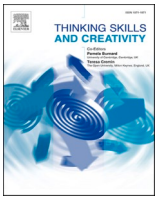
Thinking Skills and Creativity 56 (2025) 101787

Contents lists available at ScienceDirect

Thinking Skills and Creativity

journal homepage: www.elsevier.com/locate/tsc



A critical thinking thematic framework and observation tool for improved theory and developing secondary teachers' instructional practice: Proof of concept

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ARTICLE INFO

Keywords:
Critical thinking
Secondary schools
Teacher beliefs
Instructional practice
Classroom observation tool
Design based research
Teacher professional development

ABSTRACT

Theoretical understandings of critical thinking, including how it is positioned and developed across educational contexts, remains contentious. While critical thinking features across school curricula internationally with increasing prominence as an educational priority for young people, efforts to explore and develop secondary teachers' practices of critical thinking reveal diverse theoretical influences and instructional approaches, without reaching a consensus model of best practice. To address this, a new critical thinking thematic framework was developed towards reconciling theoretical tensions within the question of: what is critical thinking?, so that understandings of what it might look like as part of teacher instructional practice can be developed. Together with this thematic framework, a critical thinking observation tool and thematic coding guide were constructed to code and analyse teacher interview and classroom observations in order to guide a year-long investigation of secondary teachers' beliefs and practices of critical thinking.

Applied across multiple studies within a design-based research project, this critical thinking thematic framework enabled the effective exploration and dissemination of secondary teachers' perceptions and instructional practices of critical thinking across English, Social Science and Science subject contexts. Engaged as a community of practice, and supported with contextualised evidence, 28 participant teachers across five New Zealand secondary schools were able to reflect their beliefs and practices for future planning. Significant shifts in the frequency and conceptual nature of teachers' beliefs and practices of critical thinking in response to professional development across repeated measures suggest that the Critical Thinking Thematic Framework and Observation Tool can be employed to produce consistent and reliable coding of beliefs and practices with effective researcher training.

1. Introduction

The development of learners' critical thinking is a stated purpose of educational curriculum worldwide (OECD, 2024; Santos Meneses & Drugova, 2023). Despite this common objective and growing recognition of critical thinking as vital for lifelong intellectual growth, civic engagement, and economic success (Santos Meneses, 2020; Song et al., 2024), a cohesive and lasting understanding of its meaning has not yet emerged (Varas et al., 2023). While numerous scholarly and pedagogical efforts have been made to address this problem and equip teachers towards its development in practice, impact has been limited (Abrami et al., 2008, 2015), and theoretical

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https://doi.org/10.1016/j.tsc.2025.101787
Received 14 November 2023; Received in revised form 19 December 2024; Accepted 5 February 2025
Available online 14 February 2025

tensions persist (Giselsson, 2020; McGuirk, 2021). Further, teacher professional development initiatives around pedagogies associated with critical thinking are often brief and removed from teacher practice (Abrami et al., 2015). Despite this, teachers still commonly believe that critical thinking should be taught as part of curriculum learning, yet policy alone is insufficient in supporting improvements in practice (Davies & Willing, 2023; Sandretto et al., 2023). These enduring gaps between theory and practice contribute to a limited understanding of how teachers currently foster critical thinking, and how they can be empowered to develop it within their specific classroom contexts (Cáceres et al., 2020; Larsson, 2017; Varas et al., 2023).

Investigating the practices of teachers from various subject areas reveal potential challenges in using existing critical frameworks tied to specific disciplines. The absence of a shared language of critical thinking limits the exploration and development of best practice across subjects within a community of practice (Dunn et al., 2019; Hegazy et al., 2021). Given the lack of curriculum frameworks for critical thinking within the research context of New Zealand secondary schools, the need for a new thematic framework became evident (Davies & Willing, 2023; Ministry of Education, 2007). Furthermore, there is currently no adequate framework that captures the diverse theoretical influences informing both beliefs and instructional practices of secondary teachers (McGuirk, 2021; Santos Meneses, 2020).

In response to the ongoing challenge of defining critical thinking and understanding the factors that shape teachers' perceptions and practices (van der Zanden et al., 2020), a new critical thinking thematic framework and observation tool have been developed to support the exploration and development of teachers' instructional practices. Recognising the absence of an enduring best practice model of professional development in critical thinking (Abrami et al., 2015), these tools were utilised in a design-based investigation of secondary teachers' beliefs and practices (Anderson & Shattuck, 2012). This positioned participant teachers alongside the researcher as enquirers in a participatory and agentic manner (Dunst et al., 2015; Hegazy et al., 2021).

Conducted as part of a year-long design-based research investigation involving 28 teachers across five secondary schools, this new thematic framework and observation tool were employed to enhance understanding of how critical thinking instructional practices can be observed and developed across various subject disciplines. Engaged as a community of practice (Hennessy et al., 2021), participant teachers from English, social studies, and science subject areas received contextualised evidence of their practices and beliefs from interviews and classroom observations. By examining their stated beliefs and observed practices, participants were supported to develop their understandings and instructional methods for critical thinking. As part of this design-based research investigation, the critical thinking thematic framework and classroom observation tool enabled exploration of the following research questions:

(1) In what ways do teachers deliver critical thinking instruction in their secondary school subject?
(2) How do teacher perceptions about their teaching of critical thinking in secondary schools reflect their practice?
(3) To what extent do teacher perceptions and practices about their teaching of critical thinking in secondary schools shift following an intervention through professional development?

Findings from this investigation, explored through the Critical Thinking Thematic Framework and Critical Thinking Observation Tool, can assist future researchers and practitioners towards explicit integration of critical thinking into instructional practice. They offer an attempt to reconcile identified theoretical tensions (McGuirk, 2021; Santos Meneses, 2020) and promote practitioner-led professional development through an impactful design-based approach (Anderson & Shattuck, 2012).

This paper aims to present the Critical Thinking Thematic Framework and Critical Thinking Observation Tool as proofs of concept by demonstrating their theoretical and practical applications. It begins with a review of literature on critical thinking and instructional approaches. It will then introduce the Critical Thinking Thematic Framework of *pragmatic, dispositional*, and *transformational* and apply these alongside the Critical Thinking Observation Tool for the purpose of measuring and disseminating teachers' beliefs and instructional practices. The reliability of the framework and tool will be examined in the context of their use and findings relating to the research questions. Finally, the article discusses the investigation's results, highlighting the opportunities and limitations of the framework and observation tool for future research and practice.

2. Literature review

2.1. What has been said of teaching critical thinking?

2.1.1. Conceptual approaches

Contributions toward understanding what is critical thinking reflect diverse disciplinary and philosophical influences (McGuirk, 2021). As these influences remain contentious, their impact on effective teaching practices are often implicit, and subject to debate (Varas et al., 2023). The literature reveals ongoing tensions about whether critical thinking should be taught as a standalone subject or a set of skills (*generalist* view), or if it requires specific disciplinary or contextual focus to be effective (*specifist* view) (Abrami et al., 2015). The *generalist* view argues that critical thinking is a transferable set of skills and dispositions that can be expressed, measured, and taught (Facione, 2020; Willingham, 2019), while the *specifist* view posits that it remains subjective to specific contexts and disciplines (McPeck, 1994).

From the *generalist* perspective, the most influential attempt to define critical thinking for cross-disciplinary pedagogy was the *Delphi Report*, led by the American Philosophical Association (Facione, 1990). Building on Ennis's (1987) taxonomy of critical thinking dispositions and abilities, it presents critical thinking as a set of six skills and 19 dispositions, providing the most widely accepted framework for teaching, measurement, and research (Abrami et al., 2008; Santos Menses, 2020). This generalised approach has significantly influenced popular critical thinking assessments (Ennis & Millman, 2005), educational research and meta-analyses due to

its accessibility and scalability (Abrami et al., 2015).

From a *specifist* perspective, critical thinking cannot be captured as a standardised concept that is both broadly applied and reliably measured (McPeck, 1994). Advancements of critical thinking through training and assessment around generalised taxonomies (Facione, 1990; Watson-Glaser, 1980) and contextually neutral logical fallacies are therefore insufficient (Bernard et al., 2008). As McPeck (1984) remarked: "giving people very general principles for solving problems, even with extensive training in them, is like giving people a language with a syntax but no semantic. It is functionally meaningless" (p.39). This view is supported by critical theorists, who caution against notions of critical dogmatism (Biesta & Stams, 2001), where a top-down assessment framework or pedagogy overrides contextual needs (Freire, 1974). Critical thinking, as argued by proponents of a *specifist* lens, emerges when drawn from the lived experiences and social realities of the classroom (hooks, 2010). It acknowledges that all efforts at critical thinking carry some form of bias or subtext, and ignoring this is problematic (Missimer, 1994).

Despite alternative models of critical thinking proposed by critical pedagogists such as Freire (1974) and McPeck's (1994) endorsement of developing critical thinking within *specifist* contexts, Ennis (1989) contends that guidance for fostering critical thinking from contextual and disciplinary vantage points remain vague and inadequate. While programs and disciplinary frameworks have emerged—such as *Philosophy for Children* (Lipman, 1995), *critical literacy* (Janks, 2010), the *Cognitive Acceleration Programme, Thinking Through Science, Thinking Through Maths,* and *Thinking Through Art* (Dilekli & Erdogan, 2016), critics assert that students often struggle to apply their critical thinking skills across various academic disciplines and that not all subject areas adequately emphasise critical thinking (Willingham, 2019).

As tensions persist between *generalist* and *specifist* approaches to conceptualising critical thinking in education, neither top-down nor bottom-up solutions fully address the concerns of various theorists and pedagogists (Abrami et al., 2008). Hattie (2009) states, "it is important to have the balance: you need surface to have deep; and you need to have surface and deep knowledge and understanding in a context or set of domain knowledge" (p. 29). This notion of balance suggests that *generalist* approaches require appropriate *specifist* contexts for effective development, while *specifist* approaches may not readily apply across different domains (Hitchcock, 2020; McGuirk, 2021). Regardless of their position, the challenge remains for teachers to develop pedagogies that effectively support students in cultivating critical thinking (Desmet & Sternberg, 2024; Hennessy et al., 2021).

2.1.2. Instructional approaches

Informing understanding of the teaching of critical thinking in educational settings, Abrami et al.'s (2008, 2015) meta-analyses of research conducted from the *generalist* skills and dispositions approach explored the impact of instructional best practices and their ongoing challenges. Drawing on Ennis (1989), the 2008 meta-analyses evaluated the effects of four instructional interventions: *general* (critical thinking as a stand-alone course objective), *immersion* (implicit integration of critical thinking into subject matter), *infusion* (explicit integration of critical thinking) and *mixed* (a combination *general* and *infusion* methods). The findings from the 2008 study, which were statistically significant ($p < .01$), favoured the explicit *infusion* approach ($g+ = 0.54$), over the implicit *immersion* approach ($g+ = 0.09$), and revealed the largest effect for *mixed* approaches ($g+ = 0.94$,). However, subsequent meta-analyses (Abrami et al., 2015) with a larger sample size, found smaller effect sizes and reduced statistical significance ($p= .25$).

