



Transformative Technology Literacy Framework (TTLF) Research References

The **Transformative Technology Literacy Framework (TTLF)** is an emerging, research-based framework designed to equip learners, educators, and workforce professionals with the foundational, technical, and critical competencies needed to understand and apply transformative, immersive, and emerging technologies across disciplines.

The following references represent foundational and contemporary research that informs the development, implementation, assessment, and continuous improvement of the TTLF. They are organized by topic to support research, curriculum development, instructional design, and program evaluation.

A. Core TTLF Framework and Development

1. Zengage Learning (2024)

Transformative Technology Literacy Framework (TTLF) for College and Career Readiness

Zengage Learning. <https://zengagelearning.com>

Overview

- ⚡ Foundational publication describing the TTLF.
- ⚡ Defines the framework's pillars, competencies, learning outcomes, and implementation model.
- ⚡ Provides guidance for integrating transformative technology literacy into educational and workforce programs.

2. Zengage Learning (2024)

Transformative Technology Literacy Microlearning Series (TTLMS)

Overview

- ⚡ Self-paced online learning program covering 40 transformative technologies.
- ⚡ Demonstrates practical implementation of the TTLF through microlearning.
- ⚡ Supports college readiness, career preparation, and workforce upskilling.

3. IEEE Transactions on Learning Technologies (2024)

Evaluation of Novel Learning Technologies: Standards and Applications

<https://ieeexplore.ieee.org>

Overview

- ⚡ Reviews evidence-based methods for evaluating educational technologies.
- ⚡ Discusses learning analytics and instructional effectiveness.
- ⚡ Supports assessment methodologies applicable to TTLF implementation.

B. Educational Standards and Global Benchmarks

4. UNESCO (2023)

AI and Digital Literacy Competency Frameworks

Paris: UNESCO

Overview

- ⚡ Establishes internationally recognized AI and digital literacy competencies.

- ⚡ Provides guidance for integrating AI into education.
- ⚡ Serves as an important benchmark for TTLF alignment.

5. International Society for Technology in Education (ISTE) (2023)

ISTE Standards for Students, Educators, and Coaches

<https://iste.org>

Overview

- ⚡ Defines technology integration standards for modern education.
- ⚡ Promotes student-centered and technology-rich learning.
- ⚡ Supports instructional practices aligned with TTLF competencies.

6. Association of College and Research Libraries (ACRL)

Framework for Information Literacy for Higher Education

2017–2026 Update Cycle

<https://www.ala.org/acrl/standards>

Overview

- ⚡ Provides principles for information literacy and critical thinking.
- ⚡ Supports evaluation of digital information and responsible technology use.
- ⚡ Aligns closely with TTLF's cross-disciplinary literacy outcomes.

C. Technology Literacy and Teacher Integration

7. Bergstrand, O., & Othman, L. (2025)

A Review of Technology-Based Literacy Intervention: The Role of Teachers

Journal of Educational Research & Practice, 15, 1–14.

<https://files.eric.ed.gov/fulltext/EJ1473718.pdf>

Overview

- ⚡ Meta-analysis of technology-supported literacy interventions.
- ⚡ Examines teacher-facilitated instructional strategies.
- ⚡ Reinforces instructional practices incorporated within the TTLF.

8. Mishra, P., & Koehler, M. (2006)

Technological Pedagogical Content Knowledge (TPACK): A Framework for Teacher Knowledge

Teachers College Record, 108(6), 1017–1054.

Overview

- ⚡ Introduces the TPACK framework for integrating technology into teaching.
 - ⚡ Provides a foundation for instructional design and educator preparation.
 - ⚡ Supports TTLF implementation in educational settings.
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D. AI Literacy and Emerging Technology Education

9. Long, D., & Magerko, B. (2020)

What Is AI Literacy? Competencies, Learning Objectives, and Future Directions

AAAI AI Education Conference

Overview

- ⚡ Defines foundational AI literacy competencies.
- ⚡ Identifies essential AI knowledge, skills, and dispositions.
- ⚡ Closely aligns with TTLF competency development.

