



8th International DEFSA Conference 2019

Hosted by Cape Peninsula University of Technology and IIE Vega School.

DESIGNED FUTURES

Design educators interrogating the future of design knowledge, research and education.

Design-Based Research: Bridging the gap between fashion design education and research on design

Neshane Harvey: University of Johannesburg

Piet Ankiewicz: University of Johannesburg

Francois van As: University of Johannesburg

Abstract

Traditionally, design-based research (DBR) unifies research, design and evaluation of interventions aimed at improving educational practice. Shifts elucidate DBR as a novelty to bridge the gap between knowledge generated from research with that of design practice. DBR, therefore, locates itself in both educational and design practice contexts. This paper considers DBR in the educational context hence aimed at the affordance for improving fashion design educational practice. The DBR phases in educational disciplines may well act as guidelines to develop scholarship around research on and through design.

Locally and internationally, fashion design education is an underdeveloped research area but what is more prevalent is the evident lack of DBR to improve educational practice. Drawing from a doctoral study in South African tertiary fashion design education, this meta-research paper focuses on the research design and methodology with a two-fold aim. Firstly, from an educational perspective, the paper theoretically contextualises and maps out a framework for DBR. The second aim describes how DBR was deployed as a research design to improve fashion design pedagogical practice. The aim was engineered to align with the following research questions: 1) what are the theoretical constructs of DBR, and 2) what are the affordances of DBR, as a research design, to improve fashion design pedagogical practice?

Embedded in DBR, multiple methods of data collection from various participant sub-sets included desktop research, semi-structured interviews, participant observations and semi-structured questionnaires as primary methods and artefacts as a secondary method. These data collection methods were based on DBR phases to align with the doctoral research phases.

This paper contributes principally to discourse around research designs for postgraduate studies in design education. As a secondary contribution, mapping DBR from an educational perspective holds affordances to offer insights for research on and through design.

Keywords: Design-based research, fashion design education, research design

Introduction

Design-based research (DRB) is the widespread term, but it is also recognised as design research, development research and design experiments (Amiel & Reeves 2008; Anderson & Shattuck 2012; Wang & Hannafin 2005). DBR emerged as a new research methodology to steer educational research (Amiel & Reeves 2008; Anderson & Shattuck 2012; The Design-Based Research Collective 2003). As such, traditionally DBR unified research, design and evaluation of interventions aimed at improving educational practice (Joseph 2004; Plomp 2010). Design in educational DBR yields principles for teaching and learning interventions (Anderson & Shattuck 2012; Collins, Joseph & Bielaczyc 2004; Plomp 2010; Reeves 2006).

However, shifts elucidate DBR as a novelty to bridge the gap between knowledge generated from research with that of design practice. From the lens of design practice, DBR is an emerging field under the banner of design research. Zimmerman, Forlizzi and Evenson (2007, p. 494) argue that human-computer interaction and design practice communities refer to design research as what “research practitioners do to ground, inform, and inspire their product development process” but from the angle of the design research community, design research implies an “inquiry focused on producing a contribution of knowledge”. Similarly, Margolin (2010) argues that due to multimodal perspectives, meanings and interpretations, design research lacks clear definition. Nevertheless, contemplating the activities of design researchers, Faste and Faste (2012) put forward a taxonomy for design research under four categories of 1) design through research, 2) design of research, 3) research on design and 4) research through design.