To address the challenge of producing reliable effect sizes using Ennis's (1989) typology for teaching critical thinking, Abrami et al. (2015) proposed an alternative set of instructional categories for meta-analysis: *dialogue, authentic*, and *coaching. Dialogue* involves oral or written exercises that encourage interactive exchanges between teachers and students. *Authentic* instruction emphasises a context-relevant, high-engagement, problem-solving approach to teaching. *Coaching* focuses on one-on-one interactions through feedback and modelling. The 2015 meta-analyses revealed positive effect sizes for each of the individual instructional approaches (*dialogue, $g+ = 0.32$, $p = .03$; authentic $g+ = 0.34$, $p = .04$; coaching, $g+ = 0.39$, $p = .11$*). However, the greatest impact was observed when multiple strategies were integrated within the same intervention study ($g+ = 0.57$, $p = .04$) (Abrami et al., 2015).

The findings from Abrami et al. (2015) suggest that there is "no magic recipe", no universal best practice for teaching critical thinking, challenging the *generalist* view (p.303). Instead, analyses suggests that greatest impact may be achieved in employing a variety of pedagogical approaches, such as combining *dialogue* within *authentic* (*specifist*) contexts. This is supported by research by Rombout et al. (2021), where teacher professional development of critical thinking via *dialogue* within specifist contexts emphasised the absence of a singular best practice. Instead, a *mixed* approach drawing upon teacher expertise and the contextual needs of the classroom (*specifist* view) remains significant (Davies & Willing, 2023; Phillipson & Wegerif, 2020). These insights inform the current study by suggesting that, although teachers may prefer specific methods for teaching critical thinking, exploring and incorporating diverse strategies could significantly enhance student learning outcomes (Dunst et al., 2015).

2.1.3. Responding to limitations in understandings of best practices of critical thinking

While Abrami et al. (2008; 2015) meta-analyses discussed above offer insight towards best practices for critical thinking through a *generalist* focus on critical thinking skills (Facione, 1990), there remains a gap in understanding how emerging *specifist* approaches to critical thinking instruction, such as *critical literacy* (Pandya et al., 2021), affect learning outcomes. Abrami et al. (2015) notes that although *specifist* approaches are important, their evaluation was not within the "competence of our model"; thus, meta-analyses around their impact in developing critical thinking yet to be explored (p. 279). Nonetheless, they influence teachers' explicit and implicit understandings of critical thinking, which may impact current and potential best practices (van der Zanden, 2020; Varas et al., 2023). This situation presents an opportunity to further understand how varying theories of critical thinking might work together. Specifically, the impact of professional development on teachers' practices regarding critical thinking will be shaped by their prior values and pedagogical approaches. Values which van der Zander (2020) argue are often implicit and require further investigation. Establishing a baseline measure of these factors as part of the research design is essential for measuring the impact of any professional

development on teaching practices (Dunst et al., 2015).

Following the publication of the Delphi Report's taxonomy of critical thinking abilities and dispositions (Facione, 1990), the lead author later acknowledged that it is nonetheless essential for teachers to develop their own understanding of critical thinking (Facione, 2020). If a teacher's role is limited to providing learners with an externally prescribed view of critical thinking, they may struggle to facilitate an environment that moves beyond the "banking model" of education toward critical liberatory practice (Freire, 1970). Providing teachers with opportunities to explore their own practices and interpretations of critical thinking, through supportive professional development, offers more agentic and critical practice (Little, 2007; Timperley et al., 2007). Designed with this agentic aim for practitioners, the Critical Thinking Thematic Framework aims to help addresses the implicit nature observed in much of critical thinking instruction (Cáceres et al., 2020; Santos Meneses & Drugova, 2023) by providing a charitable, yet consistent language framework for exploration and potential development of their beliefs and *specifist* practice.

2.2. Explanation for the critical thinking thematic framework

The Critical Thinking Thematic Framework designed for this investigation aims to incorporate competing theoretical understandings of critical thinking for application across diverse *specifist* contexts, while avoiding the pitfalls of being overly *generalist* (McGuirk, 2021; McPeck, 1994). To create an effective framework for exploring values and instructional practices, critical thinking was reconceptualised through three distinct thematic lenses. These lenses seek to reconcile identified tensions in meta-analyses of effective teacher instruction in critical thinking (Abrami et al., 2015). Specifically, they address the perceived dichotomy between the six critical skills and 19 dispositions of the American Psychological Association's framework of critical thinking (Facione, 1990), and the transcendental and deconstructive approaches articulated by Biesta and Stams (2001) and Pandya et al. (2021). This reconciliation can be achieved by moving beyond what McGuirk (2021) describes as *individualist* and *collectivist* paradigms of critical thinking; the former Enlightenment paradigm, "begins with the individual thinker and moves outward into the social space," while the latter, rooted in critical pedagogy, "begins with social critique and moves inward towards the individual" (p. 610).

The literature also acknowledges that theorists and practitioners' views of critical thinking are not static; that they may draw from a variety of themes and schools of thought (Hitchcock, 2020), adapting their beliefs and pedagogies over time and across different professional and personal contexts (Santos Meneses, 2020; van der Zanden et al., 2020). Given these considerations, the thematic lenses require sufficient breadth to capture the influences informing participants' beliefs, while allowing for depth to ensure that observed instructional practices carry critical contextual meaning. A focus towards deeper self-reflection, constructive skepticism, and engagement with complexity is essential in differentiating between what Paul (1981) describes as critical thinking in the *strong*, rather than the *weak sense*. The latter being described as liable to draw on basic evaluative skills or self-reinforcing interpretations of critical thinking, such as heuristics, bias or sophistry (Abrami et al., 2015; Paul, 1981). To reconcile the tensions within the literature regarding what constitutes critical thinking, and to appropriately explore teacher beliefs and instructional practices, the three thematic lenses developed for this research investigation are identified as: *pragmatic, dispositional, and transformational.*

2.2.1. Critical thinking from a pragmatic lens

Critical thinking through a *pragmatic* lens involves methodically employing skills and frameworks to inform judgments on defined problems (Ennis, 1985; Scriven & Paul, 2019). It may be expressed through the school of logic, strategically decoding and articulating complex ideas, or developed empirically via the scientific method to test hypotheses through evidence analysis (Hitchcock, 2020). *Pragmatic* critical thinking aims for reasoned conclusions, guiding the thinker in decisive actions that serve their interests (McGuirk, 2021; Mulnix, 2012). Additionally, it can operate objectively, favouring analyses that apply independently of broader social contexts. This lens often employs a reductive approach that responds to stimuli or problems, maintaining low-error tolerance for ambiguity and disregarding factors beyond a specific framework or posed problem.

A significant influence on conceptualising the *pragmatic* lens includes the six *critical skills* of *interpretation, analysis, evaluation, inference, explanation,* and *self-regulation*, as promoted by the American Philosophical Association in the 'Delphi Report' (Facione, 1990). These skills are modelled in various taxonomies, including Bloom's (Anderson et al., 2001) and the *Structure of Observed Learning Outcomes* (SOLO) (Biggs & Collis, 1982). Within a *pragmatic* lens, critical thinking is elicited through sequential processes and strategies of analytic reductionism, leading to logical, transparent judgments (Sternberg, 1986). Opportunities for abstract thinking are facilitated by both the SOLO taxonomy, particularly in its final relational stage of *'extended abstract,'* and Bloom's taxonomy through the *'create'* level. Ultimately, the fundamental judgment or understanding of the central abstraction focuses on its generalisability and potential for new applications (Anderson et al., 2001; Biggs & Collis, 1982).

Importantly, the *pragmatic* lens presents an approach to critical thinking grounded in methodological and epistemological frameworks. Whether consciously employed or not, this approach is internally consistent and externally verifiable. The outcome of critical thinking within a *pragmatic* theme is logical, reductive, egocentric and practically applicable. In short, a *pragmatic* lens is defined by the Critical Thinking Thematic Framework as:

> *Pragmatic*. Descriptions and approaches to critical thinking which elicit problem-solving skills, logical argumentation, and higher-order thinking within methodological frameworks.

2.2.2. Critical thinking from a dispositional lens

Critical thinking viewed through a *dispositional* lens draws on the *Delphi Report*'s affective dispositions, particularly the "approaches to life and living in general," which include "inquisitive, open-mindedness, honesty in facing one's own biases, willingness to

reconsider and revise viewpoints" (Facione, 1990, p. 13). In contrast to the reductive, individualistic themes of the *pragmatic* lens, a *dispositional* focus emphasises the social view (Missimer, 1994), considering diverse perspectives and competing ideas with charity and less fixed outcomes (Elbow, 1994). By adopting this social view, a *dispositional* lens invites students to connect their experiences and worldviews in classroom learning (Cook-Sather, 2006; Paul, 1981). While a *dispositional* lens may limit decisive action or clear conclusions, it emphasises opportunities for creative interpretation and empathic understanding (Gallo, 1994).

Critical *dispositional* thinking emphasises the positioning and experiences of the thinker as a focus for examination and reflection. This lens adopts a high-error tolerance, prioritising self-reflection and deferred judgement, and draws from theories of meta-cognition (Kuhn, 2000). In this manner, it facilitates shifts between individualist or collectivist paradigms of critical thinking (McGuirk, 2021). In summary, the Critical Thinking Thematic Framework defines the *dispositional* lens as:

> *Dispositional*. Descriptions and approaches to critical thinking which elicit collaboration, curiosity and principles of charity in developing self-awareness and empathy toward diverse perspectives on multifaceted issues.

2.2.3. *Critical thinking from a transformational lens*

Critical thinking from a *transformational* lens embodies beliefs and values derived from critique, critical theory, and a rejection of dogmatism in favour of creating new knowledge and paradigms for individual and collective change (Arnold et al., 2012; Freire, 1970). This lens promotes problem-seeking through deconstruction, truth-seeking in epistemology, and the drawing of intertextual connections between discourses (Fairclough, 2010), and critical praxis in sociopolitical and geospatial contexts (Habernas, 1987).

A *transformational* approach emphasises critical thinking as an agentic concept, exercised through the creation of new knowledge or meaning making (O'Sullivan, 1999). Unlike *pragmatic*, the *transformational* lens does not strive for neutrality and objectivity; rather, it seeks to unveil and dismantle implicit and unconscious subjectivities that uphold systems of knowledge and power (hooks, 2010). Thus, critical *transformational* thinking adopts a proactive, sceptical approach to *problematising how an idea or issue is presented*, allowing the thinker to explore alternative avenues (Foucault, 1997). While *transformational* thinking may incorporate aspects of the critical skills identified in the *Delphi Report* (Facione, 1990), it rejects the report as a definitive authority and its framing of critical thinking as a decontextualised, individualistic framework. Importantly, a *transformational* lens resists passive acceptance of values and paradigms, positioning itself with the intention to provoke (Hsieh, 2017).

