Teaching Values in Technology Education through Co-Design

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ABSTRACT

Co-design pedagogy appears to be gaining momentum in technology education to counteract the critique of design education for the lack of collaborative initiatives. Hence, co-design pedagogy aligns with technology education in socially constructed values that are inter-subjective and co-constructed. Socially co-constructed values imply that technology education should pave possibilities for students to learn about and practically apply value judgments to foster futuristic change agents. Like co-design, the rationale to include values, especially moral values, in technology education has grown. Incorporating values in technology education would prevent the discipline from becoming mere technical education. The exploration of the context for designing and making is one stage in the technological process to support students' exploration of value judgements. However, replacing the current orthodox pedagogy by ones in which values relating to technology and technology education are co-constructed rather than imposed requires investigation. This conceptual paper draws on the empirical findings of three co-design principles used to guide co-design pedagogy, which are then superimposed on the theoretical framework of values in technology and technology education. Hence a two-fold: Firstly, it draws on the findings of three co-design principles emanating from co-design interventions in fashion education, namely: 1) users as core and inspirational source, 2) design with users, and 3) identify user needs for integration. Subsequently, the second purpose draws linkages to technology education and proposes strategies for the teaching of moral values. Thus, the overarching research question is: How can co-design design principles be linked to and inform strategies for teaching moral values in technology education? The three co-design principles emanated from qualitative design-based research embedded in an interpretive paradigm via social constructivist methods. Following that, the linkages were a result of a superposition of the co-design principles on the theoretical framework of the teaching of moral values in technology education. The said superposition could be instrumental in reviving the stagnant framework as a contribution for technology education.

Key Words: Co-design pedagogy, Values, Technology education, Fashion design education

1. INTRODUCTION

Scholars (Barlex, 1993; Breckon, 1998; Conway, 1994; Holdsworth & Conway, 1999; Layton, 1991; Martin, 2002; McLaren, 1997; Middleton, 2005; Pavlova, 2005; Prime, 1993; Rekus, 1991; Riggs & Conway, 1991) have recognized the rationale to include values, especially moral values,

in technology education. Thus, to empower students to become future agents of change, technology education should create occasions to learn about and practically apply value judgements. *The exploration of the context for designing and making* is one stage in the technological process to support students' exploration of value judgements (Martin, 2002). Dakers (2005) contends that conventional pedagogy should transform where technology and technology education values are co-constructed and not inflicted. Co-design, as a new pedagogy, is offered as a counteractive means.

While acknowledging various approaches to human-centered design (HCD), co-design, sometimes called participatory or collaborative design, is one such approach. Sanders and Stappers (2012) argue that HCD changes how one works and mindsets toward collaboration with people. HCD is an inclusive approach involving users with active collaboration and user consultation throughout the design development phases (Stappers & Visser, 2007; Hanington, 2010). Consequently, Steen (2011) claims that with an HCD ethos, designers aim to collaborate with or learn from users with the specific intention of developing products that align with users' practices, needs, and preferences. However, HCD is not the same as user-centered design. Scholars argue that HCD reflects a sense of humanness and "concern for people" with users as collaborators, but user-centered design designates "people's roles as users" therefore, users are study subjects (Sanders & Stappers, 2012; Steen, 2011:45). As an HCD approach, co-design is a fresh design discipline where a user significantly contributes and collaborates to counteract the values of the 'hero-designer' (Harvey, 2018, Harvey & Ankiewicz, 2022; Ordaz et al., 2018; Stables, 2017).

Subsequently, in technology education, co-design pedagogy appears to be gaining momentum (Harvey & Ankiewicz, 2022; Ordaz et al., 2018), which resonates with Fleming's (cited in Stables, 2017:65) critique that design education supports "disciplinary silos", lacks collaboration, understanding core values of inclusion and interrogation around "who designs" in the epoch of collaboration. As such, co-design pedagogy aligns with Dakers (2005) stance of socially constructed values that are inter-subjective and co-constructed in technology education. Co-design pedagogy is substantiated within Martin's (2002) stage: *the exploration of the context for designing and making* because it is at this stage in the design process that students can socially co-construct value judgements with users to offset individual values that inform later stages.

