PATT43: The 43rd International Pupils' Attitudes Towards Technology Research Conference
Hosted by the Swedish National Centre for School Technology Education (Cetis) and Technology and Science Education Research (TekNaD), Linköping University, Norrköping, Sweden, June 15th to June 18th, 2026

Exploring Student Attitude Development in Engineering and Arts/Humanities Design Activities

Sy-Yi Tzeng and Shao-An Chiu
National Kaohsiung Normal University
syt@mail.nknu.edu.tw and Shaoanchiu365@gmail.com

Abstract

Design-oriented activities are a central pedagogical strategy for integrating science, technology, engineering, the arts, and mathematics (STEAM). Among these, engineering and arts/humanities design represent two distinct approaches with differing instructional processes and philosophies. Prior studies show that students' motivations and affective responses vary across these approaches, influencing their attitudes towards technology education. Grounded in the PATT (Pupils' Attitudes Towards Technology) framework—which addresses interest, perceived difficulty, gender roles, curriculum value, and career aspirations—this study systematically reviews research on engineering and arts/humanities design within technology education. Using keyword searches in major journals and a coding scheme developed for this study, PATT-related literature was analyzed. Descriptive results and key findings are synthesized to inform future research and instructional practices in technology-based curricula.

Key Words: Design-Oriented Activities, PATT, Engineering Design, Arts and Humanities Design, Technology Education

1 INTRODUCTION

The maker culture and practical learning have a long history, including craft education, manual training, and applied arts curricula. These traditions remain essential in contemporary technology education, with varied instructional activities shown to foster positive student attitudes. Recent trends in transdisciplinary curriculum development highlight design-oriented strategies to cultivate students' problem-solving competencies (e.g., English, 2016; Kelley & Knowles, 2016; Tzeng et al., 2024). Engineering design emphasizes rational, logical processes to achieve optimal solutions. In contrast, arts and humanities-based design promotes open-ended, non-prescriptive approaches that foster divergent thinking and creativity (Brown & Wyatt, 2010; Razzouk & Shute, 2012; Runco, 2007). While both are grounded in design-based learning, students may develop different motivations and experiences depending on the design approach, shaping their engagement in technology education. The PATT (Pupils' Attitudes Towards Technology) framework offers insight into students' attitudes across dimensions such as interest, difficulty,

gender roles, curriculum value, and career aspirations. Analyzing how these dimensions vary across design-oriented activities provides a basis for informed curriculum design. This study examines research on engineering and arts/humanities-based design in technology education, focusing on their implementation and influence on students' attitudinal development.

2 LITERATURE REVIEW

2.1 Design-Oriented Activities

Technology education encompasses a range of learning activities, from hands-on and experiential tasks to engineering design focused on problem-solving and systems thinking, as well as arts and humanities-based design emphasizing creative expression, cultural context, and aesthetic judgment. These activities differ in instructional goals, pedagogical processes, and cognitive demands, shaping distinct student experiences and attitudes. Despite the growing emphasis on design-oriented strategies in interdisciplinary STEAM curricula, research often lacks clarity in distinguishing the structural and pedagogical differences among these approaches.

Engineering design-based curricula highlight rational problem-solving processes (Burke, 2014; Bybee, 2013; Dym et al., 2005; Hynes et al., 2011). According to the Next Generation Science Standards (NGSS Lead States, 2013), engineering design involves: (1) defining problems within constraints; (2) evaluating solutions; and (3) iterative testing and optimization. For novice learners, particularly those unfamiliar with engineering, identifying core problems, understanding constraints, and applying scientific and mathematical principles present significant learning challenges (Atman et al., 2007; Mentzer et al., 2014; 2015).

In contrast, arts and humanities-based design emphasizes imaginative and affective processes (Brown & Wyatt, 2010; Razzouk & Shute, 2012; Runco, 2007). As defined by IDEO, this design process includes: (1) empathy and inspiration; (2) conceptual development and visualization; and (3) iterative ideation, prototyping, and refinement. The open-ended, trial-and-error nature of such design can be frustrating for students with weak conceptual understanding, and teachers may struggle to manage outcomes due to divergent student ideas (Fukui & Sasaki, 2022; Skorinko et al., 2012).

Effective implementation of these two approaches requires addressing their inherent challenges: engineering design should not be constrained by limited materials or environments, while arts/humanities-based design must be sufficiently structured to avoid excessive divergence that impedes creativity and higher-order thinking. These considerations are essential for cultivating innovation competence.