Whereas a *dispositional* lens embraces a high-error tolerance and a charitable approach to thinking, a *transformational* lens is confrontational and may prioritise certain viewpoints over others in pursuit of individual and social transformation (Desmet & Sternberg, 2024; Freire, 1974). This lens critically examines how problems and knowledge frameworks are positioned within power dynamics (Foucault, 1997; Giroux, 2016), questioning whose knowledge is privileged and who is silenced (Janks, 2010; Sandretto, 2011). It explores how relationships and problems evolve when viewed through different anthropological, moral, and historical frameworks. To summarise, a *transformational* lens is defined by the Critical Thinking Thematic Framework as:

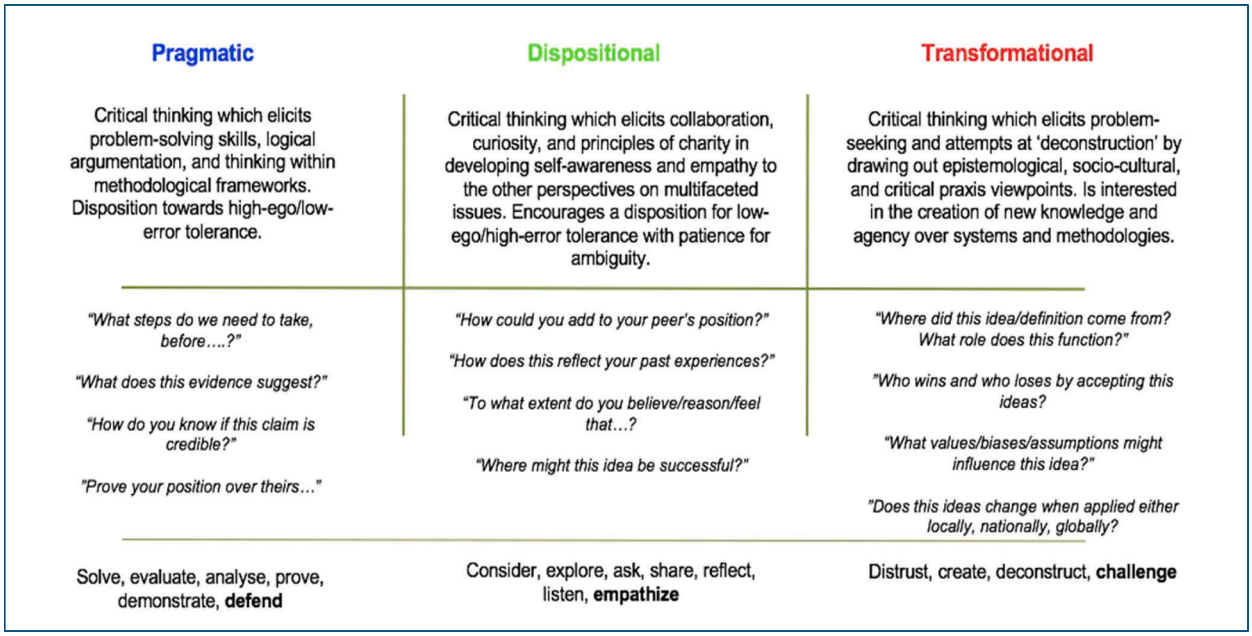


Fig. 1. Critical thinking thematic framework (professional development day rubric) (Shafer, 2022).
Fig. 1 Alt Text. Text rubric of the thematic framework, presented as a table with themes organised by column, followed by exemplar statements and verbs in rows below.

Transformational. Descriptions and approaches to critical thinking that elicit problem-seeking and "deconstruction" by exploring epistemological, sociocultural, and critical praxis viewpoints. Transformational approaches focus on creating new epistemological knowledge and fostering agency over systems and methodologies.

2.3. Critical thinking thematic framework as a guide for research and practice

Given the range of theoretical influences across the literature concerning what *is* critical thinking, and the diverse understandings and disciplinary knowledge that teachers would associate its concepts and role in practice, the three thematic lenses: *pragmatic, dispositional*, and *transformational*, provide a broad yet robust framework for educational practice. Initially conceptualised as a coding scheme to examine teachers' perceptions and practices of critical thinking, this framework was developed to facilitate dissemination of participants' baseline measure of perceptions and practices of critical thinking and contextualise literature surrounding conceptions and best practices of critical thinking during an off-site professional development day. To enhance participants' discussions around baseline findings, sharing models of best practice, and support goal setting, a breakdown of the Critical Thinking Thematic Framework was provided (See Fig. 1 below).

The provided framework utilises contextually neutral language, independent of any specific curriculum area, and includes definitions, sample question starters, and associated thinking verbs for each theme. Accompanied by a researcher-led presentation on the literature surrounding critical thinking, participants equipped with this framework were supported to foster diverse and fluid discussions about potential applications. Although the framework was not mandated for adoption in their practices, it served to anchor discussions between the researcher and participants, providing them with a common language of theory and practice (Baker, 2020; Hegazy et al., 2021). This was accomplished by applying the framework to specific subject contexts through researcher led presentation of baseline data and sharing of individual models of best practice.

Critical thinking as represented effectively by the framework should be viewed holistically across the three themes. While individual participants and subject disciplines may favour one theme over another, the framework aims to recognise them equally (See Fig. 2 below).

Conceptualised as a relational thematic framework, a *dispositional* lens may function to support and extend thinking from either a *pragmatic* or *transformational* lens as it borrows from both the critical dispositions of open-mindedness and self-regulation (Facione, 2020) and participatory dialogue (Freire, 1970). Additionally, a *transformational* lens of critical thinking towards deconstruction and problem seeking may reveal new possibilities for problem solving and evaluation within a *pragmatic* lens, or a means of empathising with new perspectives uncovered in problem posing through a *dispositional* lens. In conceptualising these themes as complimentary, rather than antagonistic, a critical thinker might employ this framework towards a critical *eudaimonia* (flourish) where each lens might be strengthened through consideration for their relationship to one another. This allows for the balanced integration of critical thinking perspectives that Santos Meneses (2020) calls for, which draws across notions of critical skills, dispositions, and the socio-cultural and ethical elements that inform its varying contexts. An active and fluid, rather than passive and inelastic framework, it can engage within and across knowledge domains, recognising opportunities to elicit critical thinking in both novel and established contexts. Conversely, a reduction of or to any single critical theme, may lead to fallacious thinking, heuristics, deceit, or critical thinking in the weak sense (McGuirk, 2021; Paul, 1981).

Positioned as a theoretical and relational concept for this investigation, the Critical Thinking Thematic Framework will be explored in the methods and analyses sections regarding its observation and coding of teacher practice through the Critical Thinking Observation Tool.

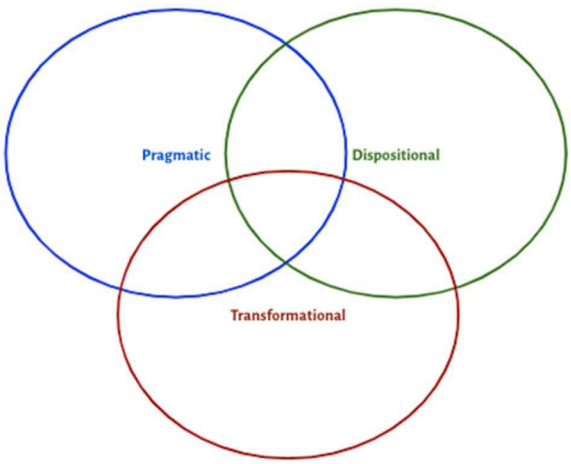


Fig. 2. A critical relational framework.
Fig. 2 Alt Text. Venn diagram of three overlapping circles, representing the three critical themes.

2.4. Professional development

Concerning the exploration and development of teacher beliefs and practices of critical thinking, education design research offered an agentic and contextualised approach to in-service teacher professional development (Dunn et al., 2019), allowing for conceptual learning and shifts in practice within a broad network of in-service secondary teachers (Timperley et al., 2007). According to Dunst et al. (2015) meta-analyses, effective professional development models share several key characteristics:

(1) they are sustained over time,
(2) they operate as communities of practice,
(3) they are linked to participants' subject-specific practices and goals,
(4) specifist over generalist,
(5) they provide access to external networks of experts, and
(6) they promote teacher agency and the implementation of new knowledge.

The Critical Thinking Thematic Framework was thus situated within Anderson and Shattuck's (2012) principles for design-based research, by positioning the teacher professional development as:

(1) situated in a real educational context
(2) focused on the design and testing of a significant intervention
(3) uses mixed-methods through multiple interactions
(4) based on collaborative partnership and evolved grounded theory, and
(5) has practical impacts on practice. (pp. 17–18)

Achieving consistent change in teachers' beliefs and practices is a challenging and gradual process that varies from individual to individual (Zhang et al., 2024). A design-based approach, therefore, facilitates a sustained focus on these beliefs and practices, grounded in robust research (Dunn et al., 2019). Although the impact of such meta-analyses have been questioned in Sims and Fletcher's (2021) review, particularly the emphasis of models be sustained over time (Dunst et al., 2015), other professional development models (Hegazy et al., 2021; Hennessy et al., 2021) continue to draw on the importance of a sustained culture of enquiry and Dunst et al. (2015) provides a guiding framework for structuring effective professional development.

3. Methods

3.1. Research context and sample

The investigation included 28 participant teachers from five secondary schools in diverse socio-economic areas of a large metropolitan city in New Zealand. Teachers were selected from English ($n = 13$), social sciences ($n = 8$), and science ($n = 7$), and were working with a nominated junior curriculum class (Year 10, approximately 15-year-old students). Participant perceptions and instructional practices of critical thinking were collected through one-on-one semi-structured interviews, a short answer questionnaire, and classroom observations throughout the academic year. Data was analysed and disseminated using pseudonyms for schools and

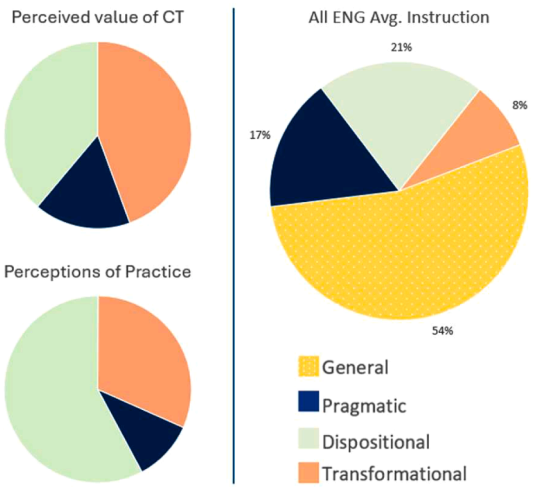


Fig. 3. English subject reporting of perceptions and practices relating to critical thinking (Shafer, 2022).
Fig. 3 Alt Text. Three pie graphs comparing critical thematic distributions of participants' beliefs and practices within the subject English grouping.