HCD, especially the three co-design principles were conceived and tested empirically for co-design interventions in university-based fashion design education as part of a doctoral project (Harvey, 2018), adds value to pedagogical activities and teaching values in fashion design education. However, replacing the current orthodox pedagogy by ones in which values relating to technology and technology education are co-constructed rather than imposed requires investigation.

This conceptual paper draws on the empirical findings of three co-design principles used to guide co-design pedagogy, which is then superimposed on the theoretical framework of values in technology and technology education. Hence a two-fold paper aim: Firstly, it draws on the findings of three design principles emanating from co-design interventions in fashion education, namely: 1) users as core and inspirational source, 2) design with users, and 3) identify user needs for integration. Subsequently, the second purpose draws linkages to technology education and

proposes strategies for teaching moral values. The underlying research question is: *How can co-design principles be linked to and inform strategies for teaching moral values in technology education?*

The discussion shifts now to the three co-design principles for co-design interventions in university-based fashion design education.

2. DESIGN PRINCIPLES FOR CO-DESIGN INTERVENTIONS

2.1. Research methodology

The methodology utilised qualitative design-based research (Amiel & Reeves, 2008; Collins et al., 2004; Plomp, 2010; Reeves, 2006) rooted in an interpretive paradigm via social constructivist methods. In a doctoral project (Harvey, 2018), scholarship on HCD was reviewed to establish design principles of co-design for teaching and learning interventions. The critical analysis of the design principles was done in the doctoral project (Harvey, 2018). While several design principles emerged from the critical analysis, three distilled design principles are considered for this paper: 1) users as a core and inspirational source, 2) design with users, and 3) identify user needs for integration with design. The first design principle (DP1) places the user as the core and source of inspiration; hence, the focus is on the user as the nucleus of design and inspirational source and not a subject of study. The second design principle (DP2) is about collaboration between users and designers in that users are active and continuously involved partners in the design process and design should unfold 'with' users and not 'for' users. The third design principle (DP3) is about identifying and addressing user needs, including values, goals and preferences through socially engaged dialogue as input into the design process before seeking to address those needs, goals and preferences (Harvey, 2018).

DP1 acts as the starting point input, the second (DP2) is about collaboration, and the third (DP3) relates to user needs as value judgements. These three design principles were selected for this paper because of the specific link to the exploration of the context for designing and making. They were used to design two teaching and learning interventions, a pilot and main, which took the form of design projects for implementation with first-year fashion design students at a South African urban university. For the pilot intervention, the project duration extended over a four-week block, but the main intervention extended over a seven-week block. Both the pilot and main interventions were made up of both contact sessions with educators and non-contact sessions for self-directed student learning (Harvey, 2018).

To engage with the exploration of the context for designing and making, students could not draw on secondary visual inspiration and manifestations of personal values and self-expression. Instead, pedagogical strategies required students to role-play in design teams of two, with one student assuming the designer position and the other that of the user with the independence to choose design team members and positions. While acknowledging that students role-playing as designers and users may possibly yield biases, the purpose was to construct a culture of teaching and learning and an alternative mind-set regarding the needs and values of users to combine with that of the designer. In the same light, consideration was given to ethics if real-world users were

involved. Hence, pedagogical strategies necessitated design teams to: 1) engage in qualitative discussions to establish the context of design use, user needs, preferences, goals, and design requirements, and 2) in collaboration, co-design, and develop a product with the user. While HCD expects collaboration with actual users, the principles of studio-based pedagogy accommodated a simulated co-design situation.