Faste and Faste (2012) consider ‘design through research’ as studious, whereby researchers generate knowledge through planning and execution of conventional research activities, but they are unaware that such activities are actually designed. Similarly, ‘design of research’ is formative with scientific roots, hence research is designed and planned via quantitative, qualitative or mixed-method approaches to generate knowledge (Faste & Faste 2012). Therefore, ‘design through research’ and ‘design of research’ are sub-sets of conventional scientific research. In contrast, Faste and Faste (2012) argue that ‘research on design’ is diagnostic aimed at critically studying and analysing the design process to improve design practice. Although ‘research on design’ is a category of the broader scope of design research, Christensen and West (2017) refer to ‘research on design’ as DBR with roots in the field of inquiry known as design methodology. Design methodology “is the study of the principles, practices and procedures of design” in relation to design process structures, how designers think and their actions (Ankiewicz, De Swardt & De Vries 2006; Cross 2018, pp. 696–697). Hence, knowledge about design lends way to design practice which in turn contributes research knowledge on design. ‘Research through design’, which is considered as embedded design research, is a combination of process, activity, cognition and research that manifest in artefacts to reflect embodied design research knowledge (Faste & Faste 2012; Gaver 2012). In essence, ‘research through design’ is practice-based research to produce transferrable knowledge (Durrant, Vines, Wallace & Yee 2017, p. 3). Perhaps this is the reason why Zimmerman, Stolterman and Forlizzi (2010, p. 310) view ‘research through design’ as a “research approach that employs methods and processes from design practice” to generate, document and deeper understand knowledge. From discussions thus far, it is evident that design research, also known as DBR, positions itself in both design and educational practice. However, ‘design’ in educational DBR differs from ‘design’ in design practice. The first yields principles for teaching and learning interventions, while the latter yields artefacts. This paper considers the educational context hence aimed at the affordance of DBR for improving fashion design education (FDE) practice that has not yet been sufficiently explored.

Locally and internationally, fashion design education is an underdeveloped research area (Harvey, Ankiewicz & Van As 2019, p. 204) but what is more prevalent is the evident lack of DBR to improve educational practice. Borrowing from Harvey's (2018) doctoral study in South African (SA) tertiary fashion design education, this meta-research paper focuses on the research design and methodology with a two-fold aim. Firstly, from an educational perspective, the paper theoretically contextualises and maps out a framework for DBR. The second aim describes how DBR was deployed as a research design to improve fashion design pedagogical practice. The aim was engineered to align with the following research questions: 1) what are the theoretical constructs of DBR, and 2) what are the affordances of DBR, as a research design, to improve fashion design pedagogical practice? Responding to the first aim and research question, discussion shifts to firstly theoretically contextualise DBR and subsequently maps out a DBR framework to align with the doctoral study.

Theoretical contextualisation of design-based research

DBR is systematic and context-specific aimed at linking educational research and real-world problems through research, iterative design, development and evaluation of educational interventions with the intention of improving pedagogical practice (Amiel & Reeves 2008; Barab & Squire 2004; Joseph 2004; Plomp 2010; The Design-Based Research Collective 2003; Wang & Hannafin 2005). However, DBR requires that the design of learning environments are guided by theory with research and development unfolding through multiple cycles of design, testing and evaluation of teaching and learning interventions thus giving way to general design principles (Anderson & Shattuck 2012; Barab & Squire 2004; The Design-Based Research Collective 2003). Therefore, scholars concur that DBR commences with some confirmatory design principles emerging from theory which act as guidelines to design teaching and learning interventions but these design principles are subsequently refined so that new design principles materialise to guide future research (Amiel & Reeves 2008; Collins et al. 2004; Plomp 2010; Reeves 2006). Additionally, Plomp (2010, pp. 13, 18) postulates that educational interventions are evaluated through reflection and analysis. Although it may be argued that DBR is the same as action research, Anderson and Shattuck (2012, p. 17) note clear differentiations claiming that DBR evolves from and lead to design principles whereby action research does not. As such, DBR is not and should not be considered the same as action research. From an educational perspective, the following section maps a framework for DBR to align with Harvey's (2018) doctoral study.

Mapping design-based research to improve fashion design pedagogical practice

Seen through the lens of DBR, the doctoral study unfolded in five research phases which aimed at exploring and establishing the underlying design principles of human-centred design (HCD) approach and its effects to fashion design education within an urban South African tertiary context (Harvey 2018). It must be noted that effects did not refer to cause and effect relations but to participant views and experiences. The aim located itself in the overarching doctoral research question: what are the pedagogical strategies and underlying design principles of a HCD approach and its effects to fashion design education at a tertiary level? However, since the scope of this paper is on meta-research, the focus is on the research design and methodology and not on the findings (results) nor the design principles of HCD that emerged from the doctoral study. Rather, employing DBR as the research design, Figure 1 visualises the doctoral research phases and objectives which were mapped to align with Amiel and Reeves's (2008, p. 34) framework for DBR rooted in analysis, development, iteration and reflection.

