

Authentic Users as Catalysts for Human-Centred Design Inquiry in Key Stage 3 Design and Technology

Philip A. Jones and Matt McLain
Liverpool John Moores University
p.a.jones@2021.ljmu.ac.uk and m.n.mclain@ljmu.ac.uk

Abstract

Design and Technology (D&T) education in England has been criticised for privileging procedural making over authentic design inquiry. Design Thinking Integrated Learning (DTIL) offers a promising pedagogical response; however, classroom practice frequently relies on hypothetical users or teacher-constructed briefs. This study investigates how embedding real end-users within a DTIL-based Key Stage 3 (KS3) D&T curriculum reshapes students' design activity and perceived 21st-Century Skill development. An embedded multiple case study was conducted across ten student teams ($n=40$) undertaking twelve weeks of DTIL-structured design projects with different adult end-users from the school and local community. Data included group presentations, classroom observations and a post-intervention focus group. Reflexive thematic analysis examined how authentic user engagement influenced design reasoning and collaboration. Findings indicate that real users acted as pedagogical catalysts through three interdependent mechanisms: empathetic reframing of problem spaces, social accountability that drove iterative persistence and collaborative negotiation of meaning. These mechanisms transformed classroom design tasks from procedural activity into socially situated inquiry, making skills visible and meaningful to students. The study contributes empirical evidence that authentic user engagement is an epistemic condition for human-centred design learning. As a bounded case study, the research offers analytically generalisable insights and proposes authentic user collaboration as a transferable design principle for strengthening inquiry-driven D&T curricula.

Key Words: Design and Technology, Design Thinking Integrated Learning, Authentic Users, Human-Centred Design, 21st-Century Skills

1 INTRODUCTION

Design and Technology (D&T) education in England claims to have a distinctive role in cultivating creative problem-solving through designing and making (McLain, 2022), however research indicates that classroom D&T practice frequently becomes dominated by procedural tasks, limited problem framing and constrained user awareness (Demetriou & Nicholl, 2022;

Design and Technology Association, 2023; Nicholl & Spendlove, 2016). National inspection evidence indicates that these conditions have persisted for over two decades. Ofsted (2008) identified fragmentation in KS3 D&T, where students complete loosely connected projects that stifle creativity and encourage formulaic thinking. In England, accountability pressures and curriculum compression have further narrowed opportunities for open-ended design exploration (Atkinson, 2023; McLain et al., 2019).

International policy frameworks increasingly focus on 21st-Century Skills, particularly creativity, collaboration, communication and critical thinking (Thornhill-Miller et al., 2023). D&T is widely recognised as a natural disciplinary space for developing these competencies because of its epistemological grounding in iterative, abductive and socially mediated design practice (Cross, 2011; McLain, 2022; Morrison-Love, 2017), however, questions remain regarding how classroom pedagogies concretely cultivate such competencies rather than claiming them as outcomes.

Design Thinking Integrated Learning (DTIL) has emerged as a pedagogical approach that adapts professional design thinking into structured classroom sequences that involve empathy, ideation, prototyping and testing (Koh et al., 2015; Li & Zhan, 2022; Park et al., 2023). DTIL has been shown to promote engagement and creative reasoning (Henriksen et al., 2020; Razzouk & Shute, 2012), although critiques highlight that empathy activities often become procedural exercises when detached from authentic stakeholders (Demetriou & Nicholl, 2022) and its model can be viewed as oversimplified and fixed in a technē paradigm (Lee, 2021).

Authentic end-users have been proposed as a means of reintroducing genuine human-centred inquiry into classroom design (Morrison-Love, 2022), but empirical evidence in D&T within schools remains limited (Bosch et al., 2022; Klapwijk & van Doorn, 2015). This study addresses this gap by examining how real user collaboration can reshape design activity within a DTIL-based Key Stage 3 (KS3) intervention at the lower secondary level.

Research question: how does authentic user engagement influence students' design activity and perceived 21st-Century Skill development within DTIL-based KS3 Design and Technology?