Three participant sub-sets formed part of the purposive sampling: students, educators and a researcher. Twenty-four first-year fashion design students participated in the pilot and 23 in the main intervention and two university educators (representing university lecturers) who taught design or product development activities. While design teams comprised of two students for the pilot intervention, one student de-registered and therefore for the main intervention, one design team had one designer and two users. The principal author served the dual role of the primary observer in data collection during the teaching and learning interventions and the secondary role of designing the two interventions in collaboration with both educators. All participants gave informed consent for qualitative data collection, including participant observation, student semi-structured questionnaires, and educator semi-structured interviews. Participant observations aimed at documenting the design team's design process activity tasks and how these actions extended in the exploration of the context for designing and making. The first-year students self-administered hard-copy questionnaires to ascertain their views and experiences regarding the three design principles. Similarly, individual, digitally recorded, face-to-face, semi-structured interviews were conducted with the two educators.

Empirical data were analysed via a constant comparative method (Merriam, 2009) with the application of Atlas.ti guided by Saldaña's (2016:14) "streamlined codes-to-theory" model via first and second coding cycles. For the second purpose of the paper, the empirical finding of the three design principles was superimposed on a conceptual meta-synthesis of technology education to draw linkages to technology education and proposes strategies for teaching moral values.

2.2. Empirical findings

A summary of the key findings is narrated around the above-mentioned three design principles; however, detailed descriptions and a more critical approach are available in a previous publication (Harvey & Ankiewicz, 2022). To support the findings, participant data quotations are included. Letters and numbered codes are assigned as pseudonyms to differentiate between participants. E2 represents educator number two, SU1 indicates student user response, SD1 is the student designer in the same design team, and PO reflects participant observation field notes carried out by the principal author.

2.2.1. Users as core and inspirational source (DP1)

Findings around DP1 were previously deliberated (Harvey et al., 2019), but the discussion pertains to values for this paper. Key findings reveal an unexpected way of thinking about and practicing design through understanding, consideration and value judgements of design with empathy. The findings are expressed in statements such as an "eye-opening" (SD6) strategy that supports "out-of-the-box" (SD7) thinking. Intrinsically, the consensus was a mindset shift towards design with empathy due to greater emphasis on user value judgement to eradicate the "notion that they [students] are star designers as seen in media" (E2). Student designers and users

confirmed an empathetic approach because of opportunities for designers to "empathise throughout the process making them [user] be part of the entire process" (SD8). Inherently, the hero-designer values metamorphosed to be "more considerate of the user" (SD9) and user value judgements to drive design. Likewise, users expressed that their designers demonstrated empathy by taking a "closer look at understanding another person" (SU4).

2.2.2. Design with users (DP2)

DP2 replaces traditional teaching practice because "... it's a novel new way of doing things which is going to become much bigger in the future" (E1). DP2 was valuable and mind-changing because user values, voice, and participation in the design process "changed their [students] mind on the role that the user can play in the design process and the benefits that come with involving them" (E2). Student users concurred that the reshaping mindset manifested in an improved design approach as exhibited in comments: "user and designer became more open-minded" (SU9) and "designing with the user brings about a better approach" (SU5). As such, students discovered the value of user engagement minus the assumption that, as designers, they know peoples' needs. Students preferred DP2 because design practice developed a better alignment with user needs and values than the hero-designer approach. Hence, the consensus of new insight about design emerged through negotiated value judgments, agreement in decision-making, inclusivity and collaboration rather than engaging in a hero-designer-driven approach and thinking whereby the designer draws inspiration from predominately visual imagery and designs with and for personal values and self-expression. Student comments reflected these findings: "we both have different tastes and values but working together made the design much better" (SU2), and "decisions throughout the process were made with the user" (SD10).

2.2.3. Identify user needs for integration with design (DP3)

In this paper, the intention was not to present the results of the users' different needs and how these needs were integrated with design. Rather the intention is to deliberate on the findings pertaining to the holistic views and experiences regarding DP3 itself.