As seen in Figure 1, Amiel and Reeves (2008, p. 34) claim that DBR commences with the analysis of practical problems by researchers and practitioners in collaboration. Aligning this with the doctoral study, analysis of the problem unfolded through two strategies. Firstly, via a literature review regarding 1) shifts in general design practice and design education, and 2) current pedagogical strategies applied in fashion design education. Secondly, being a fashion design educator, the researcher (main author) collaborated with colleagues from various South African tertiary institutions to engage in conversation regarding the need for transformation in fashion design education. This first stage set the course of theoretical and empirical action to guide the subsequent doctoral research phases to achieve the objectives visualised in Figure 1.

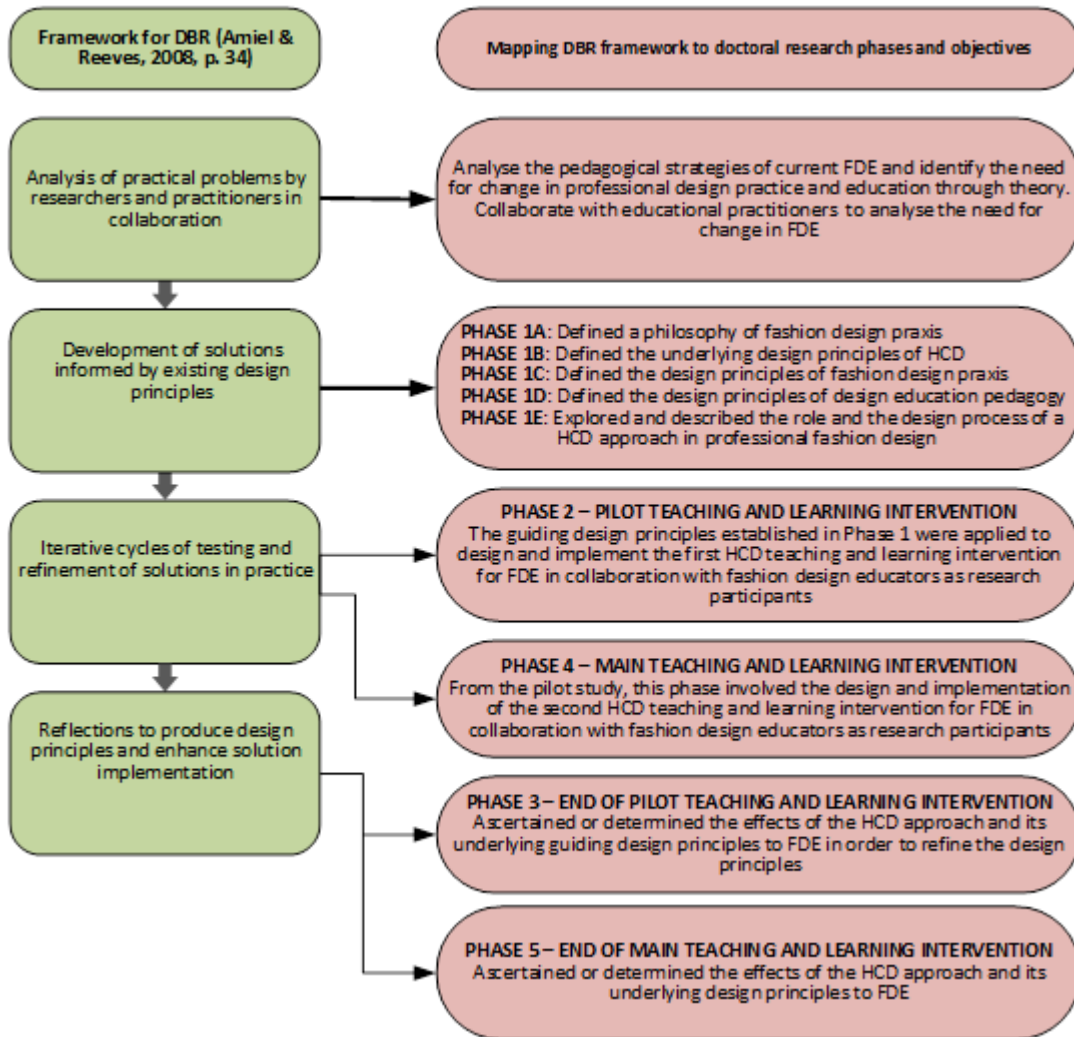


Figure 1: Doctoral research phases and objectives (Harvey 2018, p. 40). Aligned with Amiel and Reeves’s (2008, p. 34) framework for DBR