The study isolates authentic user collaboration as a specific pedagogical mechanism. The aim is analytical generalisation in identifying transferable design principles for technology-education curriculum development (Yin, 2018).

2 THEORETICAL FRAMING

2.1 Design learning as inquiry-driven and socially situated practice

Contemporary design-education scholarship conceptualises learning as an inquiry-driven practice in which knowledge emerges through interaction, negotiation and material engagement (Atkinson, 2023; Cross, 2011; Kimbell, 2011; Rusmann & Ejsing-Duun, 2022). From this perspective, design learning moves away from linear problem-solving and becomes abductive

reasoning under the conditions of uncertainty, where students frame and reframe problems through dialogue with others and artefacts (Cross, 2006; Dorst, 2011).

Within D&T education, collaboration, empathy and reflection function as epistemic rather than affective features of design activity (McLain, 2020; Morrison-Love, 2017), however, classroom studies repeatedly show that inquiry conditions are often reduced by tightly prescribed briefs and assessment routines that limit opportunities for genuine negotiation of meaning (Griffin & Care, 2015; Mawson, 2003; McLellan & Nicholl, 2013; Nicholl & Spendlove, 2016). Ofsted observed that teachers frequently retain tight control over students' activities, giving insufficient opportunity to "make decisions, plan, analyse and evaluate", which "gives a poor foundation for studying at Key Stage 4" and limits independent design reasoning (Ofsted, 2008). Despite this prolonged issue, the subject still lacks the 'human' element of design (Design and Technology Association, 2023).

Interaction with real people anchors design activity in lived contexts and ethical responsibility, which aligns classroom practice with participatory and relational traditions in design research (Morrison-Love, 2022; Sanders & Stappers, 2008).

2.2 *DTIL and human-centred pedagogy*

DTIL adapts professional design thinking into structured classroom learning cycles (Koh et al., 2015; Li & Zhan, 2022). Studies indicate that DTIL can promote engagement and creative reasoning (Henriksen et al., 2020), although empathy activities risk becoming procedural when detached from authentic stakeholders (Demetriou & Nicholl, 2022). Participatory design traditions position users as co-creators of meaning instead of passive informants (Sanders & Stappers, 2008), which suggests that authentic user collaboration could develop D&T pedagogy.

Within this study, empathic design is understood as engagement with users' lived experiences to inform problem framing, meanwhile user-centred design positions users as active contributors in shaping design outcomes.

2.3 *Authentic users and the relational turn in design education*

Design is considered as relational, where knowledge emerges through interaction between people, artefacts and contexts (Kimbell, 2011; Rusmann & Ejsing-Duun, 2022). From this perspective, users become participants in meaning-making who shape how problems are framed, values are prioritised and solutions are justified.

Within D&T, users are often represented through fictional personas or teacher-developed briefs. Although these can simulate professional processes, studies indicate that they frequently reduce empathy to a procedural step and limit opportunities for genuine engagement with lived experience (Bosch et al., 2022; Demetriou & Nicholl, 2022; Kaygan & Yargın, 2019; McLellan & Nicholl, 2013). This constrains students' exposure to authentic uncertainty and competing needs.

When participatory practices are translated into educational settings, authentic user collaboration introduces external perspectives that disrupt pre-specified problem spaces and redistribute authority for defining success, which reflects the shift from designing *for* users to designing *with* them in contemporary professional practice (Bjögvinsson et al., 2012; McDonagh, 2015). Interaction with real users deepens contextual understanding and aligns classroom practice with contemporary design epistemologies (Demetriou & Nicholl, 2022; Kaygan & Yargın, 2019; Morrison-Love, 2022).

This study therefore conceptualises authentic users as relational partners who introduce epistemic uncertainty and accountability into classroom design activity. Examining how these dynamics unfold within DTIL cycles provides insight into how school D&T can move towards inquiry-driven and human-centred practice.