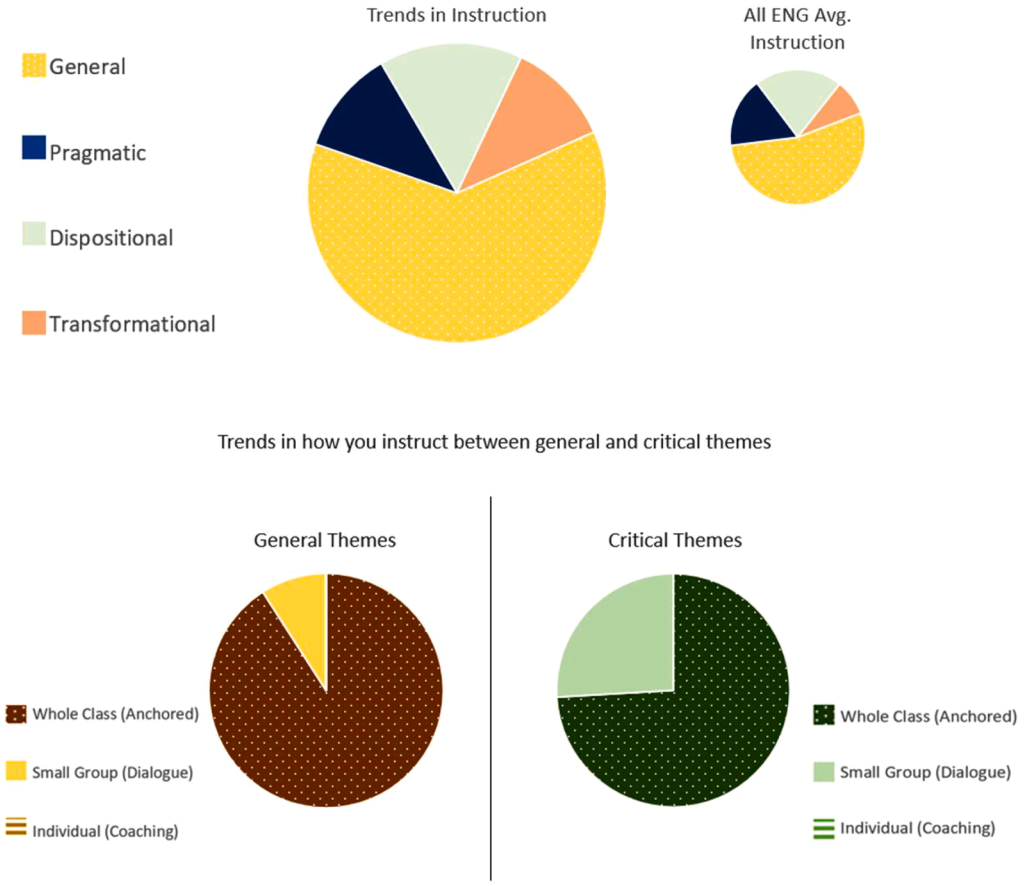


Fig. 4. Individual Data Report Sample (Baseline) Natalie Jenners 'pseudonym' (Shafer, 2022).
Fig. 4 Alt Text. Two pairs of pie graphs. First set compares distribution of coded thematic instruction between individual English participant and subject groupings. Second set compares instructional approaches of individual participant between *general* and *critical* themes.

participants.

3.2. Design and procedure

The investigation employed a longitudinal, design-based model to explore participating teachers' perceptions and instructional practices of critical thinking. It also aimed to assess the impact of an offsite professional development program, informed by contextualised evidence within a community of practice, on any shifts in those beliefs and practices.

Initial exploration of participants' perceptions and practices of critical thinking was collected through interviews and classroom observations. Each participant underwent a one-on-one semi-structured interview with the researcher, which were externally transcribed and verified by participants for accuracy. Once verified, responses to the following questions were coded using the Critical Thinking Thematic Framework:

- *What is critical thinking?*
- *What does critical thinking look like in your practice?*
- *What value does critical thinking have beyond your subject?*

Following the interviews, two classroom observations were conducted for each participant (56 observations total) within their nominated classroom. Observed instructional trends were compared to coded interview responses regarding "what does critical thinking look like in your practice?" Initial findings served as a baseline measure for professional development, participant goal setting, and the exploration of any comparative shifts (Baker, 2020).

The researcher utilised funding from a grant from The University of Auckland to provide teacher release, enabling participants to attend an off-site professional development day. Guided by a design-based approach (Anderson & Shattuck, 2012), participants were introduced to the Critical Thinking Thematic Framework and relevant research on critical thinking in secondary schools, alongside baseline findings of subject groups' perceptions and practices (Fig. 3). During this day, participants collaborated as a community of

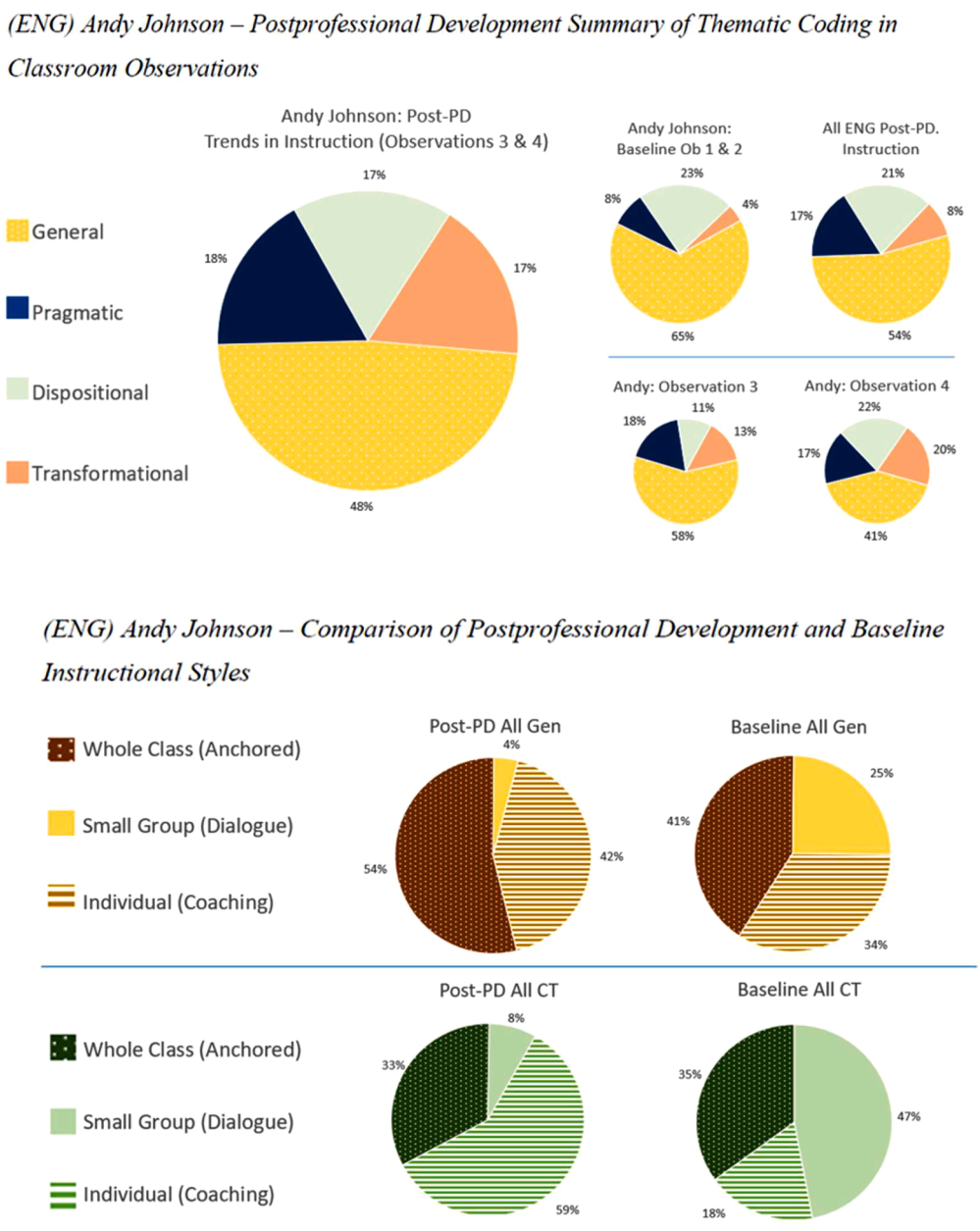


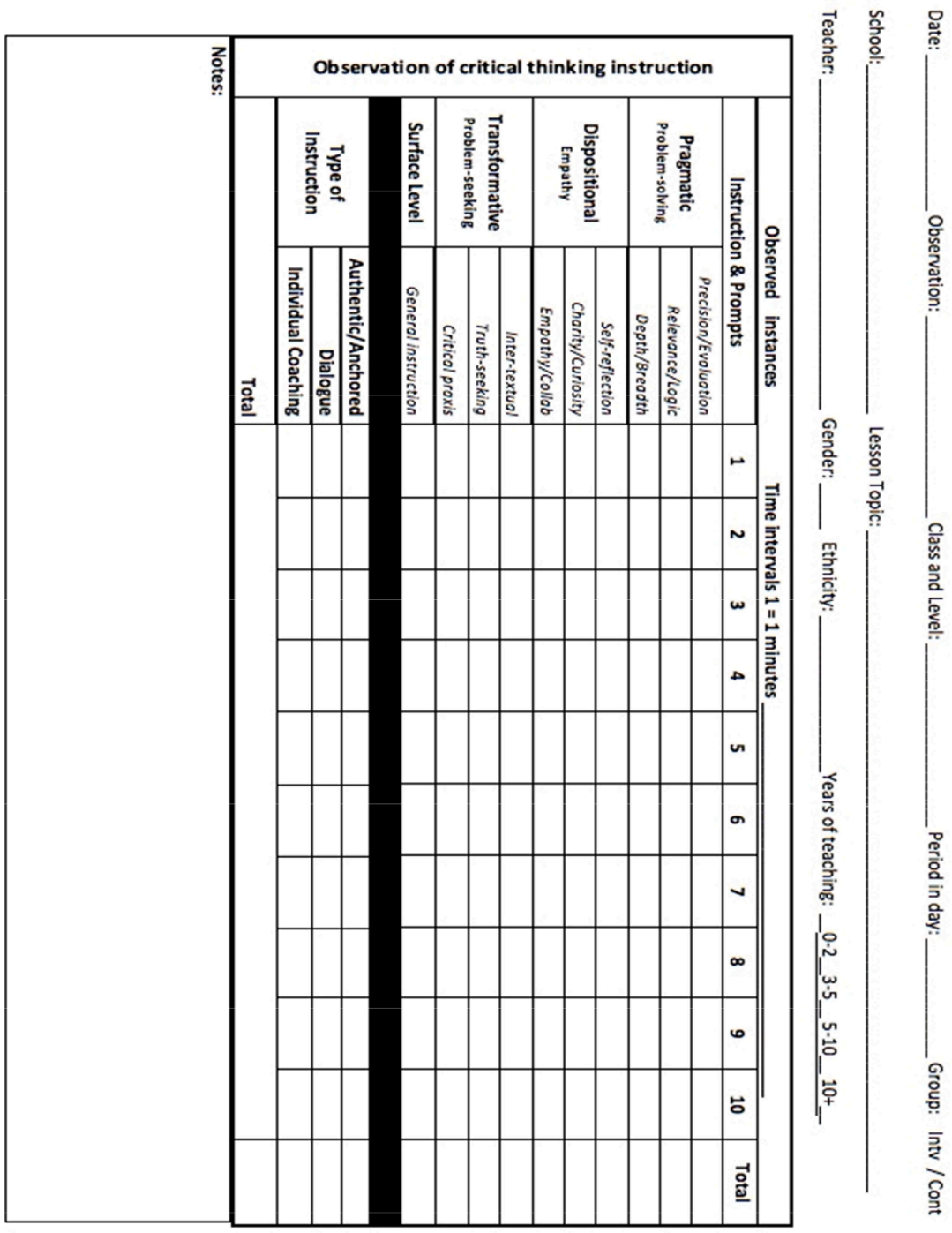
Fig. 5. Individual Data report sample (Baseline and post-professional development) Andy Johnson (pseudonym) (Shafer, 2022).
Fig. 5 Alt Text. Two sets of pie graphs. First set compares an English participant's distribution of thematic instruction across their observations with their subject grouping. Second set examines participant shifts in instructional approaches between general and critical themes at baseline and post-intervention.

practice to revisit interview questions, explore conditions and barriers to effective pedagogy in critical thinking, and share their own models of best practices (Dunn et al., 2019; Hennessy et al., 2021).

