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# TPACK-E: Integrating Ethical Knowledge as a Foundational Domain in Teacher Education

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**Research Article**

**Keywords:** TPACK, ethical knowledge, teacher education, educational technology, Teacher professional development

**Posted Date:** November 3rd, 2026

**DOI:** https://doi.org/10.21203/rs.3.rs-11579765/v1

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**Additional Declarations:** The authors declare no competing interests.

# Abstract

This study addresses a critical gap in the Technological Pedagogical Content Knowledge (TPACK) framework by integrating ethical knowledge (EK) as a foundational domain, resulting in the TPACK-E model. Through semi-structured interviews with 13 teacher education experts in Iran, thematic saturation was achieved, and data were analyzed using thematic analysis. Findings establish teaching as fundamentally an ethical endeavor requiring teachers to serve as moral exemplars, while identifying four essential teacher virtues: ethical, intellectual, professional, and civic. TPACK-E implementation requires ethics embedded across curricula, role modeling by teacher educators, pedagogy centered on ethical dilemmas, and institutional policies prioritizing ethical frameworks. Theoretically, TPACK-E redefines teacher knowledge by positioning ethics as foundational, synthesizing virtue ethics, phronesis, and critical pedagogy. This study contributes to the growing body of work on AI-TPACK and Intelligent-TPACK frameworks, which similarly recognize the centrality of ethics in technology-mediated teaching. Practically, teacher education programs must prioritize ethics through mentorship, culturally responsive content, and ethical assessment metrics. Given that findings are contextualized within Iran's centralized educational system, cross-cultural validation is warranted before claiming broader applicability.


# 1. Introduction

The rapid evolution of educational technologies—particularly generative artificial intelligence (GenAI)—has ushered in unprecedented opportunities for innovation and equally complex ethical challenges. From algorithmic bias in adaptive learning systems to student data privacy concerns and inequitable access to digital tools, educators grapple with dilemmas unanticipated by earlier frameworks. While the Technological Pedagogical Content Knowledge (TPACK) framework (Mishra & Koehler, 2006) has long guided educators in integrating technology, pedagogy, and content, it has struggled to address a critical question: *How can ethics be meaningfully embedded into teaching practice rather than treated as an afterthought?*

Recent scholarship has recognized that the original TPACK framework, developed during an era of static educational technologies, now faces growing limitations in the age of AI. As AI systems become increasingly autonomous and ethically complex, educators face new challenges: how to guide AI-student interactions, manage data privacy, ensure fairness, promote critical thinking, and maintain pedagogical control in the presence of adaptive algorithms. These challenges demand frameworks that move beyond surface-level tool familiarity toward integrating ethical reflection and explicit design-in-action practices within teacher education.

Despite extensive research on TPACK, a critical gap remains: ethical knowledge is treated as separate from rather than integral to pedagogical practice. Current frameworks offer no systematic guidance for navigating the ethical implications of technology use, potentially compromising educational quality and student well-being. Prior adaptations, such as TPACKEA (Asamoah, 2019) and TPCEK (Deng & Zhang, 2023), acknowledged ethics but relegated it to supplementary tiers or fragmented subcomponents, leaving the relationships among knowledge components unclear. More recent frameworks, such as Celik's (2023) Intelligent-TPACK, the GenAI-TPACK framework, and the AIA-PCEK framework, have made important strides by integrating ethical knowledge into AI-specific TPACK extensions. However, these models often

conceptualize AI primarily as a sophisticated tool rather than as a pedagogical partner, and they lack clear operational guidelines for embedding ethical awareness and dynamic interaction management into classroom practice. Moreover, as shown in Table 1, these frameworks treat ethics as a co-equal or parallel domain rather than as foundational, which may inadvertently allow ethical considerations to be bypassed when they appear inconvenient.

This study responds by introducing the TPACK-E model, a transformative reimagining of TPACK that positions ethical knowledge not as an optional add-on but as a foundational axis shaping every dimension of teacher expertise. Unlike prior adaptations where ethics appears as a parallel or upper-tier component, TPACK-E redefines ethics as the connective tissue binding technological, pedagogical, and content knowledge—such that no pedagogical or technological decision can be made without explicit ethical consideration.

### 1.1 Objectives of the Study

1. Integrate ethical knowledge as a foundational component within the TPACK framework, addressing gaps in earlier models.
2. Empirically examine how ethical knowledge informs teachers' pedagogical choices, technology integration, and content delivery within the Iranian educational context.
3. Identify essential teacher attributes for fostering ethical development in students.
4. Propose strategies for incorporating ethical principles into teacher education programs.

### 1.2 Research Questions

1. How does the integration of ethical knowledge within the TPACK-E model redefine teaching as an ethical endeavor in technology-enhanced education?
2. What specific responsibilities do teachers have in fostering ethical values and beliefs in students within the TPACK-E framework?
3. Which teacher attributes, as identified in the TPACK-E model, are essential for promoting ethical development in students?
4. In what ways can teacher education programs incorporate ethical principles into the TPACK-E model?

## 2. Literature Review

# 2.1 The Ethical Nexus in Education

Education has historically aimed to cultivate ethical principles among students, framing the teacher-student relationship as fundamentally ethical (Campbell, 2008; Noddings, 2013). Teaching is inherently ethical due to its significant impact on students' development (Campbell, 2008), with caring relations between teachers and students forming the core of moral education (Noddings, 2013). Research has focused on ethical frameworks guiding teachers, with scholars highlighting teachers as key role models whose influence shapes students' ethical constructs (Kotaiah, 2014; Narinasamy & Lugeswaran, 2015).

Teachers influence ethical development through multiple mechanisms: fostering connections through empathy and affirmation, serving as ethical coaches and holistic mentors, and demonstrating professional dispositions that students emulate (Narinasamy & Lugeswaran, 2015; Yashoda & Kumar, 2017; Schussler & Knarr, 2013). Four components of ethical agency in teaching have been identified: sensitivity, consideration, motivation, and action (Shannon & Cunningham, 2014). Additionally, seven essential functions that teachers fulfill related to ethical development have been outlined, including ethical modeling and communication (Gui et al., 2020).

## 2.2 Virtue Ethics and Teacher Responsibility

Advocates of virtue ethics argue that education should prioritize virtues like empathy, respect, and integrity alongside knowledge, fostering morally responsible individuals (Sockett, 2012). Peterson and Arthur (2021) contend that teacher character—exemplified by fairness, honesty, and kindness—is constitutive of professional identity and capacity to model ethical behavior. This virtue ethics approach directly informs the TPACK-E framework, which positions ethical knowledge as a core competency requiring educators to embody key virtues.

In the Iranian context, recent scholarship has emphasized the importance of designing professional ethics charters for pre-service teachers that integrate philosophical traditions such as Pragmatism and Transcendent Philosophy (Hekmat-e Mota'aliyeh). This indigenous approach recognizes that ethical conduct varies across societies, shaped by unique cultural and philosophical contexts, and that teacher education programs should reflect values at global, national, and local levels.

## 2.3 Evolution of TPACK Models Incorporating Ethics

Table 1 presents a comparative analysis of models integrating ethical considerations into the TPACK framework, highlighting the progression from implicit to explicit ethical treatment. Recent developments in AI-TPACK variants have significantly advanced this evolution.