3 METHODOLOGY

3.1 *Research design*

An embedded multiple case study design was adopted (Stake, 2006; Yin, 2018). The overarching case was a DTIL-based KS3 D&T curriculum intervention. Ten embedded cases were defined with each comprising of a team of four Year 8 students (aged 12-13 years) collaborating with a different adult end-user. This structure enabled examination of how distinct user interactions shaped the design processes under shared curricular conditions.

The study is positioned within interpretivist and social-constructivist traditions that examine how knowledge and meaning are co-constructed through collaborative design activity (Schwandt, 2000).

3.2 *Participants and context*

Forty students participated in one single-sex (girls) secondary school. Teams were heterogeneously grouped and the end-users were school staff and community members who presented genuine needs that required design solutions. The projects ran across twelve weeks of curriculum time following DTIL cycles of empathising, defining, ideating, prototyping and testing. As an example, one of the contexts was provided by an audiologist who found it challenging to provide a simple but engaging means of supporting hearing tests with 2–5-year-olds. The group considered all the constraints, including hygiene and safety, to produce a simple pick and place activity when the child hears certain sounds. Another example was a way of reminding students where to place certain ingredients in the fridge for their cooking classes. The group produced an encased electronic system that activated when the fridge door was opened, and an audio message was played aloud.

3.3 *Data collection*

Data sources included:

- Group oral presentations documenting design decisions and user feedback
- Classroom observations and researcher field notes
- A post-intervention photo-elicitation focus group (Leonard & McKnight, 2015)

This paper focuses on qualitative data that reveal how authentic users shaped design reasoning and collaboration.

3.4 *Data analysis*

Reflexive thematic analysis followed Braun and Clarke's (2022) approach. Coding progressed iteratively from descriptive accounts of user interaction towards interpretive themes that explained how authentic users functioned as pedagogical mechanisms. Cross-case comparisons identified recurring patterns.

3.5 *Trustworthiness and reflexivity*

Prolonged engagement across the twelve-week intervention enabled familiarity with classroom dynamics. Data triangulation across observations, presentations and focus group discussion strengthened the interpretive credibility, and the reflexive thematic analysis acknowledged the researcher's role in meaning-making.

3.6 *Enactment of DTIL within the curriculum intervention*

The DTIL curriculum intervention was structured around iterative cycles of empathising, defining, ideating, prototyping and testing, which was adapted for KS3 classroom conditions. Each team met their end-user to explore needs and challenges. Students conducted informal interviews, recorded their observations and produced initial problem statements. This empathising phase was followed by group discussion to define user needs and generate early concepts.

During ideation, the teams used sketching, annotation and low-fidelity modelling to explore alternative concepts. Teacher facilitation focused on prompting justification of decisions instead of directing any solutions. Prototyping involved constructing physical artefacts using workshop tools and digital modelling software. Testing cycles included presenting prototypes to end-users, gathering feedback and identifying necessary refinements.

These DTIL cycles were repeated across the twelve-week project. Although the sequence provided structural guidance, the teams retained autonomy in design direction and interpretation of the user feedback. This combination of structured cycles and authentic external interaction created conditions for emergent inquiry instead of the completion of tasks in a linear fashion. The intervention therefore provided a consistent pedagogical framework that allowed for variability in user interaction to shape each embedded case.

3.7 *AI Disclosure Statement*

Artificial Intelligence (AI) technologies were used solely to enhance clarity and structure of the written text. All scholarly contributions, theoretical perspectives, and analyses were produced by the authors.

4 FINDINGS

Three interdependent themes were identified: empathetic reframing of problem spaces, social accountability that drove iterative persistence and collaborative negotiation of meaning.

4.1 *Empathetic reframing of problem spaces*

Encountering real end-users prompted the students to reconceptualise design tasks around lived needs rather than teacher-constructed briefs.