As an outcome of the professional development day, participants received an individualised report of their baseline findings, compared to subject trends. A post-intervention questionnaire was also provided to allow participants to affirm their current understandings of critical thinking, offer feedback, and establish goals for future practice through the following question:

- *In preparation of my next observation, what aspect(s) of critical thinking am I interested in building on, or refining?*

Individual reports (Fig. 4 below) were used to reinforce the investigation's design-based approach in providing participants contextualised evidence of their own practice to help them construct their own goals for practice (Dunn et al., 2019).



Critical Thinking In-Class Observation Sheet

Date: _____ Observation: _____ Class and Level: _____ Period in day: _____ Group: Intv / Cont

School: _____ Lesson Topic: _____

Teacher: _____ Gender: ____ Ethnicity: _____ Years of teaching: _0-2_ _3-5_ _5-10_ _10+_

Observation of critical thinking instruction			Observed instances Time intervals 1 = 1 minutes										
Instruction & Prompts		Type of Instruction	1	2	3	4	5	6	7	8	9	10	Total
Pragmatic Problem-solving	*Precision/Evaluation*												
	Relevance/Logic												
	Depth/Breadth												
Dispositional Empathy	*Self-reflection*												
	Charity/Curiosity												
	Empathy/Collab												
Transformative Problem-seeking	*Inter-textual*												
	Truth-seeking												
	Critical praxis												
Surface Level	*General instruction*												
		Authentic/Anchored Dialogue											
		Individual Coaching											
		Total											

Notes:

Fig. 6. Critical thinking observation tool (Shafer, 2022).

Fig. 6 Alt Text. Coding sheet for real-time observation of participant instructional practices across instructional themes and approaches.

After participants established their goals for practice, classroom observations were conducted to assess any shifts in their instructional methods. Data collection concluded with a final audio recorded semi-structured interview, during which participants received an updated individual report comparing their baseline and post-professional development observation trends against subject averages. Recordings were externally transcribed and verified by participants for accuracy. This interview revisited baseline questions regarding their perceptions of critical thinking and included inquiries on any subsequent goals for practice (Fig. 5).

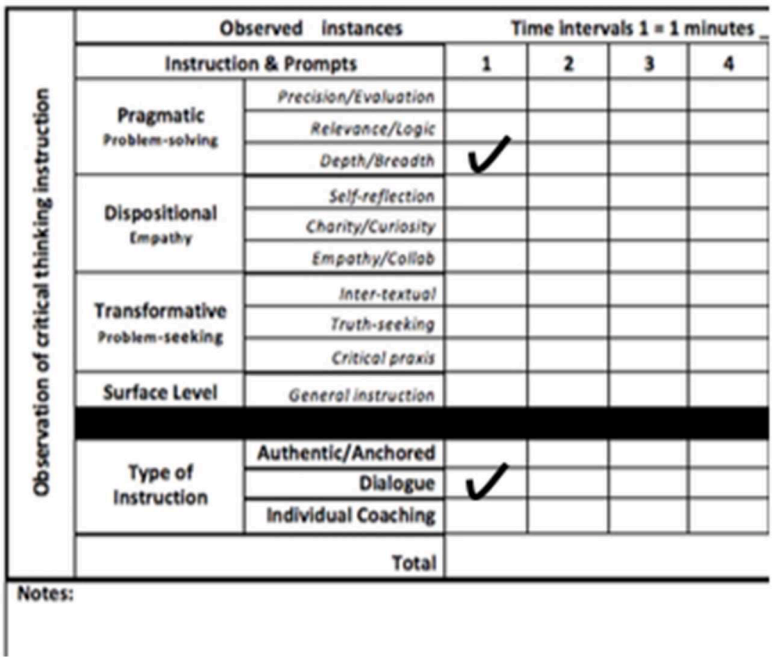


Fig. 7. Coding alignment on critical thinking observation tool (Shafer, 2022).
Fig. 7 Alt Text. Magnified section of observation tool showing how coding is entered for instructional theme and approach along a timed progression.

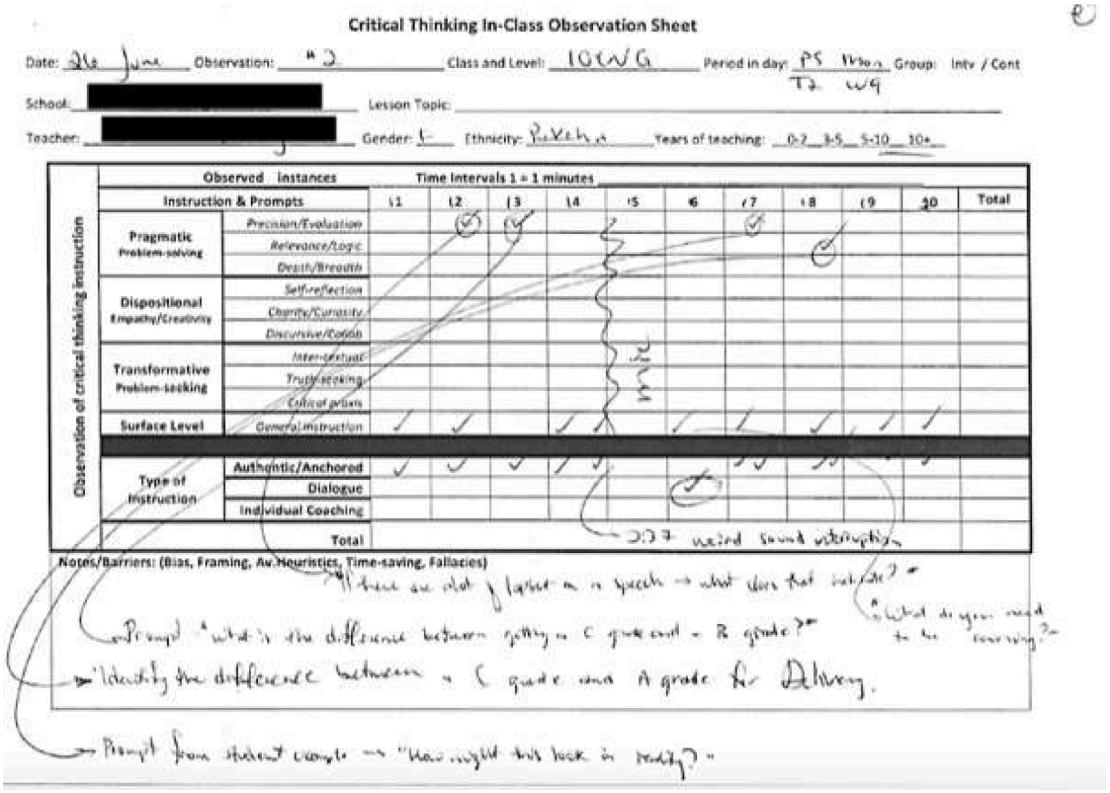


Fig. 8. Sample coding sheet using the critical thinking observation tool (Shafer, 2022).
Fig. 8 Alt Text. Scanned observational coding sheet used at baseline, capturing minutes 11–20 of observation, with annotations of coded themes expanded in notes heading.

3.3. Critical thinking observation tool

Through use of the observation tool, a trained observer can code instances of teacher instruction which elicit critical thinking across the thematic framework of *pragmatic, dispositional*, and *transformational* alongside surface level instructions (*general*). Additionally, themes can be coded to indicate the type of interaction given during instruction (*anchored, dialogue* and *coaching*), to provide a measure of how a teacher is interacting with students relative to the instructional theme (see Fig. 6, below).

Coding of the Critical Thinking Observation Tool requires the researcher to make two ticks for each teacher prompt. The first tick corresponds to the instructional theme categorised under 'Instruction & Prompts,' while the second tick falls under the 'Type of Instruction' grouping. The ticks are recorded in vertical alignment, reflecting the timing of the prompts within the observed lesson's time intervals (see Fig. 7 below).

A single observation sheet captures 10 mins of teaching, with multiple sheets used sequentially for the designated observation period. When multiple prompts are coded within the same minute interval, each unique theme is coded once if the target of instruction remains the same. However, if the target or type of instruction shifts while the theme stays consistent, it is recorded as two separate coded prompts.

3.3.1. Instructional prompts by coded theme

Guided by the Critical Thinking Thematic Framework, the coding of observed teacher instruction considers where the critical themes of *pragmatic, dispositional*, and *transformational* are elicited. While each critical theme has additional subthemes identified on the observation tool to assist live coding decisions, they do not represent the entirety of characteristics associated with the themes. Any instruction that is not inherently critical, but focuses on delivering disciplinary knowledge, directing student engagement and task orientation is classified as *general*. Data analysis and reporting focus solely on these main themes.

3.3.2. Instructional prompts by coded approach

Based on the instructional coding taxonomies of Abrami et al. (2015) and Berryman and Bishop (2011), this tool provides a coding measure of how the teacher instructs students, matching instructional theme to teacher interaction across the categories of: *anchored, dialogue* or *coaching*.

Anchored. Teacher's instructive approach is characterised by a directive, didactic, or transmissive style, often involving closed questions. Instruction typically occurs in a whole-class setting but may also take place during group interactions. Questions posed to students frequently follow the IRF (initiation, response, feedback) model, emphasising a teacher-centred focus in the introduction and development of ideas (Vrikki et al., 2019).

Dialogue. Instruction facilitates and sustains reciprocal dialogue with students, either in whole-class settings or small groups. The teacher adopts a facilitative or moderating role, offering prompts that encourage and maintain student discussion through open questions (Mercer & Littleton, 2007). Interactions are collective and collaborative, with responses leading to new questions and opportunities for diverse perspectives and elaborations (Alexander, 2018).

Coaching. Teacher engages in one-on-one interactions with students, focusing on individual learning and engagement. Instruction is tailored to each student's needs, addressing specific areas of progress through direct feedback conversations (Hattie & Clarke, 2018). While coaching may involve limited reciprocal engagement from students, the emphasis remains on the individual student as the focal point for teacher prompting.

Table 1
Thematic coding of participant responses to question: what is critical thinking? (Shafer, 2022).