Table 1
Comparative Analysis of TPACK Models Incorporating Ethics

| Model | Structure | Ethical Emphasis | Theoretical Basis | Practical Impact |
|---|---|---|---|---|
| TPACK (Mishra & Koehler, 2006) | Three core domains: CK, PK, TK with intersections | Implicit; no structured ethical component | Shulman's PCK; socio-technical systems theory | Framework for technology integration but no systematic ethical guidance |
| TPCK-W (Lee & Tsai, 2010) | Web-specific adaptation; TK replaced with web knowledge | Implicit; follows TPACK's approach | TPACK extension; affordances theory | Guides web technology integration but lacks ethical framework |
| TPACKEA (Asamoah, 2019) | Nine-tier hierarchy; ethics at Tier 8 (alongside TPACK) | Additive; ethics as standalone tier, not foundational | Maslow-inspired hierarchy; ethics as "value requirement" | Guides professional development but fails to operationalize ethics |
| TPCEK (Deng & Zhang, 2023) | 15 components adding personal, contextual, technological ethical knowledge | Explicit but fragmented; ethics as parallel domains | Ethical pluralism; virtue, situational, and techno-ethics | Recognizes diverse ethical dimensions but complicates implementation |
| Intelligent-TPACK (Celik, 2023) | AI-specific adaptation; ethics as co-equal domain with i-TK, i-TPK, i-TCK | Explicit; ethics foregrounds transparency, accountability, inclusiveness, fairness | AI literacy frameworks; socio-technical responsibility | Provides validated instrument; recognizes ethics as predictive of integrated competence |
| GenAI-TPACK (Lan et al., 2025) | Incorporates ethical assessment knowledge alongside TK, PK, CK | Explicit; ethics as essential component for professional development | Structural equation modeling of interrelationships | Reveals positive correlation between ethical knowledge and pedagogical/content knowledge |
| AIA-PCEK (Mimoudi & Mokhtari, 2025) | AI-agent as pedagogical partner; ethical knowledge as standalone domain | Explicit; emphasizes operationalization through decision checkpoints | Agentive triad: teacher, student, AI | Provides classroom-ready scenarios and indicators for implementation |

| Model | Structure | Ethical Emphasis | Theoretical Basis | Practical Impact |
|---|---|---|---|---|
| TPACK-E (Present Study) | Ethical knowledge as foundational layer underpinning all components; integrated domains (ECK, EPK, ETK) | Core and pervasive; ethics integrated across all decision-making | Virtue ethics; phronesis; socio-technical responsibility; holistic pedagogy | Systematic ethical guidance; empowers educators to navigate dilemmas; measurable framework |

Key insights from this comparison:

- Early models (TPACK, TPCK-W) treat ethics implicitly, leaving ethical considerations unaddressed.
- Later adaptations (TPACKEA, TPCEK) explicitly incorporate ethics but do so additively or fragmentedly.
- Recent AI-TPACK variants (Intelligent-TPACK, GenAI-TPACK, AIA-PCEK) have made significant progress by integrating ethical knowledge as a co-equal or essential domain.
- TPACK-E uniquely positions ethics as foundational, ensuring it informs every pedagogical and technological decision.
- The progression reflects a critical shift from ignoring ethics to peripheral inclusion to central integration —a trend accelerated by the emergence of generative AI in education.

## 3. Theoretical Framework: The TPACK-E Model

The TPACK-E framework (Fig. 1) integrates technological, pedagogical, content, and ethical knowledge, positioning ethics as a foundational pillar of teacher competency. This synthesis underscores the necessity for teachers to possess a multifaceted understanding of their roles within educational environments.

# 3.1 Core Components of TPACK-E

**Ethical Knowledge (EK)**: In the TPACK-E framework, EK is defined as comprising three interrelated dimensions: (a) declarative ethical knowledge (e.g., knowing professional codes of conduct, privacy laws such as FERPA, definitions of algorithmic bias), (b) procedural ethical knowledge (e.g., steps to identify, analyze, and resolve an ethical dilemma in the classroom), and (c) virtue ethics disposition (e.g., habituated traits such as compassion, integrity, and fairness that guide action). Teachers must possess comprehensive understanding of ethical principles to address diverse professional challenges (Campbell, 2005; Deng & Zhang, 2023). Unlike traditional TPACK where ethics remains implicit, EK in TPACK-E is explicit, teachable, and assessable. This conceptualization aligns with recent Intelligent-TPACK research, which defines Ethical Knowledge as the ability to evaluate AI-based tools through principles such as fairness, transparency, privacy, and accountability.

**Content Ethical Knowledge (CEK)**

Highlights the ethical dimensions of subject expertise and communication. Teachers with deep content knowledge can explain complex ideas clearly (Shulman, 1986), while those showing passion create engaging environments (Fredricks et al., 2004). Ethical considerations include ensuring accurate representation of diverse perspectives and avoiding disciplinary biases.

**Pedagogical Ethical Knowledge (PEK)**

Examines the link between teaching practices and ethical responsibilities, emphasizing teacher impact on student welfare and equitable learning (Garrison & Vaughan, 2008). Differentiated instruction addressing diverse needs (Tomlinson, 2001) reflects ethical commitment to each student's uniqueness (Noddings, 2013).

**Technological Ethical Knowledge (TEK)**

Addresses ethical considerations in integrating educational technologies. Teachers' management of sensitive data, safeguarding of intellectual property, and commitment to equity are shaped by ethical values (Nordkvelle & Olson, 2005). This includes evaluating algorithms for bias and ensuring equitable access. In the context of generative AI, TEK requires teachers to audit AI tools for data governance, bias detection, and equitable access.

**Pedagogical Content Ethical Knowledge (PCEK)**

Underscores ethical principles in specialized content instruction. Teachers must select methodologies, assessment strategies, and classroom management practices that are equitable and justifiable for all students (Deng & Zhang, 2023).

**Technological Content Ethical Knowledge (TCEK)**

Requires competence in utilizing educational resources to enhance learning while maintaining ethical guidelines (Hattie, 2009). Technology can either support or hinder content comprehension, particularly for students facing resource access challenges (Chnani & Alahmed, 2023).

**Technological Pedagogical Ethical Knowledge (TPEK)**

Emphasizes selecting technologies aligned with both pedagogical methods and teacher ethical values (Mishra & Koehler, 2006). For example, electronic portfolios for assessment must safeguard student privacy (Selwyn, 2009).

**Technological Pedagogical Content Ethical Knowledge (TPACK-E)**

Comprehensive understanding of how ethical considerations influence selecting pedagogical methods and technological tools for specific content. Teachers convey content knowledge by harmonizing instructional strategies with content characteristics (Koehler & Mishra, 2009) while ensuring equitable outcomes and fostering academic growth (Harris et al., 2009).

Table 2 below presents a mapping of the seven TPACK-E subdomains, providing a core question and an illustrative example for each subdomain to support practical application in teacher education and classroom practice.