“At first I thought it was just making something to store things. But when she explained how she struggles to reach things, we realised the problem was much more about accessibility.” (Group 3)

“After talking to him, we changed our idea completely. What we thought was helpful actually wouldn’t work in real life.” (Group 7)

Observations noted sustained questioning and interpretation of user narratives:

“We had to really listen because if we misunderstood her, the design wouldn’t actually help.” (Group 1)

Analytically, this reflects abductive reasoning, which is central to design cognition (Cross, 2011; Dorst, 2011) and aligns with design as knowledge creation through interaction (Grönman & Lindfors, 2021). Authentic users introduced epistemic uncertainty and inquiry conditions that are often absent from routine classroom D&T tasks (Mawson, 2003; McCormick, 2004).

4.2 *Social accountability that drove iterative persistence*

Students described a sense of responsibility towards producing functional outcomes for real users.

“When it didn’t work the first time, we couldn’t just leave it because someone was actually depending on it.” (Group 5)

“If it was only for an assessment, we probably would’ve stopped. But because she was going to use it, we kept fixing it.” (Group 9)

Authentic users redistributed evaluative authority away from teacher assessment to external stakeholders. This transformed evaluation towards a personal commitment, which aligns with accounts of design learning as inquiry that is sustained by social consequence (Rusmann & Ejsing-Duun, 2022).

4.3 Collaborative negotiation of meaning

Authentic users introduced external perspectives that required collective interpretation.

“She said she liked both ideas, so we had to decide which actually solved her problem better.” (Group 6)

“We didn’t all agree on what he meant at first, so we had to talk it through.” (Group 4)

Focus-group reflections explored this more intensive collaborative dialogue:

“We had to explain our ideas properly to each other so we could explain them to the user.” (Focus group)

This reflects collaborative knowledge construction where uncertainty that is introduced by external perspectives stimulated shared reasoning and the articulation of assumptions (Care et al., 2016).

5 DISCUSSION

5.1 Authentic users as epistemic catalysts in DTIL

Existing DTIL research demonstrates that structured design thinking cycles can promote engagement, creativity and collaboration (Henriksen et al., 2020; Li & Zhan, 2022), however, classroom-based studies caution that when empathy and ideation activities are detached from real stakeholders, design thinking risks becoming another routine pedagogical procedure (Demetriou & Nicholl, 2022). The findings show how authentic user engagement reintroduced epistemic uncertainty, responsibility and negotiation into DTIL cycles.

Empathetic reframing that was observed in this study illustrates how real users altered students’ initial assumptions and prompted abductive problem framing. This supports arguments that design competence in schools depends on opportunities to encounter authentic complexity rather than simplified tasks (Mawson, 2003; Mawson & Maor, 2001; Rusmann & Ejsing-Duun, 2022). Authentic users functioned as external reference points that required the students to iterate their interpretations of the problem space rather than accepting teacher-defined briefs.

Social accountability extended DTIL’s iterative stages beyond compliance with assessment criteria, which aligns with claims that meaningful design learning requires consequences that

matter beyond the classroom (McLain, 2022, 2023). The presence of real users therefore altered motivational structures and sustained persistence through iterative refinement.

Collaborative negotiation of meaning demonstrates how user feedback became a shared interpretive object around which teams articulated their assumptions, justified their decisions and co-constructed knowledge. This resonates with collaborative learning research that positions group dialogue as a shared practice of sustained thinking and co-construction of meaning (Mercer & Littleton, 2007). DTIL cycles became sites of collective reasoning instead of a task that “masquerades as design and make” (McLain, 2020, p. 79). These mechanisms indicate that the authentic users improved DTIL’s inquiry potential.

5.2 *Repositioning classroom D&T practice*

Persistent critiques of D&T in England describe classroom activity that is dominated by procedural making, limited problem framing and constrained student agency (Demetriou & Nicholl, 2022; Nicholl & Spendlove, 2016). This study provides empirical evidence that embedding real users can address these tendencies by re-establishing design as relational inquiry.

Instead of adding an extra activity, the inclusion of authentic users reorganised the structure of classroom authority. Evaluative judgement was no longer held exclusively by the teacher because it was distributed across the user, team and artefact. This redistribution of authority is significant because it created conditions for the students to experience design as negotiated, value-laden and socially accountable practice that is consistent with contemporary professional design epistemologies (Kimbell, 2011; Morrison-Love, 2022).