10. Velandar, K., et al. (2024)

Critical AI Literacy: Ethics and Participatory Design in Technology Education

Computers & Education, 189, 104678.

Overview

- ⚡ Explores ethical AI education.
- ⚡ Emphasizes human-centered AI design.
- ⚡ Supports reflective and responsible technology literacy.

11. Touretzky, D., Gardner-McCune, C., Masnick, A., & Seehorn, D. (2022)

AI for K–12: Preparation, Practices, and Pedagogy

AI Education Review, 2(1), 1–30.

Overview

- ⚡ Discusses effective AI instruction for K–12 education.
- ⚡ Highlights teacher preparation and classroom implementation.
- ⚡ Influences TTLF pathways for AI education.

12. Guzik, M., et al. (2024)

AI Education and Workforce Readiness: Integrating Technical Knowledge and Ethics

Education Sciences, 15, 1455.

<https://www.mdpi.com/2227-7102/15/11/1455>

Overview

- ⚡ Presents a four-pillar AI literacy framework:
 - Foundational Knowledge
 - Critical Appraisal
 - Participatory Design
 - Pedagogical Integration
 - ⚡ Closely parallels the competency model used within the TTLF.
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E. Pedagogical Design, Assessment, and Microlearning

13. Kim, J., Joseph, D., & Lintner, T. (2025)

Performance-Based Assessment in AI and STEM Curricula

Journal of STEM Education, 26(3), 45–62.

Overview

- ⚡ Examines authentic assessment methods.
- ⚡ Focuses on competency-based evaluation in AI and STEM education.
- ⚡ Supports performance-based assessment within TTLF.

14. Schleiss, C., Walter, F., & Chen, J. (2023)

Active Learning and Collaborative AI Projects: Measuring Competencies in Emerging Technology Literacy

Computers & Education, 192, 104690.

Overview

- ⚡ Investigates collaborative and project-based learning.
- ⚡ Provides validated methods for assessing technology literacy.
- ⚡ Supports competency measurement across multidisciplinary learning environments.

F. Cross-Sector Workforce Development

15. Pizzinelli, C., et al. (2023)

AI Disruption of Labor Markets: Skills, Ethics, and Workforce Development

OECD Working Paper Series

Overview

- ⚡ Examines the impact of AI on future employment.
- ⚡ Identifies emerging workforce competencies.

- ⚡ Supports TTLF career readiness objectives.

16. Schüller, K. (2022)

Algorithmic Foundations for Critical AI Literacy

Springer Nature

Overview

- ⚡ Explores algorithmic thinking and computational reasoning.
 - ⚡ Discusses responsible AI and socio-technical literacy.
 - ⚡ Provides theoretical foundations supporting TTLF competencies.
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G. Guidelines for Using These References

These references can be used to support curriculum development, instructional design, educator training, and program evaluation.

Recommended applications include:

- ⚡ Integrating TTLMS learning modules into syllabi and instructional programs.
 - ⚡ Aligning educator professional development with TPACK, AI literacy, and technology integration frameworks.
 - ⚡ Designing competency-based assessments informed by IEEE learning technology research and performance-based evaluation methods.
 - ⚡ Supporting evidence-based implementation of transformative technology literacy initiatives.
 - ⚡ Informing continuous curriculum improvement through current AI, digital literacy, and workforce research.
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H. Summary

The references presented here provide a comprehensive research foundation for the **Transformative Technology Literacy Framework (TTLF)**.

Together, they integrate educational standards, AI literacy research, instructional design models, technology integration frameworks, assessment methodologies, and workforce development studies. Collectively, these sources support the design, implementation, evaluation, and continuous improvement of technology literacy programs that prepare learners for success in an increasingly AI-driven and technology-enabled world.



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