To begin *the exploration of the context for designing and making*, in the input stage, designers engaged in primary empirical research to move away from the tradition of secondary visual inspirational research, hence, moving from the old to new. Therefore, designers engaged users in qualitative discussions to collect information about user needs, goals, preferences, and context of design usage as echoed in the excerpt: "designer was very engaging in conversation with user ... started to collect information from user ... probed the user to get clarification" (PO). The documentation and synthesis of primary research in student design journals were well documented with "data [that] was rich" (E2). Hence, primary qualitative research instituted exploration and understanding to identify design criteria without personal value judgements. One student designer remarked, "we were able to discern her actual needs and context of use. The main design criteria are not just extracted from hypotheses" (SD7). This influenced social values of rapport building, relationship development, and harmony in a non-judgemental manner, as conveyed in the remark: "the user was able to communicate with me ... without shying away from being judged or questioned" (SD8). E2 considered primary research as evoking an "empathic approach in which the designer had to empathise with the user in order to gain a better understanding of what the user required from their product (E2). These findings incline value judgements and thoughtfulness towards the other person.

Identifying user needs was "beneficial" (E1) for students' critical analysis and reasoning regarding social importance. Hence, educators could not enforce personal values because designers justified why they could not digress from their user's needs as echoed: "in class when I made suggestions, let's change this or take this particular direction ... they tell me no, the user needs this so we can't really deviate too much from it" (E1). The implications are student-directed active learning, autonomous thinking, critical analysis, and rationalization rather than passive knowledge recipients.

Through active learning, students integrated primary research to prompt co-design activities by exploring ways to engage with design activities to ensure design solutions focused on user needs. For students, primary research and incorporation with design provoked insight about research to inform design practice as echoed: "by doing primary research, I was able to get qualitative information on the user and that formed a strong bases (sic) for our design" (SD10) which afforded the opportunity to "push the boundaries" (SD4) and surpass personal values by "making sure that the user is satisfied" (SU6). Hence designers could not "design what they like" (E1) from personal values because they could not "solely focus on their own preferences and style" (E2).

The authors support the representation of technology education as 'technology informed by design' (Jones & De Vries, 2009) as found in, for example, Australia, England and South Africa (Ankiewicz, 2021; Jones et al., 2013). Thus, design is a common key tenet of both technology (De Vries, 2018) and fashion design (Harvey & Ankiewicz, 2022). Furthermore, the intervention in fashion design education was based on the philosophy of technology and technology education by applying the technological design process in fashion design (Harvey, 2018). Therefore, although contextualised within university fashion design education because of the context-specific nature of the research design, this new pedagogy may well apply to teaching values in school-context technology education. The various types of values in technology education will be discussed in the next section.

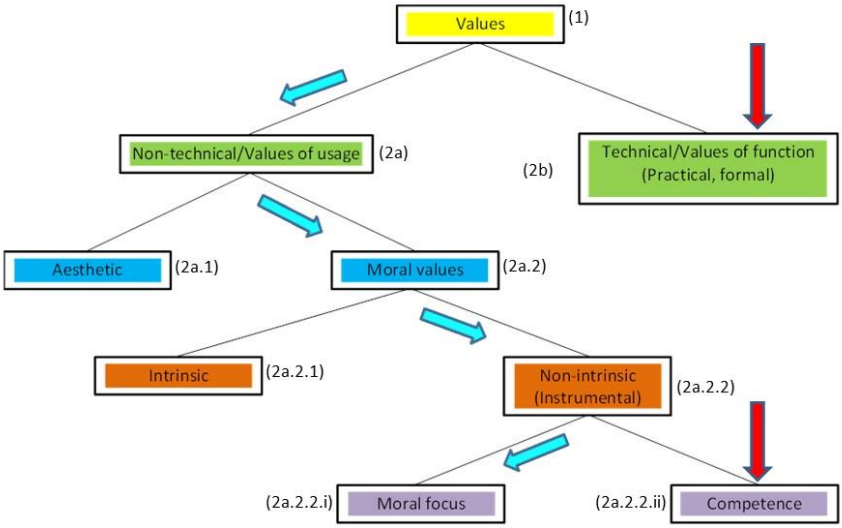
3. TYPES OF VALUES IN TECHNOLOGY EDUCATION