These findings therefore suggest that authentic user collaboration is not an optional enrichment to DTIL but is a structural condition that enables DTIL cycles to function as genuine inquiry. For curriculum designers, this highlights the importance of embedding external stakeholders where the aim is to cultivate human-centred reasoning.

5.3 *Analytical generalisation and transferability*

As a bounded case study in one school context, the study does not claim any statistical generalisation, although by identifying mechanisms through which authentic users shaped design activity, the findings support analytical generalisation (Stake, 2006; Yin, 2018). The mechanisms of empathetic reframing, social accountability and collaborative negotiation represent transferable pedagogical design principles that have the potential to inform curriculum development beyond a single school context.

Although contextual factors such as school culture, resources, timetable structure and teacher expertise inevitably mediate its implementation, the identified mechanisms offer theoretically grounded insights into how authentic user collaboration can support inquiry-driven D&T. Future research could examine how these mechanisms function across different age groups, assessment regimes and contexts, but this study provides a starting point for evidence-informed curriculum design.

6 CONCLUSION

This embedded multiple case study examined how authentic user collaboration reshaped DTIL-based design learning in KS3 D&T. Reflexive thematic analysis identified empathetic reframing, social accountability and collaborative negotiation as mechanisms through which real users transformed classroom design tasks into inquiry-driven and human-centred practice.

Although it is bounded to one school context, the study offers analytically generalisable insights into how authentic users function as epistemic conditions for meaningful design learning. Authentic user collaboration could be viewed as a transferable design principle for strengthening inquiry, collaboration and visible 21st-Century Skill development in technology education curricula. At a time when D&T curricula face increasing performativity pressures, authentic user engagement offers a practical means of protecting space for uncertainty, empathy and dialogue at the heart of D&T education.

6.1 *Limitations and future research*

The study is limited to one school context and a single twelve-week intervention. Although the embedded case study design supports analytic depth, the findings are shaped by local curriculum conditions and the availability of adult end-users. Additionally, the presence of the researcher as teacher may have influenced classroom dynamics, although reflexive analysis sought to account for this.

Future research could examine authentic user collaboration across diverse school settings, different age phases and alternative DTIL structures. Longitudinal studies could further explore how repeated exposure to authentic design inquiry may influence students' developing design identities and sustained development of 21st-Century Skills.

7 REFERENCES

- Atkinson, S. (2023). Design and Technology Education in England. In *The Bloomsbury Handbook of Technology Education* (pp. 28–41). Bloomsbury Publishing Plc. <https://doi.org/10.5040/9781350238442.0011>
- Bjögvinsson, E., Ehn, P., & Hillgren, P.-A. (2012). Design Things and Design Thinking: Contemporary Participatory Design Challenges. *Design Issues*, 28(3), 101–116. https://doi.org/10.1162/DESI_a_00165
- Bosch, N., Härkki, T., & Seitamaa-Hakkarainen, P. (2022). Design Empathy in Students' Participatory Design Processes. *Design and Technology Education: An International Journal*, 27(1), 29–48.
- Braun, V., & Clarke, V. (2022). *Thematic Analysis: A Practical Guide*. SAGE Publications Ltd.
- Care, E., Scoular, C., & Griffin, P. (2016). Assessment of Collaborative Problem Solving in Education Environments. *Applied Measurement in Education*, 29(4). <https://doi.org/10.1080/08957347.2016.1209204>