Table 2
Mapping the Seven TPACK-E Subdomains

| Subdomain | Core Question | Example |
|---|---|---|
| CEK (Content + Ethics) | Is this content presented fairly and without bias? | Teaching history includes multiple perspectives, not nationalist narrative alone |
| PEK (Pedagogy + Ethics) | Does my teaching method respect each student's dignity? | Using differentiated instruction to avoid humiliating struggling learners |
| TEK (Technology + Ethics) | Does this tool protect student privacy and promote equity? | Vetting an AI tutor for data collection and bias before classroom use |
| PCEK (Pedagogy + Content + Ethics) | Is my instructional approach for this subject ethically justifiable? | Teaching evolution while respectfully accommodating religious student beliefs |
| TCEK (Technology + Content + Ethics) | Does my use of technology distort or fairly represent this content? | Ensuring online simulation of historical events does not trivialize trauma |
| TPEK (Technology + Pedagogy + Ethics) | Does my tech-enabled pedagogy align with my ethical commitments? | Using e-portfolios but obtaining informed consent for data sharing |
| TPACK-E (All domains) | How do ethics, content, pedagogy, and technology interact in this specific teaching act? | Selecting, justifying, and implementing a fully integrated ethical lesson |

Note: Each subdomain integrates ethical knowledge (EK) with one or more of the traditional TPACK domains (CK, PK, TK). The core questions are designed to guide teacher reflection and decision-making, while the examples illustrate context-specific applications.

## 3.2 Originality and Contribution

The originality of TPACK-E lies in three specific advances over prior models. First, unlike TPACKEA's additive "ethics as tier" or TPCEK's fragmented parallel domains, TPACK-E positions EK as a foundational layer—meaning that any pedagogical or technological decision must be filtered through ethical consideration to be valid. Second, unlike Intelligent-TPACK, GenAI-TPACK, and AIA-PCEK, which treat ethics as a co-equal, essential, or standalone domain alongside AI-specific knowledge, TPACK-E treats ethical knowledge as the connective foundation beneath all seven TPACK-E subdomains; ethics is not a parallel node but the filter through which CK, PK, and TK decisions are judged. Third, the framework distinguishes between declarative, procedural, and dispositional dimensions of ethical knowledge, resolving conceptual ambiguity that has characterized earlier AI-TPACK models, and it provides a decision-making heuristic: when a teacher faces a technology-integrated teaching choice, the first question is not “Can I?” but “Should I ethically?” This addresses significant gaps in teacher education, ensuring future educators are proficient in technology, pedagogy, and navigating ethical dilemmas. These differences are conceptual and heuristic rather than

empirically validated; TPACK-E is offered as a framework to be tested, not as a demonstrated replacement for existing models.

This contribution aligns with recent scholarship on Intelligent-TPACK, which similarly emphasizes that effective AI integration requires teachers to exercise pedagogical creativity with ethical discernment, and with the GenAI-TPACK framework, which demonstrates positive correlations between ethical assessment knowledge and both pedagogical and content knowledge.

## 4. Material and Methods

# 4.1 Participants Selection

This study employed expert criterion sampling (Palinkas et al., 2015), a purposive strategy integrating expert and criterion sampling to identify authoritative figures in teacher education. Eligibility required: minimum 10 years teaching in higher education or teacher training programs, at least one publication on teacher education frameworks (2015–2023), and demonstrated ethical engagement (e.g., ethics curriculum design or service on an Institutional Review Board (IRB)).

This study was approved by the Institutional Review Board of Farhangian University (Approval No. 40009444). All participants provided informed consent prior to participation.

Data collection centered on achieving thematic saturation rather than statistical representativeness. Semi-structured interviews were conducted with 13 teacher education experts—a sample size determined by reaching data saturation (Guest et al., 2006; Vasileiou et al., 2018). Saturation was rigorously tracked: thematic redundancy emerged at Participant 11, with Participants 12–13 providing confirmatory data yielding no new codes (Creswell, 2013; Saunders et al., 2018).

Given the small sample size (N = 13) drawn from a single country, findings are considered exploratory and context-specific. No claims of statistical generalizability are made. Participants were recruited through professional networks and university dean recommendations across five Iranian universities in Tehran, Kurdistan, and Hamadan, ensuring socio-cultural and institutional diversity. Recruitment via institutional email to 22 prospective participants yielded a 59% response rate (13 of 22). Appendix A provides comprehensive demographic characteristics, including gender balance, academic rank, and institutional affiliation.

# 4.2 Data Collection

Interviews were conducted between October and December 2022 in Persian by researchers with educational framework expertise. Sessions were conducted in person (n = 5) or via Skype (n = 8), averaging 45 minutes (range 35–60 minutes)—allowing deeper exploration of complex ethical and theoretical issues. Persian language use ensured nuanced expression. Audio recordings were transcribed verbatim in Persian by the first author, a native Persian speaker with doctoral-level training in education.

Translation followed a blind back-translation procedure (Brislin, 1970). A bilingual research assistant fluent in both Persian and English, with a master's degree in English translation, translated the Persian transcripts into English. A second independent translator, also bilingual but unaware of the study's research questions and objectives, back-translated the English transcripts into Persian. The original Persian transcripts and the back-translated Persian versions were compared by the research team. Discrepancies were identified, discussed, and resolved through consensus, with a third bilingual expert consulted when agreement could not be reached. Cultural-linguistic challenges included concepts related to Islamic ethical traditions and Persian terms for virtues (e.g., "akhlaq," "ta'ahhod") that carry specific cultural connotations not fully captured by English equivalents.

A structured interview protocol (Appendix B), pilot-tested with two educators and revised based on feedback, systematically explored: (1) ethical challenges in technology-integrated teaching, (2) TPACK-E applicability, and (3) cultural-contextual considerations. Protocol aligned with research questions through thematically organized inquiries progressing from theoretical reconceptualization to practical training strategies.

## 4.3 Data Analysis

Analysis followed Braun and Clarke's (2006) six-phase thematic analysis with embedded validation strategies:

Phase 1—Data Familiarization: Transcripts were transcribed within 24 hours, anonymized (P1–P13), and researchers documented initial impressions in reflexive journals (Nowell et al., 2017).

Phase 2—Initial Code Generation: Transcripts were manually coded line-by-line. Two researchers independently coded 30% of transcripts; inter-rater reliability was calculated using Cohen's kappa ($\kappa = 0.82$, indicating strong agreement). Discrepancies were resolved via peer debriefing with a third qualitative expert, refining the codebook (Appendix C).

Phase 3—Theme Construction: Codes were grouped into provisional themes using affinity diagrams. Negative case analysis documented divergent cases to mitigate confirmation bias.

Phase 4—Theme Validation: Member checking with 11 participants (85%; 11 of 13) verified synthesized theme accuracy. Peer debriefing with two external researchers auditing 20% of coded transcripts provided external validation.

Phase 5—Theme Definition: Relationships between themes were visualized, and themes included representative quotes, frequency counts, and analytic memos linking to TPACK-E.

Phase 6—Trustworthiness: Confirmability was achieved through reflexivity journals tracking researcher biases. Dependability was secured through iterative codebook revisions and archival of rationales, following Lincoln and Guba's (1985) criteria.

### 4.3.1 Use of Interview Findings to Develop the TPACK-E Model

The model was developed through an iterative, abductive thematic process rather than imposed deductively. Initial coding was sensitized by the TPACK literature and the research questions, but codes were generated openly from participants' accounts. In Phase 3, affinity diagrams grouped codes into provisional themes concerning (a) teaching as an ethical endeavor, (b) teacher responsibilities, (c) teacher virtues, and (d) ethics integration strategies. In Phase 5, the research team mapped these themes onto the traditional TPACK domains and the proposed EK dimensions: declarative ethical knowledge, procedural ethical knowledge, and virtue-ethics disposition. Specifically, themes concerning ethical role modeling and responsibility informed PEK and TPEK; themes concerning technology-related dilemmas, privacy, bias, and equitable access informed TEK and TCEK; themes concerning content representation and bias informed CEK; and themes concerning virtues informed the dispositional dimension of EK across all subdomains. Team debriefing compared these mappings with existing ethics-integrated TPACK models, and the TPACK-E diagram and subdomain descriptions were revised iteratively until the thematic structure and the framework were mutually consistent. Thus, the interview findings did not simply illustrate a pre-existing model; they were used to specify, refine, and justify the model's components and subdomain questions.