This study focuses on two types of design-oriented activities in technology education—engineering and arts/humanities-based design—each characterized by defined processes and demands for higher-order thinking. Activities based solely on experience, imitation, manual operation, or skill acquisition are excluded. Instead, the focus is on instructional activities involving problem definition, conceptual development, and reflective iteration.

2.2 Attitudes Towards Technology

Students' attitudes towards technology are a central focus in technology education research. The Pupils' Attitudes Towards Technology (PATT) instrument has been widely used to measure students' perceptions and experiences. Developed by Raat and de Vries in the 1980s, early studies showed that cognitive and affective responses to technology were influenced by gender, conceptual understanding, and prior experience (Raat & de Vries, 1985; Boser & Daugherty, 1998).

Later efforts to standardize and revalidate the instrument identified several key dimensions. Ardies et al. (2013), through reconstruction and factor analysis of the PATT scale, confirmed subdimensions such as Career Aspirations, Interest in Technology, Tediousness, Perceived Difficulty, and Perception of Technology as a Subject for Boys or for Both Boys and Girls.

Grounded in these theoretical and empirical foundations, this study adopts these dimensions as its analytical framework. By incorporating students' subjective experiences in design-oriented curricula, the study explores how these attitude dimensions relate to learning motivation and perceptions across technology, engineering, and arts/humanities-based activities.

3 METHODOLOGY

This study followed systematic content analysis procedures (Tzeng & Yu, 2024). Literature was retrieved using keywords related to student attitudes towards technology, with a focus on studies utilizing attitude measurement instruments. Content analysis was conducted based on the instructional features of technology curriculum activities. Descriptive statistics and key analytical findings were reported to inform future research in technology education.

Three journals were selected: Design and Technology Education: An International Journal (DTEAJ), International Journal of Technology and Design Education (IJTDE), and Journal of Technology Education (JTE). Searches using the keywords "attitude," "perception," "attitude towards technology," "Attitudes Towards Technology," "PATT," "PATT-USA," "PATT-SQ," and "PATT-NL" yielded 50 articles from DTEAJ, 802 from IJTDE, and 11 from JTE, totaling 863 articles.

From these, 29 studies using the PATT instrument were identified. Applying inclusion criteria related to design orientation and attitude dimensions, studies not involving engineering or arts/humanities-based design activities were excluded. After screening, nine articles were retained for analysis. Since only IJTDE and JTE contained studies of both design orientations, DTEAJ articles were excluded.

A three-digit coding system was used: the first digit indicated the journal, and the next two indicated the article number. IJTDE was coded as "1" (101–107) and JTE as "2" (201–202).

The analysis was conducted collaboratively. One author retrieved articles and compiled metadata (title, abstract, DOI) using Microsoft Excel. Initial categorization by design orientation and attitude dimension was followed by review and verification by a second author. Final coding and analysis were completed through joint discussion.

4 RESULTS

The analysis consisted of two parts: (1) the distribution of publication years for design-oriented activity studies, and (2) a cross-comparison of design orientations and technology attitude dimensions.

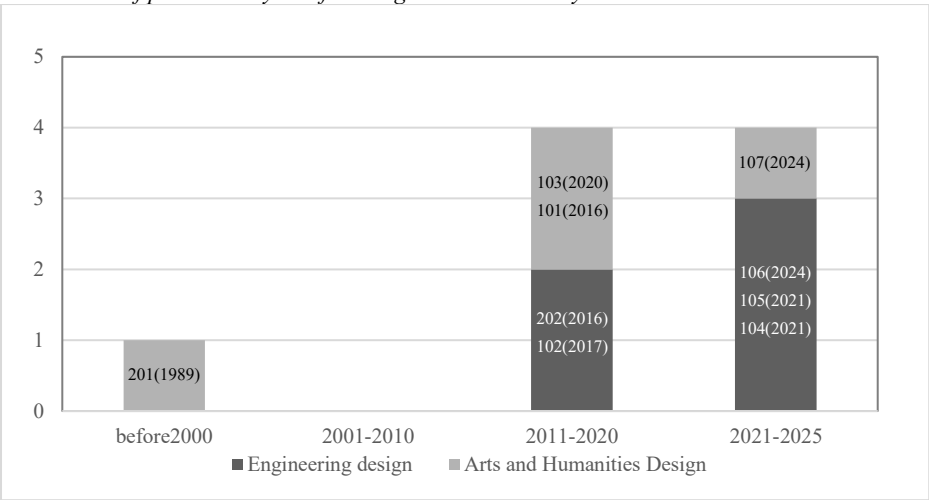
4.1 Publication Year Distribution of Design-Oriented Activity Studies

Figure 1 presents the distribution of publication years. One study was published before 2000, none between 2000 and 2010, four between 2011 and 2020, and four between 2020 and 2025. Among them, five focused on engineering design and four on arts and humanities-based design.