- Cross, N. (2006). Designerly Ways of Knowing. In *Designerly Ways of Knowing*. Springer London Ltd. <https://doi.org/10.1007/1-84628-301-9>
- Cross, N. (2011). *Design Thinking: Understanding How Designers Think and Work* (1st ed.). Berg Publishers.
- Demetriou, H., & Nicholl, B. (2022). Empathy is the mother of invention: Emotion and cognition for creativity in the classroom. *Improving Schools*, 25(1), 4–21. <https://doi.org/10.1177/1365480221989500>
- Design and Technology Association. (2023). *Reimagining D&T*. <https://www.designtechnology.org.uk/media/4843/reimagining-dt-our-vision-v9.pdf>
- Dorst, K. (2011). The core of ‘design thinking’ and its application. *Design Studies*, 32(6), 521–532. <https://doi.org/10.1016/j.destud.2011.07.006>
- Griffin, P., & Care, E. (2015). *Assessment and Teaching of 21st Century Skills* (P. Griffin & E. Care, Eds.). Springer Netherlands. <https://doi.org/10.1007/978-94-017-9395-7>
- Grönman, S., & Lindfors, E. (2021). The Process Models of Design Thinking: A Literature Review and Consideration from the Perspective of Craft, Design and Technology Education. *Echne Serien - Forskning i Slöjdpedagogik Och Slöjdvvetenskap*, 28(2), 110–118.
- Henriksen, D., Gretter, S., & Richardson, C. (2020). Design thinking and the practicing teacher: addressing problems of practice in teacher education. *Teaching Education*, 31(2). <https://doi.org/10.1080/10476210.2018.1531841>
- Kaygan, P., & Yargin, G. T. (2019). Design for the well-being of domestic animals: implementation of a three-stage user research model. *Design and Technology Education: An International Journal*, 24(3), 12–30.
- Kimbell, L. (2011). Rethinking Design Thinking: Part I. *Design and Culture*, 3(3), 285–306. <https://doi.org/10.2752/175470811X13071166525216>
- Klapwijk, R., & van Doorn, F. (2015). Contextmapping in primary design and technology education: a fruitful method to develop empathy for and insight in user needs. *International Journal of Technology and Design Education*, 25(2), 151–167. <https://doi.org/10.1007/s10798-014-9279-7>
- Koh, J. H. L., Chai, C. S., Wong, B., & Hong, H.-Y. (2015). *Design Thinking for Education*. Springer Singapore. https://doi.org/10.1007/978-981-287-444-3_1
- Lee, K. (2021). Critique of Design Thinking in Organizations: Strongholds and Shortcomings of the Making Paradigm. *She Ji: The Journal of Design, Economics, and Innovation*, 7(4), 497–515. <https://doi.org/10.1016/j.sheji.2021.10.003>
- Leonard, M., & McKnight, M. (2015). Look and tell: using photo-elicitation methods with teenagers. *Children's Geographies*, 13(6), 629–642. <https://doi.org/10.1080/14733285.2014.887812>
- Li, T., & Zhan, Z. (2022). A Systematic Review on Design Thinking Integrated Learning in K-12 Education. *Applied Sciences*, 12(16), 8077. <https://doi.org/10.3390/app12168077>