The design-based research units of analysis

Rooted in DBR, the doctoral study employed an interpretive paradigm drawing on social constructivist methods, as well as a qualitative research approach to explore the multiple realities and capture “what people say and do as a product of how they interpret the complexity of their world, to understand events from the viewpoints of the participants” (Burns 2000, p. 11).

In light of the above, the primary unit of analysis was the fashion design education teaching and learning interventions (simply referred to as interventions) designed for implementation at a fashion design department at an urban South African tertiary institution. However, the secondary unit of analysis, namely exploration of HCD within professional fashion design practice was required as input to address the primary unit of analysis. Hence, the secondary unit of analysis was carried out in participants' fashion design studios within the Johannesburg area.

Design-based research as methodology

The methodology employed to execute DBR in the doctoral study included: 1) sampling methods used to select participants, 2) data collection methods to achieve the DBR phases and objectives (Figure 1), 3) the methods used to analyse empirical data, 4) trustworthiness methods, and 5) ethical implications. As such, the narrative shifts to sampling method.

Sampling method

A purposive sampling method was utilised to generate information-rich data. Purposive sampling warrants that participants are selected based on their applicable data and knowledge and because they have certain characteristics that parallel with pre-determined criteria (Babbie 2008; Silverman 2014; Yin 2011). Five participant sub-set groups were purposively sampled based on specific criteria.

Phases 1A, 1B, 1C and 1D (Figure 1) were theoretical in nature and therefore did not involve any participants. For Phase 1E (visualised in Figure 1), two Johannesburg-based professional fashion designers were selected based on criteria reflected in Table 1. As data collection proceeded, it became evident that one of the participating fashion designers was using an HCD approach by including actual users in the design process. Although the inclusion of actual users was not the intention of the doctoral study, the opportunity arose to include a user as a participant. Moving to the educational context, Phases 2, 3, 4 and 5 seen in Figure 1, involved three participant sub-sets namely, 1) fashion design students, 2) fashion design educators and 3) the researcher. Table 1 highlights the pre-determined selection criteria used to select these participants.

Table 1: Criteria to select participants

Participant	Criteria
Professional fashion designers	Expert fashion designers with five or more years of professional practice
	Needed to have experience and expertise in showcasing fashion design collections at South African fashion events such as the South African Fashion week
Fashion design students	First-year students registered for the BA Fashion Design programme
	Registered for the first-semester module entitled Fashion Design and Technology 1A
	Registered for the second-semester module entitled Fashion Design and Technology 1B
Fashion design	Academic cohort at the Fashion Design Department

educators	Responsible for teaching in the modules Fashion Design and Technology 1A and 1B
	Collaborate in the design of interventions and facilitate implementation with participating fashion design students
Researcher	Experience as a fashion design educator
	Knowledge in HCD and design-related activities
	Experience as a professional fashion designer

Of the 25 students registered for the first-semester module, 24 participated in the pilot intervention due to continued absenteeism of one student. For the main intervention, 23 students registered for the second-semester module and thus participated. In addition, two fashion design educators were involved as participants, but they were also collaborative and consultative partners. These educators contributed to the design of both the pilot and main interventions and facilitated the implementation of procedural knowledge activities.

In addition, the researcher assumed a dual role of observer and participant. The observer role acted as the data collection instrument during the implementation of both the pilot and main interventions. As participant, the role was to design the interventions in collaboration with participating educators but also to facilitate the theoretical knowledge required to support implementation of procedural knowledge in both interventions. Hence, the primary role was that of observer and data collection instrument.