It has already been mentioned and acknowledged in the literature on technology and technology education that technology is value laden. The research methodology employed for this part of the paper was a systematised literature review followed by a meta-synthesis of a selection of literature on the theoretical framework of values in technology and technology education. Firstly, a systematised literature review was firstly conducted in the International Journal of Technology and Design Education (ITDE), the field's top tier journal (Williams, 2016), using the search terms 'values', 'value-free' and 'value-neutral', 'aesthetic', 'attitudes', 'beliefs', 'efficient', 'effective', 'ethic', 'environment', and 'judgements'. The time perioded covered the inception of ITDE up to 2018 when the author was on sabbatical. Secondly, the result of nine ITDE articles directed us to three more technology education journals (four articles) and three book chapters which focus on the theoretical framework of values in technology and technology education (cf. Buckley et al., 2022). Parts of the theoretical framework that underpins this section have been published elsewhere in a different format like the implications of Andrew Feenberg's critical theory of

technology (Ankiewicz, 2019), and the affordances of a human-centered design pedagogy (Harvey & Ankiewicz, 2022) for the teaching of values in technology education.

Technology exists because of human activity and is developed and used in social and environmental contexts. As such, it is shaped by communal beliefs, values, and attitudes of individuals, organisations, and society and, in turn, has a significant effect on shaping culture and the environment (Conway, 1994; Martin, 2002; Stables, 2017). Technology education based on determinism and instrumentalism that views technology as value-neutral will reduce technology education to technical education (Conway & Riggs, 1994; Hansen, 1997; Martin, 2002; Stables, 2017). Literature reveals distinct types of values in technology and technology education, for example aesthetic, economic, social, moral, environmental, political, and spiritual values (Jones et al., 2013; Martin, 2002; Pavlova, 2005). Scholars have classified these values into broader categories. Figure 1 visually summarises the current theoretical framework of values (1) in technology education.

Figure 1.
Types of values in technology education



Accordingly, there are two major types of values in technology education, namely technical values (2a) and non-technical values (2b) (The bracketed numbers refer to the relative position in Fig. 1). Scholars use various synonyms for these types of values. Formal, practical, and technical

values (Pavlova, 2005) or values of function (Rekus, 1991) are synonymous and referred to as technical values, which relate to value judgements concerning the functionality/efficiency and effectiveness of technology.

Non-technical values (Pavlova, 2005) or values of usage (Rekus, 1991) are judgments concerning the morality of action related to the usage of technology, which may only be done by acting individuals themselves (Rekus, 1991). These values can be divided into aesthetics (2a.1) and moral values (2a.2). Although some non-technical values (for example aesthetics) are mentioned as part of technological knowledge, moral values are not.

Moral values can be further divided into intrinsic (technical or economic and good in itself) (2a.2.1) and non-intrinsic or instrumental values (as a means to an end) (2a.2.2) Pavlova (2005). Instrumental values encompass such concepts as ambitious, open-minded, capable, helpful, honest, imaginative, intellectual, logical, responsible, and self-controlled (Pavlova, 2005). Technology education mostly deals with instrumental values, of which two major kinds are those with a moral focus (2a.2.2.i) and those related to competence or self-actualisation (2a.2.2.ii). Pavlova (2005) also distinguishes epistemologically between knowledge about and knowledge within technology. The former is aimed at understanding the nature, values and ethical issues of technology in the complex relationship between person, society and nature. It is thus closely related to STS studies and includes analyses of technology at inter-disciplinary, disciplinary and practical levels within different areas. Knowledge within technology includes knowledge about objects and processes, and requires of students to design and make, analyse, use and maintain products (cf. Khunyakari, 2019).

According to this theoretical classification of values, technical values are strongly dominating in most approaches in technology education, but without explicitly referring to them as values (Pavlova, 2005). Teachers put the highest priority in design and technology classrooms on the teaching of technical values (2b) and values related to competence (2a.2.2.ii) take priority over moral values (Holdsworth & Conway, 1999; Pavlova, 2005) (refer to the red arrows in Fig. 1), with their hierarchy of values resembling the following: technical, aesthetical, economic, environmental, social, cultural, moral, and political (Pavlova, 2005). The priority and emphasis assigned by teachers can easily reduce technology education to technical education.