- Mawson, B. (2003). Beyond 'The Design Process': An Alternative Pedagogy for Technology Education. *International Journal of Technology and Design Education*, 13(2), 117–128. <https://doi.org/10.1023/A:1024186814591>
- Mawson, B., & Maor, D. (2001, December). Beyond design: A new paradigm for technology education. *AARE 2001 International Education Research Conference*.
- McCormick, R. (2004). Issues of Learning and Knowledge in Technology Education. *International Journal of Technology and Design Education*, 14(1), 21–44. <https://doi.org/10.1023/B:ITDE.0000007359.81781.7c>
- McDonagh, D. (2015). Design students foreseeing the unforeseeable: Practice based empathic research methods. *International Journal of Education Through Art*, 11(3), 421–431. https://doi.org/10.1386/eta.11.3.421_1
- McLain, M. (2020). Key pedagogies in design and technology. In A. Hardy (Ed.), *Key pedagogies in design and technology* (4th Edition). Routledge.
- McLain, M. (2022). *Secondary Teacher and Teacher Educator Perspectives on 'demonstration' as a Signature Pedagogy for Design and Technology: Implications for Initial Teacher Education* [Doctor of Philosophy by Published Work]. Liverpool John Moores University.
- McLain, M. (2023). What's so special about design and technology anyway? In A. Hardy (Ed.), *Debates in Design and Technology Education* (2nd ed., pp. 77–97). Routledge. <https://doi.org/10.4324/9781003166689-8>
- McLain, M., Irving-Bell, D., Wooff, D., & Morrison-Love, D. (2019). How technology makes us human: cultural historical roots for design and technology education. *The Curriculum Journal*, 30(4), 464–483. <https://doi.org/10.1080/09585176.2019.1649163>
- McLellan, R., & Nicholl, B. (2013). Creativity in crisis in Design & Technology: Are classroom climates conducive for creativity in English secondary schools? *Thinking Skills and Creativity*, 9, 165–185. <https://doi.org/10.1016/j.tsc.2012.11.004>
- Mercer, N., & Littleton, K. (2007). *Dialogue and the Development of Children's Thinking*. Routledge. <https://doi.org/10.4324/9780203946657>
- Morrison-Love, D. (2017). Towards a Transformative Epistemology of Technology Education. *Journal of Philosophy of Education*, 51(1), 23–37. <https://doi.org/10.1111/1467-9752.12226>
- Morrison-Love, D. (2022). Technological problem solving: an investigation of differences associated with levels of task success. *International Journal of Technology and Design Education*, 32(3), 1725–1753. <https://doi.org/10.1007/s10798-021-09675-5>
- Nicholl, B., & Spendlove, D. (2016). "Academic Tasks" in Design and Technology Education: Past, Present and Future. In M. J. de Vries, S. Fletcher, S. Kruse, P. Labudde, M. Lang, I. Mammes, C. Max, D. Münk, B. Nicholl, J. Strobel, & M. Winterbottom (Eds.), *Technology Education Today: International Perspectives* (Vol. 1, pp. 125–146). Waxmann Verlag.

- Ofsted. (2008). *Education for a technologically advanced nation*. <https://dera.ioe.ac.uk/id/eprint/8197/1/Education%20for%20a%20technologically%20advanced%20nation%20%28PDF%20format%29.pdf>
- Park, H., Kim, M. S., & Ifewulu, H. A. (2023). Reviewing Design Thinking in and out of Education. *Research in Integrated STEM Education, 1*(2). <https://doi.org/10.1163/27726673-bja00012>
- Razzouk, R., & Shute, V. (2012). What Is Design Thinking and Why Is It Important? *Review of Educational Research, 82*(3), 330–348. <https://doi.org/10.3102/0034654312457429>
- Rusmann, A., & Ejsing-Duun, S. (2022). When design thinking goes to school: A literature review of design competences for the K-12 level. *International Journal of Technology and Design Education, 32*(4), 2063–2091. <https://doi.org/10.1007/s10798-021-09692-4>
- Sanders, E. B.-N., & Stappers, P. J. (2008). Co-creation and the new landscapes of design. *CoDesign, 4*(1), 5–18. <https://doi.org/10.1080/15710880701875068>
- Schwandt, T. R. (2000). Three Epistemological Stances for Qualitative Inquiry. In N. K. Denzin & Y. S. Lincoln (Eds.), *Handbook of Qualitative Research*. SAGE Publishing.
- Stake, R. E. (2006). *Multiple Case Study Analysis*. The Guilford Press.
- Thornhill-Miller, B., Camarda, A., Mercier, M., Burkhardt, J. M., Morisseau, T., Bourgeois-Bougrine, S., Vinchon, F., El Hayek, S., Augereau-Landais, M., Mourey, F., Feybesse, C., Sundquist, D., & Lubart, T. (2023). Creativity, Critical Thinking, Communication, and Collaboration: Assessment, Certification, and Promotion of 21st Century Skills for the Future of Work and Education. In *Journal of Intelligence* (Vol. 11, Number 3). <https://doi.org/10.3390/jintelligence11030054>
- Yin, R. K. (2018). Case study research and applications : design and methods. In *SAGE Publication, Inc* (3rd ed.). Sage Publications, Inc.