Data collection methods

Philosophy of fashion design praxis and design principles

As seen in Figure 1, Phase 1 of the doctoral study was sub-phased. Phases 1A, 1B, 1C and 1D employed desktop research as a method of data collection, which aimed at reviewing theoretical perspectives to guide the design of the interventions. Desktop research is a qualitative meta-synthesis of existing literature (Blaxter, Hughes & Tight 2006; Given 2008; Hallström & Ankiewicz 2019).

Phase 1A aimed at defining a philosophy of fashion design praxis. This was achieved by reviewing Love's (2000) meta-theoretical taxonomy of design theory for the philosophy of design, as well as Mitcham's (1994) philosophical framework for the four modes of manifestation of technology. From these, visualised in Figure 2, theoretical elements were selected for a philosophy of fashion design praxis comprising of the four modes of 1) volition, 2) design knowledge, 3) design methodology, and 4) product.

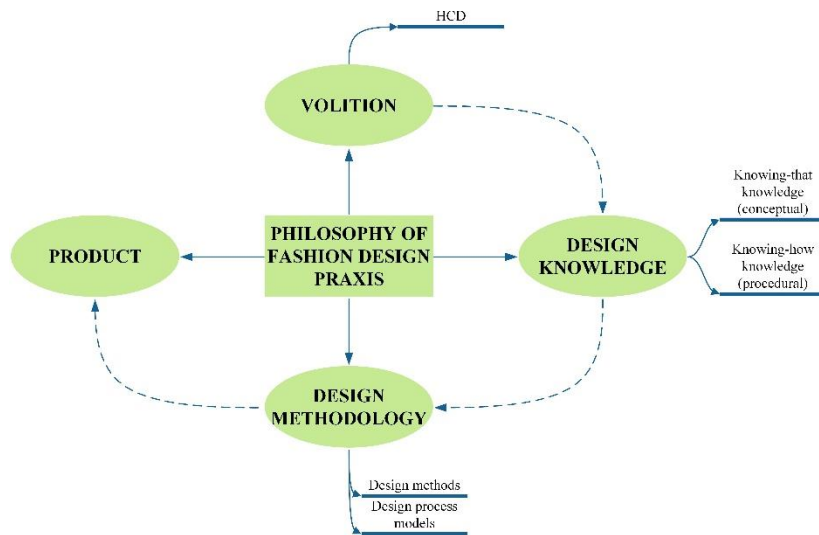


Figure 2: Personal framework for a philosophy of fashion design praxis (Harvey 2018, p. 86)

HCD was positioned as the underlying volition for fashion design education hence a sub-mode in Figure 2. Intrinsically, for Phase 1B, desktop research entailed the review of HCD scholarship to define the underlying design principles of HCD. Through extensive literature review, 24 tentative design principles of HCD were established. Subsequently, Phase 1C involved the review of scholarship around the four modes that formed part of the philosophy of fashion design praxis (Figure 2). This review funnelled from general design to professional fashion design praxis culminating in 34 tentative design principles for fashion design praxis. Finally, Phase 1D reviewed scholarship around design education culminating in 32 tentative design principles for design education pedagogy (DEP).

Professional fashion design

The tentative design principles defined in Phases 1B, 1C and 1D were used as input to design the pilot intervention thus aligning with Anderson and Shattuck's (2012, p. 17) argument that DBR requires interventions to be designed based on design principles. However, DBR also necessitates input from practitioners in real-world settings (Reeves 2006, p. 58). As seen in Figure 1, Phase 1E set out to explore and describe the role and the design process of an HCD approach in professional fashion design. To achieve this, individual and dyadic face-to-face, semi-structured, interviews were employed as a primary method of data collection.