Pavlova (2005) argues that moral values should take priority in technology teachers' hierarchy of values. Moral education will be emphasised if technology education includes technical (formal, practical or values of function) and non-technical values (instrumental or values of usage) (Rekus, 1991). Teachers need to introduce students to the kinds of moral dilemmas they will face in everyday life as a direct result of the spread of technology (Dakers, 2005). Table 1 lists some examples of such moral dilemmas against specific moral values.

Table 1.
Kinds of moral dilemmas students will face in everyday life

Moral values	Descriptions of examples	Specific examples
Honesty, responsibility and integrity	Moneymaking, substandard design solutions at the expense of quality	Preventing structural failure of buildings, bridges, towers etc.

Caring, fairness and respect	Bias towards gender, disability, cultural and religious groups in design solutions	Ensuring access for people with disabilities
Work ethic (including being punctual, responsible and reliable)	The negative impact of design solutions on individual users, communities and the environment	Managing waste, including air and noise pollution

In the next section we argue that emphasising a co-design pedagogy, based on the above-mentioned three design principles, might be instrumental to create a shift from the dominance of technical values (2b), as well as values related to competence (2a.2.2.ii), to non-intrinsic values with a moral focus (2a.2.2.i) in technology education (refer to the turquoise arrows in Fig. 1). As the findings of this paper, the three design principles will be linked to the theoretical framework of teaching values with a moral focus in technology education, and the linkages will be indicated by showing the relevant design principles in brackets.

4. FINDINGS: LINKING THE THREE CO-DESIGN PRINCIPLES TO TEACHING VALUES WITH A MORAL FOCUS IN TECHNOLOGY EDUCATION

As moral values are inherently part of acting individuals themselves (Rekus, 1991), the most frequently proposed way of teaching values in technology education is to encourage students to think about values themselves (DP3) (Pavlova, 2005). Technology teachers and students need to be explicit about the values involved at all levels of technology and to clarify, justify and debate their choices (Conway, 1994; Conway & Riggs, 1994; McLaren, 1997; Riggs & Conway, 1991). Technology teachers should be upfront about the collective values guiding technological development in society and in technology education, as well as the specific values which guide both technologists and prospective technologists in schools (Riggs & Conway, 1991). Students should have opportunities of valuing technology independently without teachers imposing their own sets of values and norms (DP3) (Rekus, 1991).

Within Martin's (2002) stage of *exploring the context for designing and making*, the choice of the starting point of a technology project is important to show the connections between context, technology, and value judgments (DP1) (Conway & Riggs, 1994; Martin, 2002). The teacher should choose an issue or project brief that relates to the current value system of the students (DP3), taking psychological and sociological aspects of the students' situation into consideration (DP1, 3) (Rekus, 1991). In this regard, technology teachers may capitalise on the pedagogies associated with science, technology, and society (STS) studies. STS studies may promote a critical approach to technology in curriculum documents by considering the relationship between society and technology (Pavlova, 2005). STS teaching commences with everyday issues instead of organizing technology lessons around concepts and processes (DP1, 3). Furthermore, interdisciplinary project work and integrated STS programmes may create a context in which students construct their relationship with technology and learn about its topical, motivational, and interpretative meaning (DP2, 3) (Hansen, 1997). It may also require some integration across artificial subject boundaries of the school curriculum (DP2) (McLaren, 1997). It is important for technology teachers to encourage critical thinking and questioning so that students are aware that technology is related to people, society, and the environment (DP3). How students' value

technology will shape their future (DP3) and they are entitled to discuss such issues in the classroom (DP1) (Jones et al., 2013; Martin, 2002).