How would you describe critical thinking?		
Theme	Description	*Coding sample*
Pragmatic	Descriptions and approaches which elicit problem-solving skills, logical argumentation, and higher-order thinking from within methodological frameworks	Victoria (Science) *"I would say independent problem-solving. Being able to rely on your brain and the processes of what you've learn in order to be able to understand things or figure out stuff around you – based on thinking skills"*
Dispositional	Descriptions and approaches which elicit collaboration, curiosity and principles of charity in developing self-awareness and empathy for differing perspectives on multifaceted issues. Willingness to re-evaluate and patience for ambiguity with a low ego and high error tolerance.	Gilly (Social studies) *"…that development of empathy and being able to look at something from multiple sides and putting on different hats and seeing it from another point of view".*
Transformational	Descriptions and approaches that encourage problem-seeking and deconstruction by exploring epistemological, socio-cultural, and critical praxis viewpoints. Focus on creating new epistemological knowledge and fostering agency over systems and methodologies.	Crystal (English) *….is about not being manipulated, but more than that it is about actually seeing how you can bring about change. That an individual or an organisation can bring about change in the environment.*

3.3.3. Observational notes

The *Notes* section at the bottom of the observation tool allows the researcher to make incidental notes and annotations during observations. This may include direct quotes, explanations of coded prompts, signals to revisit unclear parts of the audio recording, and comments on the flow and structure of learning activities. It also provides space for assessing the overall depth, engagement, and challenge of classroom learning. Throughout 92 classroom observations, this section was consistently utilised to aid in live coding, indicate important transitions, and provide timestamps for follow-up questions during subsequent coding checks of the audio recordings (see Fig. 8 below).

3.4. Validity and reliability

3.4.1. Critical thinking observation tool

In developing the Critical Thinking Observation Tool, preliminary testing for the suitability of coding teacher practices was conducted with a non-participating teacher in a junior English curriculum classroom. Validity checks by the chief researcher and a research advisor using audio recordings demonstrated that the observation sheet effectively facilitated authentic classroom observations and the coding of instructional practices, aligning directly with the Critical Thinking Thematic Framework (Gliner & Morgan, 2000). Furthermore, the consistent application of the thematic framework in coding across observations and interviews enhanced the validity of the tool for comparative analyses and data dissemination to participants (Cohen et al., 2011). Throughout the investigation, the tool was employed to observe teacher practices across baseline (56 observations of 25 mins each) and post-professional development measures (36 observations of 50 mins each).

To facilitate real-time coding, timed audio recordings of participant observations were utilised for coding checks, ensuring consistency and reliability in the themes identified (Creswell, 2014). This approach minimised potential disruptions by allowing the researcher to make timed annotations on the observation sheets whenever coding opportunities were missed and to note sections of the audio that required later review (Shafer, 2022). Observation trials revealed that closely shadowing the teacher during lessons was both impractical and intrusive, compromising authentic teacher-student interactions and dialogue.

3.4.2. Critical thinking thematic framework

The Critical Thinking Thematic Framework was employed throughout the investigation to ensure a consistent measure for the analysis and dissemination of findings with participants. Reliability checks of the framework involved double-blind coding of participant responses by both the chief researcher and an independent researcher across baseline and post-professional development measures. Checks on participants' interview transcripts focused on two key questions: '*What does critical thinking look like in your practice?*' and *'What value does critical thinking have beyond your subject?'* A high initial coding consensus of 80 % was achieved, with divergences resolved through further checks and consensus between the chief researcher and the independent researcher. Table 1 provides definitions and examples of participant responses coded to each critical theme as part of thematic analysis.

3.5. Analyses

3.5.1. Baseline interviews and observations

Initial coding checks for accuracy were conducted by the chief researcher while baseline observational data was manually entered into a digital spreadsheet for analysis in preparation for professional development. This provided opportunity to revisit missed teacher prompts due to obstructions such as classroom noise, distance between the participant and researcher, and quick pace of teacher instruction (Creswell, 2014). Audio recordings were reviewed to address any identified gaps, resulting in a total of 20 baseline observations (36 %) being re-coded in full for further case study analysis.

While coding checks typically focused on the accuracy of coded *themes*, simultaneous checks for *anchored, dialogue*, and *coaching* codes were conducted through assessment of participants' pitch, tone, and incidental student responses in the recordings (Alexander, 2018). Annotations on observation sheets also highlight gaps and significant transitions in the lesson, guiding researcher coding checks during student group activities or teacher-focused content delivery. Throughout the investigation, there were no instances where live observation failed to discern the teacher's instructional approach.

Table 2
(*Baseline*) Semi-structured interviews - 3 Questions coded with the critical thematic framework (Shafer, 2022).

Coded Questions	Participant sub.	Sample size	Sum responses coded from all questions	Coded themes	#	% of subject total responses coded
How do you define critical thinking?	English	13	53	Pragmatic	9	16.98
				Dispositional	24	45.3
				Transformational	20	37.73
What does critical thinking look like in your practice?	Social studies	8	39	Pragmatic	14	35.9
				Dispositional	12	30.8
				Transformational	13	33.33
What value does critical thinking have beyond your practice.	Science	7	26	Pragmatic	18	69.23
				Dispositional	4	15.38
				Transformational	4	15.38

Table 3
(*Baseline*) All subjects observation thematic coding: 1982 prompts (Shafer, 2022).

Subject Area	Sum observation time (min)	Sum and Distribution of Instructional theme (Sum total and %)				
		Prag.	Disp.	Trans.	All CT	General
English	927	154 (16.31 %)	197 (20.87 %)	76 (8.05 %)	427 (**45.23 %**)	517 (54.77 %)
social studies	566	81 (14.26 %)	72 (12.68 %)	78 (13.73 %)	231 (**40.67 %**)	337 (59.33 %)
science	486	91 (19.36 %)	46 (9.79 %)	25 (5.32 %)	162 (**34.47 %**)	308 (65.53 %)
All subjects	1979	326 (16.45 %)	315 (15.89 %)	179 (9.03 %)	820 (**41.37 %**)	1162 (58.93 %)

Table 4
(*Baseline*) All subjects' instructional approach, coded for theme (Shafer, 2022).

All subjects' instructional approach	Coded prompts by theme %					
	Prag.	Disp.	Trans.	All critical thinking themes	General	All prompts coded
Anchored (Whole Class)	139 (12.66 %)	125 (11.38 %)	101 (9.2 %)	365 (33.24 %)	733 (66.76 %)	1098
Dialogue (Group Discussion)	97 (26.36 %)	102 (27.72 %)	49 (13.32 %)	248 (67.4 %)	120 (32.8 %)	368
Coaching (Individual)	90 (17.44 %)	88 (17.05 %)	29 (5.62 %)	207 (40.12 %)	309 (59.88 %)	516
Sum All styles	326 (39.76 %)	315 (38.41 %)	179 (21.83 %)	820 (41.37 %)	1162 (58.63 %)	1982

3.5.2. Professional development of teachers – goal setting

In exploring participants' post-professional development goals for observation, thematic coding was applied to responses from the post-professional development day questionnaire. Goals were coded either across multiple themes or isolated within a single theme. Themes were identified when explicit references were made or ideas were conveyed in the responses, and each theme could only be coded once per participant response. Goals that did not explicitly align with a critical theme were categorised as *general*.

3.5.3. Post-intervention observations

Like baseline observations, post-professional development checks were conducted by the chief researcher while observational data was being collated, using both audio and video recordings to verify the live coding in preparation of participants' individual exit interview reports. Audio recordings remained the primary source for validity checks, as they provided the most accurate capture of teacher prompts. Video recordings served as a secondary measure for coding checks, allowing the researcher to confirm coding decisions, revisit activity contexts within observations, and cross-reference gaps highlighted on coding sheets with the audio recordings (Alexander, 2018).

To assess the reliability of observed shifts in post-intervention practice, nine participants (distributed evenly across English, social science, and science) underwent a fourth observation toward the end of the investigation. The data from this observation was compared and then integrated into the post-intervention subject data sets.

4. Results

4.1. Teachers' perceptions of critical thinking: a baseline

The initial interviews conducted with 28 participants yielded diverse yet thematically linked narratives, providing a baseline measure for understanding teacher perceptions regarding the following questions:

- *What is critical thinking?*

Table 5
(*Baseline*) What does critical thinking look like in the classroom? perceptions vs. practice Shafer, 2022.

Subject	Coding Theme	Perception of Practice %	Observed Practice %	Difference %
English	Pragmatic	10.00	36.07	+26.07
	Dispositional	55.00	46.16	−8.84
	Transformational	35.00	17.8	−17.2
Social science	Pragmatic	33.33	35.06	+1.73
	Dispositional	16.66	31.17	+14.51
	Transformational	50.00	33.77	−16.23
Science	Pragmatic	63.63	56.17	−7.46
	Dispositional	27.27	28.4	+1.13
	Transformational	9.09	15.43	+6.34
All Subjects	Pragmatic	30.23	42.43	+12.2
	Dispositional	37.20	35.24	−1.96
	Transformational	32.55	22.33	−10.22

Table 6
(Post-professional development) distribution of subjects' critical thinking goals, coded by theme (Shafer, 2022).

SUBJECT	SAMPLE SIZE	ALL THEMES CODED (TOTAL)	CODED THEMES (TYPE)	NUMBER OF CODED THEMES (TYPE) AT BASELINE	DISTRIBUTION OF THEMES CODED (TYPE) AT BASELINE (%)
ENGLISH	13	14	*Pragmatic*	1	7 %
			Dispositional	2	14 %
			Transformational	6	43 %
			General	5	36 %
SOCIAL STUDIES	8	14	*Pragmatic*	3	21 %
			Dispositional	4	29 %
			Transformational	6	43 %
			General	1	7 %
SCIENCE	7	11	*Pragmatic*	1	9 %
			Dispositional	5	45 %
			Transformational	4	36 %
			General	1	9 %
ALL SUBJECTS	28	39	*Pragmatic*	5	13 %
			Dispositional	11	28 %
			Transformational	16	41 %
			General	7	18 %

- *What does it look like in practice?*
- *What value does it have beyond subject classroom learning?*

A summary of results in Table 2 reveal comparative perceptions of critical thinking within and across subject areas. Findings are presented across the columns as: coded question, participant subject group, sample size, sum coded responses, theme, sum of theme coded within group, and the weighted distribution of each theme against sum subject coded.

Participants in each subject area exhibited notable differences in their conceptualisations of critical thinking and approaches to its development within their practice. For instance, science participants predominantly associated critical thinking with *pragmatic* themes (69 %), whereas English participants emphasised *dispositional* (45 %) and *transformational* (38 %) themes. In contrast, findings from social studies participants showed a more balanced distribution across the critical thinking themes (36 % *pragmatic*, 31 % *dispositional*, 33 % *transformational*).

4.2. Teachers' observed instructional practices of critical thinking: a baseline

Baseline results from 56 classroom observations, collected via the Critical Thinking Observation Tool and analysed through the Critical Thinking Thematic Framework, allowed for exploration of the first research question: *In what ways do teachers deliver critical thinking instruction in their secondary school subject?* Table 3 provides a summary of each subject participant group, total time observed within group, along with the sum and weighted distribution (%) of all coded prompts.

Where findings reveal a majority focus on *general* coded instruction for each subject group's sum instructional practice, the distribution of critical thinking themes offered greater diversity across subject findings. Subject English provided the greatest concentration of *dispositional* themes (21 %), followed by *pragmatic* (16 %), and *transformational* (8 %). Within science, results show a greater distribution of *pragmatic* (19 %) themes, compared to *dispositional* (10 %) and *transformational* (5 %). While *transformational* themes were coded least among English and science, in social studies, the critical themes were comparatively balanced in distribution (14 % *pragmatic*, 13 % *dispositional*, 14 % *transformational*). The sum of all subject coding revealed *general* themes as majority (59 %), followed by *pragmatic* (16 %), *dispositional* (16 %), and *transformational* (9 %).