## 4.4 Methodological Overview

The study's research process is visually summarized in Fig. 2.

# 5. Results

## 5.1 Research Question 1: Teaching as an Ethical Endeavor

**Overarching Theme: The Ethical and Normative Nature of Teaching**

Findings indicate that teaching involves essential ethical considerations, with teachers' ethical conduct central to the educational process. Three predominant themes emerged from the analysis, with theme frequencies indicating strong consensus across participants:

**Holistic Education** (mentioned by 12 of 13 participants): Education is complex and multi-faceted; neglecting any component hinders individual development. Teachers must support learners' growth in all dimensions, including moral aspects essential for human capability.

"*Teaching and the status of teachers empower educators to significantly influence students' development. Upholding ethical standards provides a foundation for holistic growth, essential across all educational dimensions, as education effectiveness is closely tied to moral development*" (P11).

**Prescriptive Nature of Teacher Ethics** (mentioned by 10 of 13 participants): Participants underscored that students and society view teachers as role models, making moral issue management crucial. Students, especially at lower levels, rely on teachers to define right from wrong.

"*Students are often heavily influenced by their teachers, rarely questioning their accuracy. When a teacher gives an incorrect answer, students often dismiss feedback from parents or others, struggling to believe a teacher could make a mistake*" (P4).

**Teacher Role Modeling** (mentioned by all 13 participants): Findings indicate teachers play a crucial role in shaping moral conduct, carrying moral obligation alongside societal expectation. As influential role models, teachers impart moral values and foster virtues.

"*Typically, a teacher fulfills two distinct roles: an indirect role and a direct role. The indirect role involves serving as a role model, where the teacher exemplifies behaviors and values students may emulate*" (P11).

TPACK-E mapping: These findings support the foundational status of EK in TPACK-E. Participants' accounts of holistic education and role modeling indicate that ethical knowledge is not a separate tier but a precondition for PEK and TPEK: pedagogical and technology-mediated decisions are described as valid only when they protect student dignity and model ethical conduct.

# 5.2 Research Question 2: Teacher Responsibilities in Fostering Ethics

**Overarching Theme: Ethical and Normative Dimensions of Education**

Findings indicate teachers assume multiple roles during the educational process, with four predominant themes emerging. Table 3 presents theme frequencies and representative quotes.

Table 3
Teacher Responsibilities in Fostering Ethics—Theme Frequencies

| Theme | Frequency | Representative Quote |
|---|---|---|
| Ethical Role Modeling | 13/13 | "Teachers may not be remembered for specific lecture details, but their behavior and ethics leave a lasting impression on students, shaping their character. Students often emulate mannerisms and style of respected teachers. I noticed changes in my speech and gait during school, which I later realized were influenced by admiration for a great history teacher" (P5, P11) |
| Ethical Responsibility | 11/13 | "In our society, when students exhibit misconduct in schools, teachers frequently become primary subjects of inquiry. There are assertions that the education system and teacher performance are evaluated critically in light of these occurrences" (P3, P5) |
| Fostering Ethical Virtues | 10/13 | "A teacher's influence on ethical values extends beyond direct instruction through subtler means. Even without explicit ethics discussion, teachers can foster ethical awareness by demonstrating sensitivity to these issues, enriching students' understanding of ethical concepts" (P13) |
| Supporting Role and Care | 9/13 | "A professional teacher mentors novice teachers, providing guidance and promoting effective teaching methods. This includes helping manage students' emotional and behavioral issues. When novice teachers struggle with parent communication, experienced educators should offer mediation, intervention strategies, and ongoing support" (P1) |

TPACK-E mapping: Ethical role modeling and responsibility map most directly onto PEK and TPEK. When participants described teachers as exemplars whose conduct shapes students' values, they were describing the dispositional dimension of EK operating through pedagogy and through technology-mediated interaction. This supports the TPACK-E claim that technology integration cannot be treated as ethically neutral.

# 5.3 Research Question 3: Essential Teacher Attributes

**Overarching Theme: Four Pillars of Teacher Virtues**

Participants identified four categories of virtues that teachers must embody to foster ethical development in students. Decision rule for categorization: A virtue is classified as ethical if it directly governs moral conduct toward others; intellectual if it governs epistemic and reflective practices; professional if it governs occupational competence; civic if it governs community-oriented action. Overlaps (e.g., fairness as both ethical and professional) were resolved by asking: "Is the primary function moral character (ethical), judgment quality (intellectual), job performance (professional), or social responsibility (civic)?"

**Ethical virtues** (love, compassion, integrity, fairness) create classroom environments conducive to ethical learning. As one participant stated:

"Students learn respect when they are treated with respect. A teacher's kindness and consistency shape students' moral compass more than any lesson plan" (P6). *(mentioned by 12/13 participants)*

**Intellectual virtues** (critical thinking, creativity, intellectual humility, reflection) enable teachers to navigate complex ethical terrain. Participants emphasized that:

"teaching is a complex and creative profession requiring adaptability and the willingness to question one's own assumptions" (P7). *(mentioned by 11/13 participants)*

**Professional virtues** (expertise, responsibility, reliability, effective communication) ensure teachers possess the technical competence required for ethical practice. As noted:

"teachers must recognize and implement factors enhancing learning. Competence itself is an ethical obligation" (P1, P5). *(mentioned by 10/13 participants)*

**Civic virtues** (empathy, social responsibility, community engagement) proved crucial for establishing moral classroom climates. One participant shared how a teacher recognized a student's hardship and initiated a fundraising initiative, embodying:

"the teacher's role as a responsible member of the community" (P13). *(mentioned by 9/13 participants)*

TPACK-E mapping: The four virtue pillars inform the dispositional dimension of EK across TPACK-E. Ethical and civic virtues primarily shape PEK and TPEK; intellectual virtues support PCEK and TCEK by enabling critical evaluation of content and technology; professional virtues support TEK and TCEK by grounding competent, responsible technology use in ethical obligation.

# 5.4 Research Question 4: Integrating Ethics into Teacher Education

**Overarching Theme: Strategies for Ethical Integration in Teacher Preparation**

**Prediction of Ethical Goals** (mentioned by 10/13 participants): Ethical goals must align with global, national, and local values. Teacher training institutions should emphasize goals reflecting societal and familial expectations, avoiding impractical aims.

"Ethical conduct varies across societies, shaped by their unique contexts. It's essential to define ethical boundaries based on the prevailing philosophical frameworks, which may arise from sacred texts or human reasoning. The ethical goals in teacher education programs should reflect the values and relationships at global, national, and local levels. These goals must be realistic; overly ambitious objectives can be impractical and ineffective" (P5, P12).

**Selection of Ethical Content in Curricula** (mentioned by 11/13 participants): Personal, social, and professional ethics should be incorporated into educational curricula, with ethical sensitivity as a key teacher competency. Simulated scenarios can integrate values, ethical understanding, and pedagogical skills to effectively foster ethical beliefs among student teachers.