5. CONCLUSION

Following from the findings which emanated from the qualitative design-based research in fashion design education, and congruent to Dakers' (2005) call for a new pedagogy in which values relating to technology and technology education are co-constructed rather than imposed, a pedagogy based on the three design principles might be conducive to affect a shift from the dominance of technical values and competence as non-technical values to moral values. Resulting from the superposition of the three empirically researched co-design principles on the theoretical framework of values in technology and technology education, we propose new pedagogy for co-design to teach moral values in technology education that comprises the following: When introducing a technology project to students for the stage of *exploring the context for designing and making* divide them in pairs of two where the one assumes the role of designer and the other one the role of user. For example, if there are 20 students in a class then essentially there would be ten users and ten designers. As another example, with larger groups students could be paired in groups of three with either one designer and two users or vice versa. The technology teacher must ensure that the curriculum, learning outcomes and activities are planned to accommodate for: 1) users to be the core and inspirational driver, 2) for students to engage in primary qualitative research with users to explore their views and values for integration with design, 3) create opportunities for co-design activities and 4) place less emphasis on the functionality/efficiency and effectiveness of students' products. Likewise, teachers should change their ideological beliefs, imposition of personal value-judgements and pedagogical strategies to accommodate for student engagement, co-constructed values, and collaboration. This proposed new co-design pedagogy in technology education should be further explored at school level through action research cycles as further empirical research in future.

6. REFERENCES

Amiel, T., & Reeves, T. C. (2008). Design-based research and educational technology: Rethinking technology and the research agenda. *Educational Technology & Society, 11*(4), 29–40.

Ankiewicz, P. (2019). The implications of Feenberg's critical theory for technology education. In J. R. Dakers, J. Hallström, & M. J. de Vries (Eds.), *Reflections on technology for educational practitioners: Philosophers of technology inspiring technology education*. Brill/Sense.

Ankiewicz, P. (2021). Technology education in South Africa since the new dispensation in 1994: An analysis of curriculum documents and a meta-synthesis of scholarly work. *International Journal of Technology and Design Education, 31*(5), 939–963.

Barlex, D. (1993). The Nuffield approach to values in design and technology. *Design and Technology Teaching, 26*(1), 42–45.

Breckon, A. (1998). National curriculum review in design and technology for the year 2000. *The Journal of Design and Technology Education, 3*(2), 101–105.

Buckley, J., Adams, L., Aribilola, I., Arshad, I., Azeem, M., Bracken, L., ... , & Zhang, L. (2022). An assessment of the transparency of contemporary technology education research employing interview-based methodologies. *International Journal of Technology and Design Education*, *32*(4), 1963–1982.

Conway, R. (1994). Values in technology education. *International Journal of Technology and Design Education*, *4*(1), 109–116.

Conway, R., & Riggs, A. (1994). Valuing in technology education. In F. Banks (Ed.), *Teaching technology*. Routledge.

Collins, A., Joseph, D., & Bielaczye, K. (2004). Design research: Theoretical and methodological issues. *The Journal of the Learning Sciences, 13*(1), 15–42.

Dakers, J. R. (2005). The hegemonic behaviorist cycle. *International Journal of Technology and Design Education*, *15*(2), 111–126.

De Vries, M. J. (2018). The T and E in STEM: From promise to practice. In M.J. de Vries, S. Fletcher, S. Kruse, P. Labudee, M. Lang, I. Mammes, C. Max, D. Münk, B. Nicholl, J. Strobel, & M. Winterbottom (Eds.), *Research in Technology Education* (pp. 11–19). Waxmann.

Hanington, B. M. (2010). Relevant and rigorous: Human-centered research and design education. *Design issues,* 26(3):18–26.

Hansen, K. H. (1997). Science and technology as social relations towards a philosophy of technology for liberal education. *International Journal of Technology and Design Education, 7*(1–2), 49–63.

Harvey, R. N. (2018). *A Human-centered design approach to fashion design education* (Doctoral thesis). University of Johannesburg. https://ujcontent.uj.ac.za/vital/access/manager/Repository/uj:32308?site_name=GlobalView.

Harvey, N., & Ankiewicz, P. (2022). Human-centered design pedagogies to teach values. In P. J. Williams, & B. von Mengerson. (Eds.), *Applications of research in technology education: Helping teachers develop research-informed practice*. Springer Nature.