Engineering design studies first appeared in 2016, with the highest number published between 2021 and 2025. Arts and humanities-based design studies first emerged in 1989, with most published between 2011 and 2020.

Figure 1

Distribution of publication years for design-oriented activity studies.



Note: Article codes are arranged chronologically. Engineering design: 102, 104, 105, 106, 202; Arts and humanities-based design: 101, 103, 107, 201.

4.2 Cross-Analysis of Design-Oriented Activities and Technology Attitude Dimensions

As shown in Table 1, differences emerged in the distribution of PATT-related dimensions between engineering design and arts/humanities-based design studies.

Engineering design studies addressed all seven PATT dimensions: six focused on *Interest*, four on *Gender Role* and *Career Aspiration*, three on *Importance*, two on *Boredom*, and one each on *Difficulty* and *Curriculum*. In contrast, arts/humanities-based design studies covered only four dimensions: two on *Interest*, and one each on *Gender Role*, *Importance*, and *Career Aspiration*.

Table 1

Cross-analysis of design-oriented activities and technology attitude dimensions

Dimensions	Engineering design	Arts and humanities-based design
Gender role/ role pattern	102,104,105,202	201
Importance/consequences	104,105,106	201
Difficulty	104	
Interest	102,104,105,106,107,202	107,201
Boredom/ tediousness	104,202	
Curriculum/ Curricula	106	
Career aspiration	104,106,107,202	107

Note: Articles 101 and 103 referenced the PATT instrument but did not classify items by dimension. Article 102 partially applied the PATT dimension framework.

5 DISCUSSION AND SUGGESTIONS

This systematic review compared the research landscape of two design orientations—engineering design and arts/humanities-based design—in relation to students' attitudes towards technology (PATT). Two key findings are highlighted.

First, in terms of publication trends, the earliest study appeared in 1989. No studies were published in the 2000s, but interest has grown significantly since 2011, with four articles

published from 2011–2020 and another four from 2020–2025. This indicates the increasing prominence of design-oriented activities in technology education research.

Second, while the number of studies for each design orientation was similar, engineering design studies addressed a broader range of PATT dimensions. These included *Interest, Gender Role, Career Aspiration, Importance, Boredom, Difficulty*, and *Curriculum*. For instance, del Olmo-Muñoz et al. (2021) investigated six dimensions and found that engineering design strategies effectively reduced students' perceived difficulty and increased girls' interest in technology, demonstrating broad positive attitudinal impacts.

In contrast, arts/humanities-based design studies primarily examined *Interest, Gender Role, Importance*, and *Career Aspiration*, with no discussion of *Difficulty, Boredom*, or *Curriculum*. For example, Autio (2016) reported that although Finnish girls showed increased acceptance of everyday technologies, gender stereotypes in career aspirations persisted—suggesting that general exposure to technology may not sufficiently address deeper gender-related attitudinal gaps, unlike targeted engineering design interventions.

In sum, design-oriented activities have become a key pedagogical strategy in shaping students' attitudes towards technology over the past three decades, with engineering and arts/humanities design representing two primary trajectories. Current research shows a strong emphasis on *interest*, with less focus on *difficulty*. Engineering design studies tend to demonstrate integrative impacts across multiple dimensions and show promise in reducing gender disparities. In contrast, research on arts/humanities-based design remains limited, particularly in addressing students' cognitive challenges and curriculum-related experiences. Future work should explore students' difficulty and negative perceptions during the design process to strengthen transdisciplinary STEAM curriculum development. This article was originally written in the author's native language. Artificial intelligence tools were subsequently employed to assist with English translation and linguistic editing..