"In centralized educational systems, the curriculum is not developed by individual teachers; rather, they are responsible solely for delivering pre-established content. Regardless of their personal inclinations, teachers are significantly affected by the curriculum, which is frequently shaped by prevailing ideological frameworks" (P12).

**Teachers as Role Models** (mentioned by 13/13 participants): Veteran teachers play a crucial role in shaping student teachers' ethical values. Recruiting experienced teachers who foster respectful and inclusive environments is vital for fair assessments and ethical development.

"Ethical beliefs are more effectively demonstrated in practice than in theory, often shaped by teachers' experiences and interactions rather than abstract frameworks. When teachers' words, actions, and beliefs are misaligned, student teachers struggle to embody ethical virtues. Moreover, nonverbal cues can signal a lack of genuine commitment, undermining the educational experience" (P7, P12).

**Teaching and Learning Strategies** (mentioned by **10/13 participants**): Various pedagogical approaches can enhance ethics education within teacher training programs, including dialectical discussions and exploration of ethical dilemmas.

"In teacher education, exploring ethical dilemmas is crucial for student teachers. Discussing these dilemmas fosters meaningful dialogue and critical reflection, enhancing their understanding of the teaching profession. A key strategy for this engagement is the use of dialectics, a method highlighted by various philosophers. By integrating dialectical approaches into the curriculum, educators can strengthen future teachers' critical thinking and ethical reasoning skills" (P11).

TPACK-E mapping and technology integration: Participants' strategies map onto specific TPACK-E subdomains. Dialectical discussion of ethical dilemmas develops PEK; role modeling by teacher educators develops TPEK when exemplars make technology choices visibly justified by ethical reasoning; culturally responsive content development develops CEK; and attention to privacy, bias, and equitable access in digital tools develops TEK and TCEK. These mappings show how the interview findings concretize the technology-integration dimensions of TPACK-E rather than leaving ethics as a general aspiration.

## 6. Discussion

# 6.1 Research Question 1: Teaching as an Ethical Endeavor

Findings demonstrate that teaching constitutes an ethical endeavor through its effects on student development, teacher-student relationships, and education's societal implications. Participants acknowledged teachers' considerable influence, observing that "students are often heavily influenced by their teachers, rarely questioning their accuracy" (P4), underscoring ethical responsibility weight. This aligns with Palmer (1998) on teachers as role models and Noddings (2005) on learning as character formation.

The emphasis on equitable treatment and social justice resonates with Ladson-Billings' (1994) culturally relevant pedagogy. Teachers must be conscientious of students' cultural and social contexts, advocating inclusive approaches respecting diverse backgrounds. As Freire (2000) argued, teaching practices can either perpetuate or challenge societal inequalities.

Teacher-student power dynamics require reflective practice ensuring trust, safety, and open communication. Zinn (1997) notes teacher-student relationships should be collaborative, with teachers encouraging critical thinking and respecting students as active participants. Participant emphasis that "teaching must uphold core values to differentiate between ethical and unethical behavior, as neglecting human dignity undermines recognition of individuals as rational beings" (P11) confirms this perspective.

# 6.2 Research Question 2: Teacher Responsibilities in Fostering Ethics

Findings underscore teachers' critical role in imparting ethical virtues including integrity, respect, and empathy, fostering ethical responsibility among students (Nucci & Krettenauer, 2008). Participants articulated that teachers fulfill "an indirect role as a role model, exemplifying behaviors and values students may emulate" (P11), highlighting modeling's centrality to ethical responsibility (Lovat et al., 2010).

The significance of modeling ethical behavior cannot be overstated. Participants powerfully illustrated that "teachers may not be remembered for specific lecture details, but their behavior and ethics leave lasting impressions" (P5, P11). This aligns with Lickona's (1991) argument that children emulate respected adults and Kohlberg's (1981) theory that moral development evolves through social interaction.

Teachers' role extends to facilitating discussions around ethical dilemmas and fostering environments where students feel safe expressing beliefs and values. Rest (1986) emphasizes developing moral reasoning requires practice engaging dialogues challenging personal beliefs. Participants described how

ethical influence extends beyond explicit instruction through "subtler means" such as demonstrating sensitivity to ethical issues, fostering "ethical awareness" (P13).

## 6.3 Research Question 3: Essential Teacher Attributes

The four pillars of teacher virtues—ethical, intellectual, professional, and civic—provide a comprehensive framework for understanding attributes facilitating student ethical development. Ethical virtues (love, compassion, integrity) create environments conducive to ethical learning. Lickona (1991) notes that "the character of the teacher becomes a vital influence on the character of the pupil" (p. 29).

Intellectual virtues (critical thinking, creativity, reflection) enable teachers to navigate complex ethical terrain. As participants noted, "teaching is a complex and creative profession requiring adaptability" (P7). This aligns with Dewey's (1938) emphasis on reflective thought in moral education.

Professional virtues (expertise, responsibility, effective communication) ensure teachers possess technical competence for ethical practice. Participants emphasized that "teachers must recognize and implement factors enhancing learning" (P1, P5), suggesting professional competence and ethical practice are inseparable.

Civic virtues (empathy, social responsibility) proved crucial for establishing moral classroom climates. P13's account of recognizing student hardship and initiating a fundraising initiative embodies the social responsibility and care identified as vital. As Nucci and Krettenauer (2008) indicate, empathy helps teachers connect with students personally, enhancing capacity to guide discussions on ethical dilemmas.

## 6.4 Research Question 4: Integrating Ethics into Teacher Education

Findings emphasize integrating ethical principles in teacher education programs to prepare future teachers for moral challenges. Participants stressed that "ethical beliefs are more effectively demonstrated in practice than in theory" (P7, P12), highlighting authentic modeling's necessity. They noted contextual constraints: in centralized systems, "teachers are significantly affected by curriculum shaped by prevailing ideological frameworks" (P12).

Practical strategies addressing these challenges include "exploring ethical dilemmas using dialectics to strengthen future teachers' critical thinking and ethical reasoning skills" (P11). Mapping these strategies to TPACK-E subdomains: dialectical discussions primarily develop PEK (Pedagogical Ethical Knowledge) by rehearsing ethical decision-making; role modeling develops TPEK (Technological Pedagogical Ethical Knowledge) when exemplars demonstrate technology choices justified by ethical reasoning; and culturally responsive content development addresses CEK (Content Ethical Knowledge).

Contribution and caution. The central contribution of this study is conceptual: it proposes TPACK-E as a heuristic that positions ethical knowledge as foundational and specifies declarative, procedural, and dispositional EK across seven subdomains. The qualitative findings support the plausibility and practical relevance of this framing, but they do not validate the model. The framework has not yet been tested through classroom observation, pre/post measures, or quantitative instrument validation. Accordingly,

claims about TPACK-E's effectiveness should be read as provisional and context-specific rather than as evidence of demonstrated impact.

# 7. Conclusion

This study makes a timely and substantive contribution to digital ethics in education by addressing pressing challenges—from data privacy and algorithmic bias to equitable access—through the proactive TPACK-E framework, which positions ethical knowledge as foundational rather than peripheral. This contribution aligns with the broader evolution of TPACK frameworks toward integrating ethics as a core component, as seen in recent AI-TPACK models. However, the framework is presented as a heuristic requiring local recontextualization, not a universal prescription. Its empirical basis is currently limited to the Iranian centralized educational context.