Harvey, N., Ankiewicz, P., & Van As, F. (2019). Fashion design education: Effects of users as design core and inspirational source. In *Conference Proceedings of the 37th International Pupils' Attitudes Towards Technology (PATT) Conference held in Malta.* Conducted by the L-Università ta' Malta.

Holdsworth, I., & Conway, B. (1999). Investigating values in secondary design and technology education. *The Journal of Design and Technology Education*, *4*(3), 205–214.

Jones, A., Buntting, C., & De Vries, M. J. (2013). The developing field of technology education: A review to look forward. *International Journal of Technology and Design Education*, *23*(2), 191–212.

Jones, A. T., & De Vries, M. J. (Eds.). (2009). *International handbook of research and development in technology education.* Rotterdam: Sense.

Khunyakari, R. (2019). Analysing "values' in collaborative development of D & T education units. In *Conference Proceedings of the 37th International Pupils' Attitudes Towards Technology (PATT) Conference held in Malta.* Conducted by the L-Università ta' Malta.

Layton, D. (1991). *Aspects of national curriculum: Design & technology*. National Curriculum Council.

Martin, M. (2002). Values and attitudes in design and technology. In S. Sayers, J. Morley, & B. Barnes B. (Eds.), *Issues in design and technology teaching*. Routledge Falmer.

McLaren, S. V. (1997). Value judgements: Evaluating design—A Scottish perspective on a global issue. *International Journal of Technology and Design Education, 7*(3), 259–278.

Merriam, S. B. (2009). *Qualitative research: A guide to design and implementation*. Jossey-Bass.

Middleton, H. (2005). Creative thinking, values and design and technology education. *International Journal of Technology and Design Education, 15*(1), 61–71.

Ordaz, M. N., Klapwijk, R., & van Dijk, G. (2018). Supporting learning design language in primary education. In *Conference Proceedings of the 36th International Pupils' Attitudes Towards Tech- nology (PATT) Conference held in Malta.* Conducted by the Athlone Institute of Technology, Co. Westmeath.

Pavlova, M. (2005). Knowledge and values in technology education. *International Journal of Technology and Design Education, 15*(2), 127–147.

Plomp, T. (2010). Educational design research: An introduction. In T. Plomp, & N. Nieveen (Eds.), *An Introduction to Educational Design Research. Seminar Proceedings Conducted at the East China Normal University, Shanghai (PR China).* Netherlands Institute for Curriculum Development: SLO.

Prime, G. M. (1993). Values in technology: Approaches to learning. *Design and Technology Teaching, 26*(1), 30–36.

Reeves, T. (2006). Design research from a technology perspective. In J. V. D. Akker, S. Gravemeijer, S. McKenny, & N. Nieveen (Eds.), *Educational design research*. Routledge.

Rekus, J. (1991). Teaching technology with a focus on moral education. *International Journal of Technology and Design Education, 2*(2), 41–46.

Riggs, A., & Conway, R. (1991). Values and technology education. *Design & Technology Teaching, 24*(1), 31–33.

Sanders, E. B. N., & Stappers, P. J. (2012). *Convivial toolbox: Generative research for the front end of design*. BIS Publishers.

Saldaña, J. (2016). *The coding manual for qualitative researchers* (3rd ed.). Sage.

Stables, K. (2017). Critiquing design: Perspectives and world views on design and design and technology education, for the common good. In P. J. Williams, & K. Stables (Eds.) *Critique in design and technology education. Contemporary issues in technology education*. Springer.

Stappers, P. J., & Visser, F. S. (2007). Bringing participatory techniques to industrial design engineers. *Conference proceedings of the 9th International Conference on Engineering and Product Design Education held in Newcastle.* Conducted by the University of Northumbria. United Kingdom: University of Northumbria.

Steen, M. (2011). Tensions in human-centred design. *CoDesign, 7*(1), 45–60.

Williams, P. J. (2016). Research in technology education: looking back to move forward… again. *International Journal of Technology and Design Education, 26*, 149–157.