6 REFERENCES

Ardies, J., De Maeyer, S., & Gijbels, D. (2013). Reconstructing the pupils' attitude towards technology-survey. *Design and Technology Education, 18*(1), 8–19. https://files.eric.ed.gov/fulltext/EJ1007134.pdf

Atman, C. J., Adams, R. S., Cardella, M. E., Turns, J., Mosborg, S., & Saleem, J. (2007). Engineering design processes: A comparison of students and expert practitioners. *Journal of Engineering Education, 96*(4), 359-379.

Autio, O. (2016). Changes in attitudes toward craft and technology during the last 20 years. *Journal of Technology Education*, *28*(1), 53–70. https://doi.org/10.21061/jte.v28i1.a.4

Boser, R. A., & Daugherty, M. K. (1998). Students' attitudes toward technology in selected technology education programs. *Journal of Technology Education, 10*(1), 4–19. https://jte-journal.org/articles/10.21061/jte.v10i1.a.1; DOI: 10.21061/jte.v10i1.a.1

Brown, T., & Wyatt, J. (2010). Design thinking for social innovation IDEO. *Development Outreach, 12*(1), 29-31.

Burke, B. N. (2014). The ITEEA 6E learning by DeSIGNTM model, maximizing informed design and inquiry in the integrative STEM classroom. *Technology and Engineering Techer, 73*(6), 14-19.

Bybee, R. W. (2013). *The case for STEM education: Challenges and opportunities.* National Science Teachers Association.

del Olmo-Muñoz, J., Cózar-Gutiérrez, R., & González-Calero, J. A. (2022). Promoting second graders' attitudes towards technology through computational thinking instruction. *International Journal of Technology and Design Education*, *32*, 2019–2037. https://doi.org/10.1007/s10798-021-09679-1

Dym, C. L., Agogino, A. M., Eris, O., Frey, D. D., & Leifer, L. J. (2005). Engineering design thinking, teaching, and learning. *Journal of Engineering Education, 94*(1), 103-120.

English, L. D. (2016). STEM education K-12: perspectives on integration. *International Journal of STEM Education, 3*, 3. https://doi.org/10.1186/s40594-016-0036-1

Fukui, M. & Sasaki, Y. (2022). Proposal of a Small-C creativity cultivation method with modified problem-posing for use in computer studies education. In P. J. Williams (Chair), *The 11th Biennial International Design and Technologies Teaching and Research Conference (DATTArc)*. Conference conducted at Southern Cross University, Bilinga, Queensland.

Kelley, T. R., & Knowles, J. G. (2016). A conceptual framework for integrated STEM education. *International Journal of STEM education, 3*, 1–11.

Mentzer, N., Becker, K., & Sutton, M. (2015). Engineering design thinking: High school students' performance and knowledge. *Journal of Engineering Education, 104*(4), 417–432.

Mentzer, N., Huffman, T., & Thayer, H. (2014). High school student modeling in the engineering design process. *International Journal of Technology and Design Education, 24*(3), 293–316.

NGSS Lead States (2013). *Next generation science standards: For states, by states.* National Academies Press.

Raat, J. H., & de Vries, M. (1985). *What do 13-Year old pupils think about technology? The conception of and the attitude towards technology of 13-year old girls and boys*. Eindhoven University of Technology, Netherlands. (ERIC Document Reproduction Service No. ED 262998). https://eric.ed.gov/?id=ED262998

Razzouk, R., & Shute, V. (2012). What is design thinking and why is it important? *Review of Educational Research, 82*(3), 330-348.

Runco, M. (2007). *Creativity: Theories and themes: Research, development and practice.* MA: Elsevier Academy Press.

Skorinko, J. L., Doyle, J. K., & Tryggvason, G. (2012). Do goals matter in engineering education? An exploration of how goals influence outcomes for FIRST robotics participants. *Journal of Pre-College Engineering Education Research (J-PEER)*, *2*(2), 3. https://doi.org/10.5703/1288284314867

Tzeng, S. Y., & Yu, K.C., (2024). The Influence of Schooling Environment: A Review of Instruments Used to Evaluate Students' Attitudes Toward Technology. *Journal of Technology Education, 36*(1), 83-105. https://doi.org/10.21061/jte.v36i1.a.5

Tzeng, S. Y., Yu, K. C., Wu, P. H., & Fan, S. C. (2024). Do attitudes matter? An investigation into students' attitudes toward engineering and learning performances through engineering-focused STEM curricula. *International Journal of Technology and Design Education*, 1-28. https://doi.org/10.1007/s10798-024-09899-1