Findings redefine teaching as an ethical endeavor (RQ1), demonstrating technology integration cannot be decoupled from moral responsibility. As one participant asserted, "ethical teaching is not an add-on but the foundation" (P3). TPACK-E shifts the paradigm, framing ethical knowledge as core competency alongside pedagogical and technological expertise.

Regarding teachers' responsibilities in fostering ethical values (RQ2), findings highlight teachers' dual role as instructors and moral exemplars. Participants emphasized that "students may forget lessons, but they never forget how a teacher made them feel" (P8), underscoring the imperative for educators to embed fairness, respect, and critical digital literacy into practice.

Analysis of essential teacher attributes (RQ3) reveals virtues like compassion, integrity, and cultural humility are non-negotiable for ethical digital pedagogy. As noted, "the best teachers are not just experts in their subject but exemplars of fairness, patience, and unwavering commitment" (P6). These qualities enable educators to navigate dilemmas with moral clarity.

Insights into integrating ethics into teacher education (RQ4) call for systemic reforms. TPACK-E's multi-level approach provides a scaffold for programs to move beyond additive models. As warned, "education devoid of ethics risks producing skilled but morally adrift individuals" (P10). TPACK-E is designed to mitigate this risk by making ethical reasoning explicit, but its capacity to do so requires empirical validation.

# 8. Theoretical Implications

The TPACK-E framework presents profound theoretical implications, reshaping discourse at the intersection of teacher knowledge, ethics, and technology integration. By synthesizing virtue ethics, practical wisdom (phronesis), and empirical insights, the framework advances a reconceptualization of teacher expertise foregrounding ethical agency as constitutive of technological and pedagogical competence.

# 8.1 Reconceptualizing Teacher Knowledge

TPACK-E fundamentally challenges traditional models by asserting ethical knowledge's integral rather than peripheral nature. This responds to critiques of techno-centric educational paradigms marginalizing moral

dimensions (Selwyn, 2016). By embedding ethical reasoning across technological, pedagogical, and content domains, the framework establishes that effective teaching in digital environments requires ethical disposition, resonating with virtue ethics' emphasis on moral character (Noddings, 2013) and Deweyan pragmatism's conception of education as moral practice (Dewey, 1938).

Two significant theoretical advances emerge: First, epistemological expansion dissolving artificial dichotomies between technical and moral knowledge, proposing dialectical interdependence and challenging positivist assumptions reducing teacher expertise to measurable competencies. Second, normative transformation in understanding teacher professionalism by conceptualizing pedagogical and technological decisions as inherently value-laden, aligning with critical pedagogy's vision of education for social transformation (Freire, 2000) and care ethics' relational morality (Gilligan, 1982).

## 8.2 Virtue Ethics and Phronesis

In TPACK-E, phronesis (practical wisdom) is operationalized as a teacher's situated ability to: (a) recognize the ethical dimensions of a specific classroom situation involving technology, (b) deliberate among possible responses using relevant virtues (e.g., fairness, care), (c) make a context-sensitive judgment, and (d) act while reflecting on consequences. This is distinct from both rule-based deontology and consequence-based utilitarianism. Unlike deontological or utilitarian approaches, TPACK-E's grounding in virtue ethics privileges contextual judgment, moral character, and habituated ethical practice (MacIntyre, 1981).

The framework reconceptualizes ethical knowledge as enacted practice rather than abstract proposition. TPACK-E demonstrates how teachers' ethical understanding becomes performative through daily pedagogical choices—from selecting equitable technologies to fostering responsible digital citizenship. This performative dimension bridges the theory-practice divide, offering a dynamic model of teacher cognition aligning with Schön's (1983) reflective practice.

TPACK-E advances understanding of moral exemplarity by illuminating how educators model core virtues. This establishes theoretical connections with exemplarist virtue theory (Zagzebski, 2017), suggesting effective ethical pedagogy operates through dual mechanisms—explicitly taught through curriculum and implicitly "caught" through role modeling.

## 8.3 Advancing Critical Digital Pedagogy

TPACK-E contributes to critical digital pedagogy by systematically linking technological knowledge with ethical considerations, enabling interrogation of power structures embedded in educational technology (Selwyn, 2009). The framework resonates with postdigital theory's rejection of binary distinctions between digital and non-digital domains (Jandrić et al., 2018), conceptualizing technology as value-laden social practice.

Unlike standalone ethical frameworks such as the AAE Code of Ethics or ISTE Standards, which list principles but do not integrate them into pedagogical content knowledge, TPACK-E provides a structural mechanism—the foundational EK layer—ensuring that ethical questions are not optional add-ons but necessary starting points for any lesson design involving technology.

The emphasis on equitable technology integration offers theoretical counterpoint to concerns about surveillance edtech and algorithmic bias (Noble, 2018). Through systematic ethical knowledge integration, TPACK-E provides conceptual foundation for developing pedagogies of resistance challenging discriminatory technological systems while promoting justice-oriented practices.

## 9. Implications for Practice

# 9.1 Curriculum Integration in Teacher Education

Teacher preparation programs should embed ethical principles across curricula, moving beyond standalone ethics courses (Shapiro & Stefkovich, 2016). Required coursework should address ethical decision-making frameworks, implicit bias, and moral dimensions of educator roles. Practitioner perspectives from experienced educators sharing authentic ethical challenges ensure both conceptual understanding and practical relevance. This approach aligns with findings from studies on Iranian teacher education, which emphasize that ethical beliefs are more effectively demonstrated in practice than in theory.

# 9.2 Role Modeling by Teacher Educators

Teacher educators must exemplify ethical decision-making through case studies, moral dilemma discussions, and reflective practices (Campbell, 2008). Aspiring teachers observing ethical behavior in action internalize and commit to ethical practices, developing core professional dispositions (Schussler et al., 2010). Given participants' emphasis on the centralized nature of Iran's educational system, teacher educators should be explicitly trained to model ethical practice within the constraints of prescribed curricula.

# 9.3 Pedagogical Strategies for Ethical Reflection

Collaborative, inquiry-based, and problem-based learning create spaces for ethical discourse (Sternberg, 2012). Dialectical discussions on dilemmas like AI-driven surveillance sharpen critical thinking. Role-playing classroom conflicts practices equitable resolution strategies, fostering empathy and moral agency (Nucci & Krettenauer, 2008). This aligns with recent Intelligent-TPACK research demonstrating that embedding ethical decision-making checkpoints across performance-based activities makes ethics visible in teacher work.

# 9.4 Prioritizing Teacher Attributes

Teacher education must cultivate foundational virtues (sincerity, empathy, fairness) and civic virtues (social responsibility, commitment) through targeted training. Teacher character is not peripheral but the medium through which students' moral reasoning and community engagement are fostered (Arthur et al., 2016). In the Iranian context, this cultivation should be sensitive to the integration of Islamic ethical traditions and the philosophical foundations of Transcendent Philosophy.

# 9.5 Holistic Assessment Practices

Evaluation metrics should prioritize ethical development alongside academic achievement (Berkowitz & Bier, 2005). Multidimensional rubrics incorporating criteria like "demonstrates respect for student diversity" and

"maintains ethical communication" with 360-degree feedback mechanisms emphasize formative development rather than punitive accountability. Recent empirical research on embedding ethics in assessment practices in Tehran teacher education has identified key principles including fairness, transparency, confidentiality, respect for student autonomy, cultural sensitivity, and avoidance of bias.

