enthusiast*, *2*(22), 1551–3440. https://doi.org/10.54870/1551-3440.1025

Zwiers, J., & Crawford, M. (2011). *Academic conversations: Classroom talk that fosters critical thinking and content understandings*. Stenhouse Publishers.