The Critical Thinking Observation Tool also enabled analyses of all subjects' instructional approaches, distributed across coded themes (Table 4).

Summative findings of all subjects' instructional approaches reveal that participants most frequently instruct via *anchored* (55 %), compared to *coaching* (26 %) and *dialogue* (19 %). Whereas *anchored* was identified as the majority coded instructional approach, it was least likely (33 %) to elicit a critical theme. Conversely, *dialogue* was the least coded approach but was most likely (67 %) to elicit a critical theme, compared to *coaching* (40 %) and *anchored* (33 %).

4.3. Comparing teacher perceptions and observed practice

In exploring the second research question, "*How do teacher perceptions about their teaching of critical thinking in secondary schools reflect their practice*?", comparative analysis of participants' observed practices and their responses to the questions "*What value does critical thinking have beyond your subject?*" and "*What does critical thinking look like in your practice?*" reveals the degree of congruence between their beliefs and practices (see Table 5).

Findings from interviews and observations revealed that teachers' beliefs do not always match their practices, and that they often held beliefs associated with critical thinking which they struggled to enact within their instructional practices (Shafer, 2022). Results from all subject participants revealed a tendency to overestimate *transformational* themes and underestimate *pragmatic* themes in their teaching practice. Analyses of individual participants also revealed variance within subject groupings, and instances where gaps were much wider. In the case of science, a single participant was coded for 48 % of all *transformational* themes within the grouping yet offered no *transformational* themes as part of their perceptions of practice (Shafer, 2022). With analyses conducted for individual and grouped results, the professional development would draw on these comparative measures for collaborative discussion and inform future practice.

4.4. Post-Professional development goals for future practice

From responses to the post-professional development questionnaire prompt: *In preparation of my next observation, what aspect(s) of critical thinking am I interested in building on, or refining*?, Table 6 reveals participant distribution of thematic coding, grouped by subject.

Table 7
(*Post-professional development*) All subject observational thematic coding: 3481 prompts (Shafer, 2022).

Subject Area	Sum observation time (min)	Sum and Distribution of Instructional theme (Sum total and %)				
		Prag.	Disp.	Trans.	**All CT**	General
English	760	342 (23.06 %)	356 (24.00 %)	254 (17.12 %)	952 (**64.20 %**)	531 (38.80 %)
social studies	597	219 (20.28 %)	269 (24.90 %)	201 (18.61 %)	689 (**63.79 %**)	391 (36.21 %)
science	526	265 (28.87 %)	155 (16.88 %)	86 (9.37 %)	506 (**55.11 %**)	412 (44.89 %)
All subjects	*1883*	*826 (23.37 %)*	*780 (22.41 %)*	*541 (15.54 %)*	*2147* (***61.68 %***)	*1334 (38.32 %)*

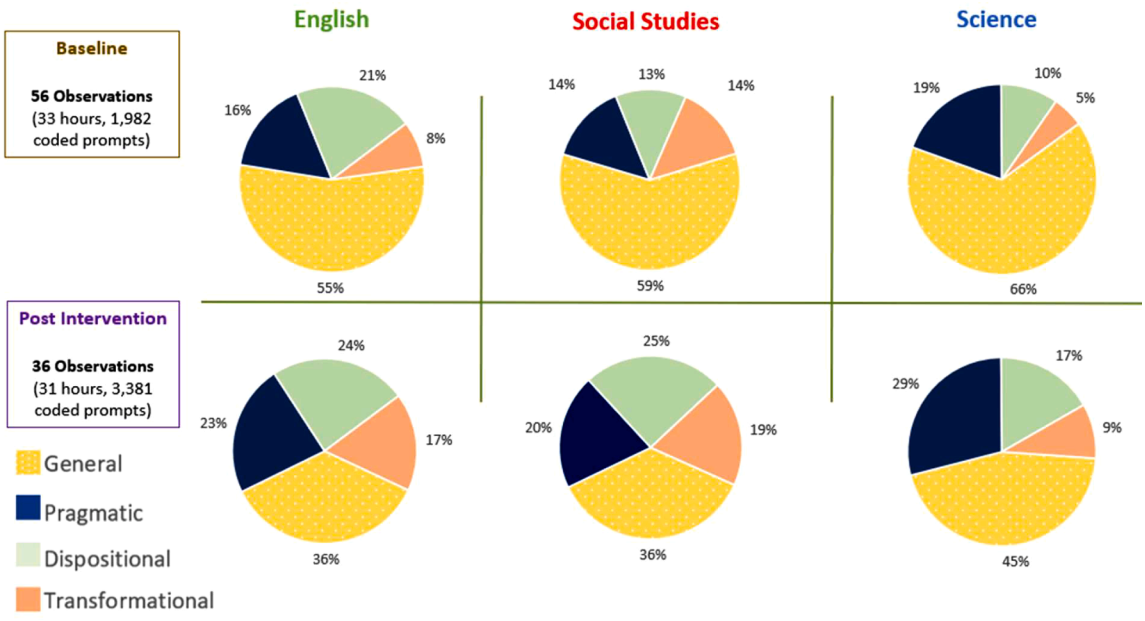


Fig. 9. Comparative shifts in observed practice by subject: baseline vs. post-professional development (Shafer, 2022).
Fig. 9 Alt Text. Two sets of subject grouped pie graphs, comparing distribution of thematic coding between baseline (top) and post-professional development (bottom) coded prompts.

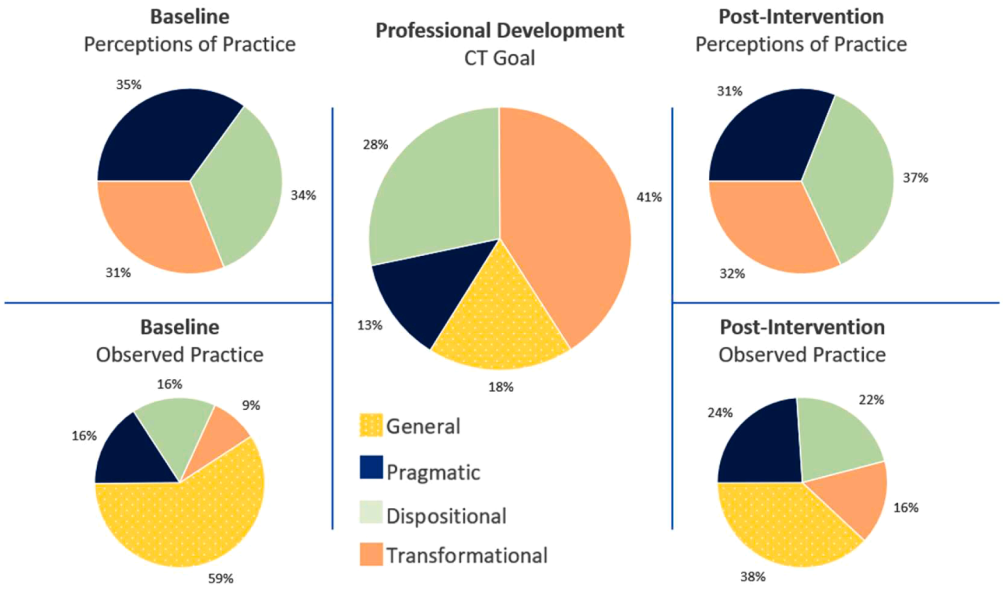


Fig. 10. Comparing thematic coding of all participants across all measures: baseline vs. post-professional development (Shafer, 2022).
Fig. 10 Alt Text. A series of comparative pie graphs containing all participant coded distributions of thematic coding across interview, questionnaire and observational measures.

Findings show the most frequently identified theme in stated goals was *transformational* (41 %), with 16 of 28 participants coded. This theme appeared both as a sole focus in some responses and alongside multiple themes in others. For participants who included *transformational* themes in their goals, the reasons and methods for integration varied based on their priorities for students, their professional development needs, and the feasibility of implementing such practices within their learning programs. For Crystal (English), the *transformational* theme was justified as her intended outcome for students: "to promote risk-taking intellectually." For Fred (science), exposure to baseline data was a driver for change "I thought that I spent a lot more time in this domain, but the data suggests otherwise". Within Kelly's (social studies) planning, it was about timing within a topic of learning "We are looking at World at War –

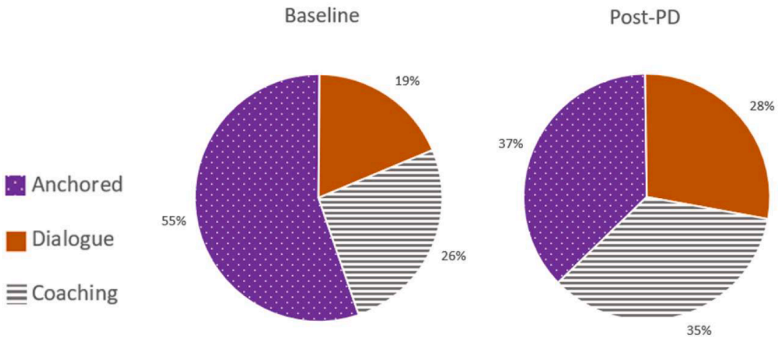


Fig. 11. Shifts in instructional distribution across all coded prompts (baseline vs. post-professional development (Shafer, 2022).
Fig. 11 Alt Text. Two pie graphs comparing all participants' sum distribution of instructional approaches between baseline (left) and post-professional development (right).

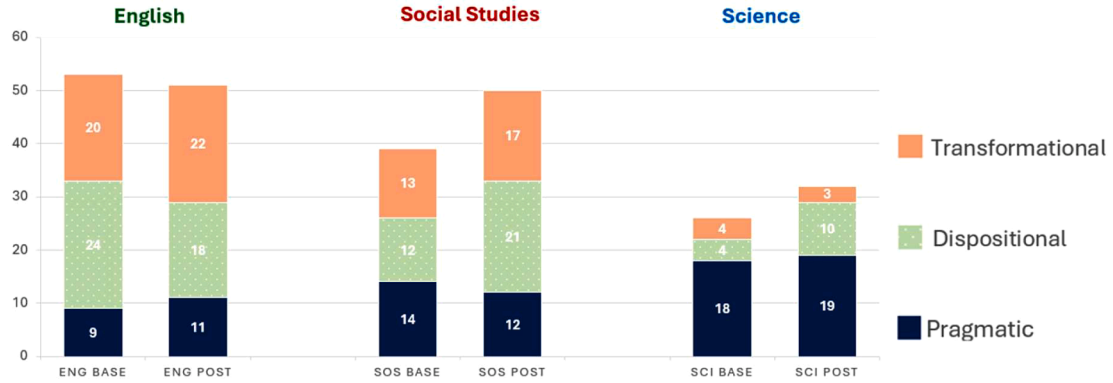


Fig. 12. Thematic coding comparing subject perceptions of critical thinking (Baseline & Post-professional development) (Shafer, 2022).
Fig. 12 Alt Text. Three sets of bar graphs comparing thematic coding of English, social studies, and science subject responses across two measures.

the changing look of conflict over time, i.e., form personal to more impersonal. This lends itself more to *dispositional* and *transformational* critical thinking" (Shafer, 2022).