## 9.6 Institutional Support

Adopting TPACK-E as a guiding framework ensures ethics is positioned as core competency. Mentorship programs pairing novice teachers with exemplary practitioners focusing on modeling ethical decision-making cultivate professional cultures where ethical conduct becomes normative. Digital platforms for ethical discourse—curated multimedia resources, structured online forums, case repositories—democratize access while respecting contextual differences.

# 10. Limitations and Future Directions

## 10.1 Contextual Limitations

The specific cultural and institutional characteristics of Iran—particularly its centralized curriculum and integration of Islamic ethical frameworks into public education—may restrict applicability to regions with different sociocultural dynamics. Therefore, findings should be treated as contextualized insights, not universal truths. Future cross-cultural or comparative studies exploring ethical knowledge integration in diverse environments (e.g., Nordic countries with different ethical traditions, East Asian collectivist societies) would deepen understanding of both universal and culturally specific elements of ethical pedagogy.

## 10.2 Methodological Limitations

While qualitative data offers in-depth insights, inherent limitations exist regarding statistical assessment and validation. The sample size of 13, while adequate for thematic saturation in exploratory qualitative research, cannot support statistical generalization. No claims of representativeness beyond this expert sample are made. Future investigations employing mixed-methods approaches merging qualitative and quantitative techniques would facilitate more thorough analysis.

The study relies exclusively on self-reported interview data. No classroom observations, pre/post measures of teacher ethical reasoning, or student outcome data were collected. Therefore, findings reflect expert beliefs about TPACK-E's potential, not demonstrated changes in teacher behavior or student ethical development. This limitation is compounded by reliance on self-reported data from semi-structured interviews, which introduces social desirability bias—participants, as teacher education experts, may overstate the importance of ethics due to professional identity and normative expectations. Consequently, the frequency of ethical themes in results may reflect what experts believe they should say rather than enacted practice. Future studies should explore triangulation techniques incorporating classroom observations, focus groups, or quantitative surveys to validate self-reported information.

Additionally, the participant pool of 13 experts, while sufficient to achieve thematic saturation, remains contextually bound to the Iranian educational system. Future studies could broaden participant bases to encompass larger, more diverse arrays of experts from different regions and sectors (e.g., Nordic countries with different ethical traditions, East Asian collectivist societies), potentially yielding more thorough insights and enabling cross-cultural comparisons.

Finally, the qualitative design prioritizes depth over breadth. While this approach is appropriate for an exploratory study proposing a new theoretical framework, it does not permit statistical testing of relationships between TPACK-E components or predictive claims about teacher performance. A further limitation is that the present study establishes the conceptual plausibility and expert-perceived relevance of TPACK-E, not its predictive validity or classroom effectiveness. The model should therefore be treated as a candidate framework awaiting validation through mixed-methods, observational, and intervention research. Future research should develop and validate quantitative instruments (see Section 10.3) to complement the qualitative foundations established here.

## 10.3 Future Research Directions

Specific actionable directions include:

1. **Cross-cultural validation studies** comparing TPACK-E implementation in collectivist versus individualist societies, and between centralized (e.g., Iran, China) and decentralized (e.g., US, Germany) educational systems.
2. **Longitudinal research** (e.g., 2–3-year follow-up studies) examining how teacher ethical reasoning develops through TPACK-E-informed preparation programs using pre/post measures of ethical judgment (e.g., Defining Issues Test adapted for teaching contexts).
3. **Development and validation of instruments** measuring TPACK-E competencies with demonstrated reliability (e.g., Cronbach's alpha > 0.80) and construct validity (confirmatory factor analysis). This aligns with recent developments in Intelligent-TPACK and GenAI-TPACK measurement instruments.
4. **Design-based research** implementing and refining TPACK-E integration strategies in diverse teacher education contexts with classroom observation protocols to document changed teaching practice.
5. **Quasi-experimental studies** examining student outcomes (ethical reasoning, digital citizenship behaviors) in classrooms taught by teachers prepared through TPACK-E frameworks compared to control groups.
6. **Integration with emerging AI-TPACK frameworks**: Future research should explore how TPACK-E relates to and can be integrated with Intelligent-TPACK, GenAI-TPACK, and AIA-PCEK frameworks, creating a comprehensive model for ethical technology integration in teacher education.

# 11. Toward Cross-Cultural Adaptation of TPACK-E

The TPACK-E framework shows potential for cross-cultural adaptation through its foundational integration of ethics into pedagogical practice. However, the present empirical basis is limited to Iran's centralized educational system, where Islamic ethical traditions shape both curriculum and teacher expectations. Therefore, rather than claiming global applicability, we offer TPACK-E as a heuristic—a conceptual tool for

thinking about ethical integration—requiring systematic recontextualization for other settings, rather than a universal prescription.

Findings establishing teaching's inherently ethical nature—affecting both intellectual development and value formation—position TPACK-E as a candidate model for ethical education that warrants testing across diverse contexts. This aligns with culturally relevant pedagogy (Ladson-Billings, 1994) and critical pedagogy (Freire, 2000), emphasizing contextually responsive, inclusive teaching practices.

Central to adaptability is emphasis on teacher-student relationships as moral enterprises grounded in trust. TPACK-E provides concrete mechanisms for educators across cultural contexts to cultivate learning environments fostering ethical development by prioritizing reflective practice and intentional ethical engagement. However, the specific virtues prioritized (e.g., from Iran's emphasis on religiously grounded ethics) may differ in secular contexts or societies with different philosophical traditions. Researchers adapting TPACK-E should precede implementation with local stakeholder deliberation about which virtues are culturally valued.

The focus on virtue cultivation—particularly qualities like integrity, empathy, and cultural responsiveness—offers culturally flexible guidelines for establishing positive classroom climates. These universal ethical foundations permit local adaptation, allowing educators to embody professional virtues in ways resonating with specific cultural contexts while maintaining core ethical principles. For example, "respect" may manifest differently in hierarchical versus egalitarian classroom cultures; TPACK-E accommodates such variation as long as the underlying ethical commitment remains explicit and defensible.

TPACK-E's implementation in teacher education demonstrates particular promise for preparing educators to navigate ethical challenges across diverse settings. Strategic approaches—integrated ethics curricula and modeled ethical practice—can be thoughtfully contextualized to address local educational priorities and cultural values. Future research should systematically document such adaptations, creating a typology of culturally specific implementations (e.g., TPACK-E-Iran, TPACK-E-Finland, TPACK-E-Singapore) to build comparative knowledge.

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## Figures

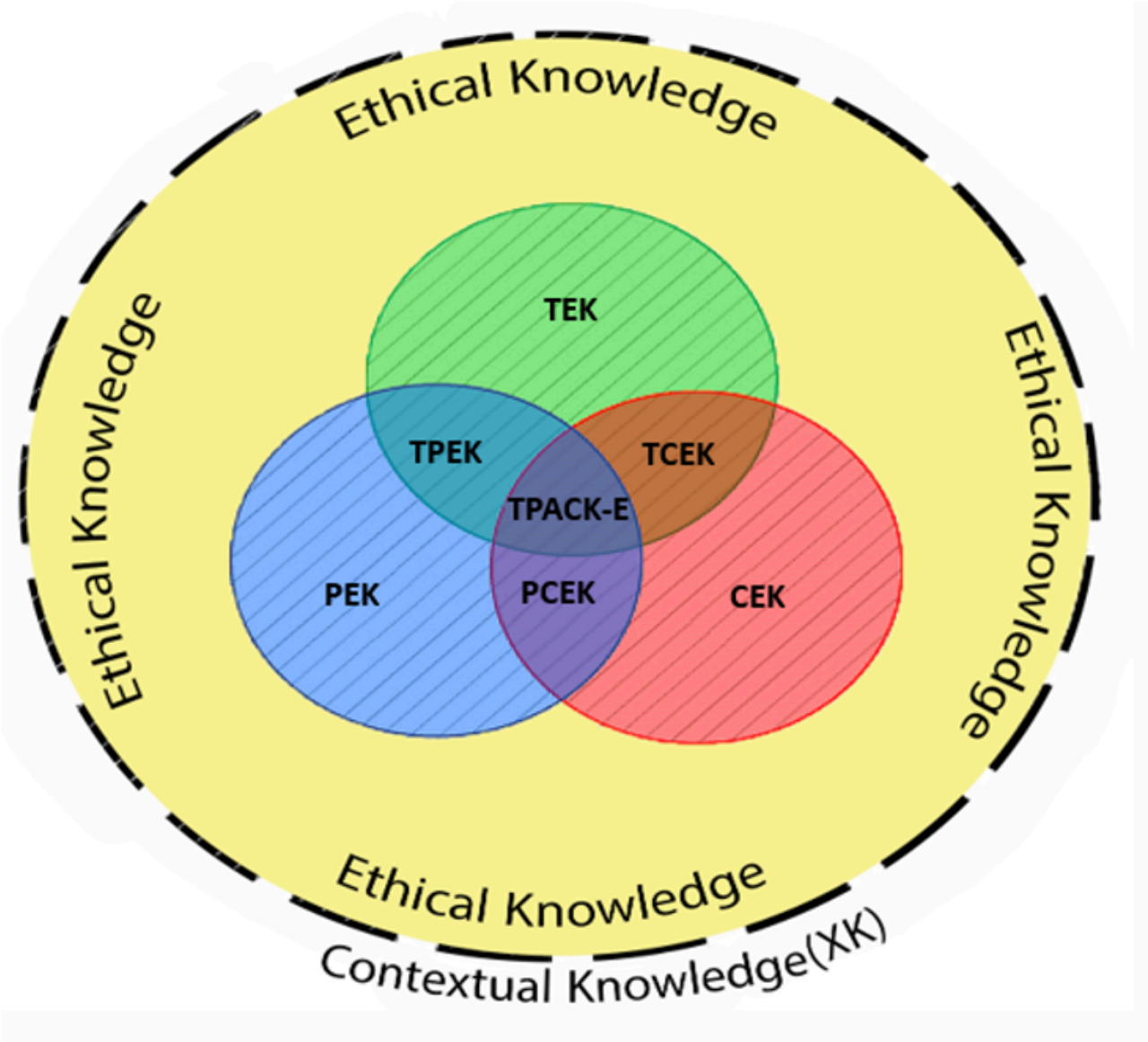



**Figure 1**

The TPACK-E Framework — Ethical Knowledge (EK) serves as the foundational layer underpinning all seven domains of technology-integrated teaching. The framework positions ethics not as an add-on but as the base upon which content, pedagogical, and technological knowledge intersect.

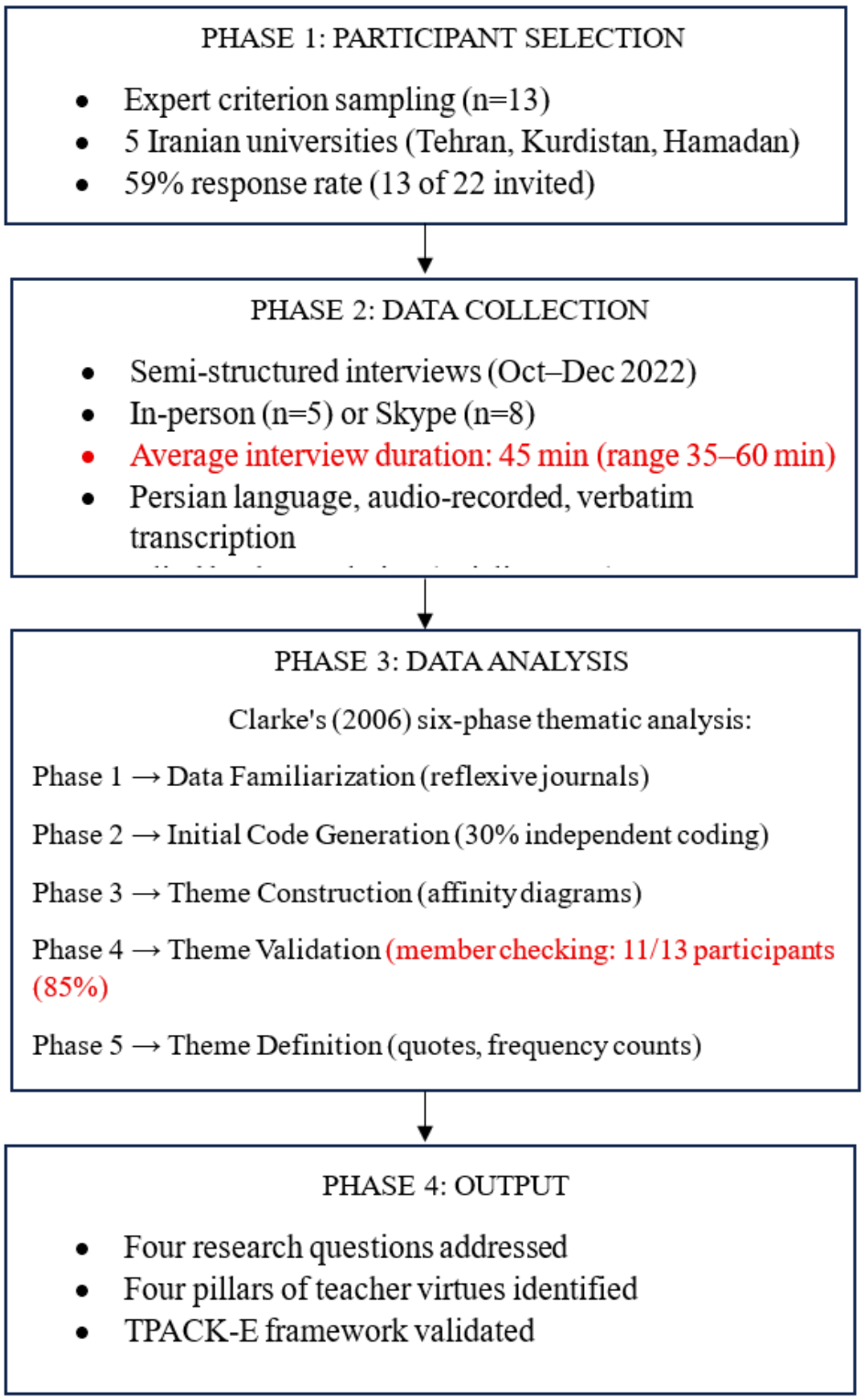



**Figure 2**

Methodological Flowchart of the Study — The diagram outlines the sequential and iterative phases of participant selection, data collection, and analysis, highlighting key methodological decisions and quality control measures implemented to ensure rigor.