4.5. *Impact of professional development on teachers' beliefs and practices*

Comparative analyses of participants' responses and observed practices across baseline and post-professional development measures enabled exploration of the final research question: "*To what extent do teacher perceptions and practices about their teaching of critical thinking in secondary schools shift following an intervention through professional development?*" Towards this, initial findings from 36 post-professional development observations (Table 7), reveal the instructional practices of participant subject groupings, by thematic code.

From post-professional development observation, the distribution of instructional practice across all subjects reveal 62 % critical themes coded (23 % *pragmatic*, 22 % *dispositional*, 16 % *transformational*). Comparative shifts in thematic coding with baseline are illustrated in Fig. 9 below.

Comparative results by subject indicate that the distribution of coded themes (*pragmatic, dispositional*, and *transformational*) consistently increased from baseline across English, social studies, and science. Overall, participants demonstrated *a* + 21 % increase in critical thematic instruction, rising from 41 % at baseline to 62 % post-professional development (Fig. 10). Notably, post-professional development *transformational* themes (16 %), which comprised approximately 60 % of participant stated goals, showed the greatest proportional growth (+303 %) from baseline observations, compared to all other coded themes (Fig. 10).

Post-professional development findings observed a more balanced distribution of instructional approaches (±9 %) compared to baseline (±36 %). *Dialogue* emerged as the most effective instructional approach for producing critical themes, with an 82 % likelihood and a notable proportional growth of +266 % in coding frequency (Fig. 11).

Exploring the impact of professional development on participants' perceptions of critical thinking, comparative findings between baseline and exit interview responses to the three coded questions revealed thematic shifts across most participants' (68 %) understandings of critical thinking, its value, and perceptions of practice.

5. Discussion

This investigation was conducted as a longitudinal study involving secondary school teachers over an academic year. The results demonstrated that the Critical Thinking Thematic Framework and Observation Tool effectively captured, disseminated, and supported the development of teachers' perceptions and instructional practices of critical thinking in English, social science, and science. By engaging with contextualised evidence of their own practices through the framework, participants identified specific goals for critical thinking instruction, enabling them to reinforce and expand their existing practices across the *pragmatic, dispositional*, and *transformational* themes.

Both the Critical Thinking Thematic Framework and Observation Tool provide innovative methods to explore, disseminate, and develop critical thinking across various theoretical influences, offering practical tools for theory and research, and address the research questions:

(1) In what ways do teachers deliver critical thinking instruction in their secondary school subject?
(2) How do teacher perceptions about their teaching of critical thinking in secondary schools reflect their practice?
(3) To what extent do teacher perceptions and practices about their teaching of critical thinking in secondary schools shift following an intervention through professional development?

5.1. Critical thinking thematic framework

Definitions of critical thinking and its development across educational contexts remain contentious (McGuirk, 2021; Santos Meneses & Drugova, 2023). Supporting literature indicates that teachers' beliefs and practices regarding critical thinking are shaped by a diverse array of values and influences (Davies & Willings, 2023), and that critical thinking is not confined to a single knowledge domain or critical theme (Abrami et al., 2015; Kincheloe & McLaren, 2011). By utilising the Critical Thinking Thematic Framework encompassing *pragmatic, dispositional*, and *transformational* aspects, this investigation empowered teachers from various subject domains to explore and develop their beliefs and instructional practices through a community of inquiry (Dunn et al., 2019).

Participants' exposure to contextualised evidence of practice through the Critical Thinking Thematic Framework contributed to the growth of all critical themes observed post-professional development, showing an increase of +21 % over *general* instruction. Notably, there were substantial gains in the least coded baseline theme, *transformational*, which experienced a growth of +303 %. Post-professional development interviews indicated that most participants (68 %) had either shifted or expanded their articulation of critical thinking to incorporate new themes compared to their baseline measure. That these shifts were not uniform supports findings from other research (van der Zanden, 2020; Zhang et al., 2024) (see Shafer, 2022 for further analyses and discussion of qualitative findings).

Together, these findings support the Critical Thinking Thematic Framework as an effective theoretical tool for reconciling tensions surrounding the definition of critical thinking and integrating multiple schools of thought to enhance both theory and explicit practice (Facione, 2020; McGuirk, 2021).

5.2. Critical thinking observation tool

From 92 classroom observations across English, social studies, and science, the Critical Thinking Observation Tool enabled reliable coding of teachers' instructional practices for comparative analyses. By coding instruction within the Critical Thinking Thematic Framework alongside specific teacher-student interactions (*anchored, dialogue*, and *coaching*) the tool provided valuable insights into how critical thinking instruction was delivered, the forms it took, and any relationship between these elements. The dissemination of this data through collaborative inquiry and individual reporting encouraged teachers to reflect on their practices, engage in discussions, and set goals for future practice (Dunn et al., 2019).

Significantly, instruction coded *dialogue* demonstrated the highest distribution of critical themes compared to *general* instruction (67 % baseline; 82 % post-professional development). This supports Davies et al.'s (2024) findings on the importance of engaging students in questioning and discussion as a key factor in developing critical thinking. Additionally, there were notable increases in the distribution of critical themes across all forms of instruction, reinforcing the notion that a *mixed* instructional approach is effective (Abrami et al., 2015). Despite holding the highest distribution of critical themes, *dialogue* was the least coded during observations (19 % at baseline and 28 % post-professional development). Even as a focus for practice, there remains debate on the best ways to facilitate *dialogue* for critical thinking (Rombout et al., 2021). This underscores the need for further research into dialogic pedagogies for critical thinking, with potential opportunities to explore the thematic framework integration within other models, such as Davies et al.'s (2023) *Street Smarts Model*, Hennessy et al. (2021) *Teacher Scheme for Educational Dialogue Analysis* (T-SEDA), and Phillipson and Wegerif's (2020) *Thinking Together*.

5.3. Design based professional development

The observed shifts in participants' practices align with Dunn et al.'s (2019) meta-analysis, which indicates that a design-based professional development model effectively engages in-service teachers in exploring their beliefs and instructional practices. In providing a common language through the thematic framework, and contextualised evidence from the observation tool, teachers can

be supported to collaboratively discuss and develop best practices around critical thinking (Hegazy et al., 2021). While broader theories and pedagogies of critical thinking remain contested (Abrami et al., 2015; McGuirk, 2021), the design-based model facilitates an authentic and meaningful exploration of teachers' beliefs and instructional practices (Anderson & Shattuck, 2012).

5.4. Opportunities

5.4.1. Critical thinking thematic framework

While the Critical Thinking Thematic Framework was employed to code secondary teachers' interview responses and instructional practices in English, social science, and science, it has potential for application across other subject disciplines and educational sectors. With broader applicability and enhanced training for teachers to observe peers using the framework, it may foster greater agency and sustained impact beyond the current investigation (Hegazy et al., 2021).

Although this investigation focused on teacher beliefs and instructional practices, the framework could also be employed to examine how students express critical thinking in their speaking, writing, and presentation of ideas across various subjects. Such application could deepen our understanding of students' contextual relationships with knowledge and the transfer of critical thinking skills between domains.

The thematic framework may offer new avenues for enhancing educational assessments of critical thinking, such as the Cornell Critical Thinking Test (Ennis & Millman, 2005). This framework provides broader thematic perspectives for focusing critical thinking instruction and assessment in students' reasoning skills. Moreover, the three critical themes present a cohesive structure for developing curriculum policy and content design, addressing challenges related to implementation (Angelelli et al., 2023; Sandretto et al., 2023; Santos Meneses, 2020). An expanded rubric, beyond what was provided in the professional development (Fig. 1), can further guide explicit instructional practices (Desmet & Sternberg, 2024). This approach has the potential to add cohesion between *generalist* conceptions of critical thinking with *specifist* applications (Abrami et al., 2008). Thus, the thematic framework emerges as a valuable tool for future research investigations both within and beyond educational settings (Song et al., 2024).

5.4.2. Critical thinking observation tool

The format and focus of the Critical Thinking Observation Tool could be adapted to identify and code critical themes in various instructional modes beyond *anchored, dialogue*, and *coaching*. It may also extend to a broader range of sources, such as multimodal texts, digital gaming, and social media. Consequently, critical themes could be observed and coded from diverse classroom materials, including audio, written, and visual resources. Additionally, the observation tool could be modified to incorporate new themes, refine existing ones, and expand data collection to include student responses. Enhancing teachers' capabilities in effective critical thinking instruction, particularly in *dialogue* (Davies & Willing, 2023; Virikki et al., 2019), could further amplify the tool's impact. By aiming to design an adaptive yet robust model for observing critical thinking in practice, this framework demonstrates potential for future applications in educational research and beyond, whether guided by a professional facilitator, community of practice, or individual study (Anderson & Shattuck, 2012).

5.5. Limitations

While coding teachers' instructional practices serves as an effective measure of the exposure students receive to critical thinking, other factors within the learning environment also contribute to the transfer of critical thinking skills (Davies & Willing, 2023; Hattie, 2009). Additional findings explored in Shafer (2022) revealed a range of conditions and barriers that affect the enactment of beliefs surrounding critical thinking, categorised into five key themes:

- classroom learning environment,
- learning focus,
- students background and dispositions,
- teacher beliefs and practices, and
- school structures and curriculum.

Observations of teachers' instructional practices alone limit the understanding of how learning resources, such as multimodal texts, prompt or reinforce critical themes within the classroom. While participants were provided with copies of their interview transcripts and their post-professional development video recorded classroom observations, observational transcripts can be effective tools for professional development (Baker, 2020; Sedova et al., 2016).

Given the scale and timeframe of this school-based research project, future projects could benefit from more funding and a larger research team to support an increase of measures and prompt reporting of verified coded results. Additionally, the Critical Thinking Observation Tool did not capture student dialogue and engagement, as this was outside the scope of the investigation. With an expanded observation tool, greater access to teacher resources, and a broader capture of student dialogue, the Critical Thinking Thematic Framework could be applied to explore the implicit and explicit indicators of critical thinking both within and beyond the classroom environment.

6. Conclusion

The Critical Thinking Thematic Framework comprising *pragmatic, dispositional*, and *transformational* offers a novel approach in understanding critical thinking. From the results of this investigation, it provides a proof of concept for exploring teachers' beliefs and instructional practices through mixed methods across various school and subject contexts. The Critical Thinking Observation Tool, when utilised for observing and coding critical themes within this framework, serves as a reliable instrument for examining teachers' instructional practices across both themes and approaches (*anchored, dialogue*, and *coaching*).

The successful implementation of the framework and observation tool in a year-long design-based study of 28 sary teachers demonstrates its potential for future research in other educational and professional contexts. Both live classroom coding and blind coding checks using audio and video transcripts indicate that a trained observer can consistently apply the observation tool to yield reliable results. Additionally, coding from 92 classroom observations (56 for baseline and 36 for post-professional development) demonstrates the tool's effectiveness as a reliable measure for collecting data on teaching practices, providing formative feedback, and informing teachers' professional development and future goals. The author hopes this study will stimulate further discussions about the nature, observation, and development of critical thinking in schools, contributing to ongoing research in the field.

Author statement

Ethics was obtained for this investigation from the University of Auckland Ethics Committee, reference number: 018340. Findings have not been altered for this submission.

CRediT authorship contribution statement

Derek Shafer: Writing – review & editing, Writing – original draft, Methodology, Investigation, Formal analysis, Data curation, Conceptualization.

Data availability

Data will be made available on request.

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