Semi-structured interviews were conducted with the two professional fashion designers with the aim of gaining an in-depth understanding of their design processes and design methods, as well as the role of user and extent of user participation. Interviews were selected to explore and understand the situation through interpretation and socially constructed meanings that represent individuals' realities. In the same light, semi-structured interviews were selected because it allowed for identification of some guiding, open-ended questions, but also to probe for clarification in the attempt to obtain in-depth data. These interviews lasted approximately 25 minutes until data saturation occurred. Additionally, one face-to-face, semi-structured dyadic interview was conducted with one of the participating professional fashion designers and an actual user. Dyadic interviews bring two participants together in one interview session (Morgan, Ataie, Carder & Hoffman 2013, pp. 1276–1277). Likewise, dyadic interviews allow for more in-depth data collection as participants recall and reconstruct information (Morgan et

al. 2013; Flick 2014). The dyadic interview was chosen so that the professional fashion designer and actual user could steer the conversation and prompt each other for more in-depth data that the professional fashion designer may have otherwise overlooked in the individual interview. The dyadic interview ensured that both the professional fashion designer and user had equal opportunity to express their views resulting in a 25-minute conversation. All interviews were digitally recorded and transcribed verbatim. In addition, artefacts, in the form of photographs, were collected as a secondary method of data collection. Following the recommendation of Banks (2018, p. 7) and Prosser (2011, p. 479) artefacts were selected to serve a three-fold empirical purpose of 1) documenting the social reality, 2) as evidence for trustworthiness and 3) for contextualisation. Approximately 45 photographs were self-captured to document the conceptualisation stage activities of the design process executed by these professional fashion designers. From the empirical data collected for Phase 1E, no new design principles of HCD and fashion design praxis emerged. As such, the tentative 24 design principles for HCD, 34 for fashion design praxis and 32 for design education pedagogy were applied to design the pilot intervention for fashion design education.

Pilot intervention

Responding to Phase 2 in Figure 1, the pilot intervention aligned with project-based learning and role-playing in a simulated situation so that students could learn about HCD, learn to design from an HCD perspective and become future HCD designers. Surely, students cannot be expected to become future HCD designers if their education does not foster and create opportunities to acquire knowledge, skills and tools to do so. The researcher acknowledges that HCD involves real-world users. Table 2 outlines the rationale for selecting role-play as a pedagogical strategy.

Table 2: Reasons for implementing role-playing

Reason	Consideration
HCD as an approach	HCD can be used as a research strategy or approach. In this situation, HCD was viewed as a mind-set (philosophy or way of thinking) and an approach to engaging with design and generation of products. As such, an HCD approach could be contained within an education setting.
Implemented with first-year students	Participants were first-year fashion design students who were still adjusting to an academic environment. Exposing them to a learning space outside the academic environment, with real-world users, may have presented them with discomfort due to their unfamiliarity with such settings.
Access to real-world users	Use of real-world users from outside the educational environment may have posed challenges for students regarding continuous accessibility of users throughout all the design process stages. In addition, such accessibility issues may have presented challenges regarding systematic control and collection of comprehensive evidence for the doctoral study.
Ethics in research	Several ethical issues were considered. Firstly, the involvement of real-world users in the design process would necessitate their consent to participate in the doctoral study. Secondly, to maintain the safety and security of students in an attempt to prevent any harm or possible risks.

Participating students role-played in design teams of two where one student assumed the role of designer and the other that of user. The project aimed to integrate and apply conceptual

knowledge regarding the design principles for HCD as an underlying design approach to design and prototype a solution. The project extended over four weeks serving as the assessment method using the four assessment instruments of 1) a design journal to document and justify all design process activities, 2) a two-dimensional fashion illustration and technical drawings of the final design solution, 3) a flow diagram that holistically visualised the design process and respective designer and user involvement, tasks and functions, and 4) and a three-dimensional prototype.

Reacting to Phase 3 (Figure 1), data collection methods for the pilot intervention employed primary participant observation and self-administered, open-ended questionnaires and secondary artefacts. Participant observation implied observer as primary role and participation as secondary. Participant observation was selected because the researcher designed the intervention in collaboration with participating fashion design educators. Similarly, the participatory role also allowed immersion into the participants' social and natural setting allowing the researcher to walk around the teaching and learning studios and occasionally, but unobtrusively, pose questions to educators and students while observing and understanding how the activities of an HCD process unfold. The observations served the purpose of exploring and documenting the design-related activity tasks and prototype evaluation stages of the design process as executed by participating students and how these actions unfolded in a way that incorporated the design principles of HCD. However, observation also aimed at documenting unforeseen, emergent issues such as student attendance, punctuality or non-engagement with an HCD approach. These observations were captured through a pre-drafted observation scheduled with field notes. To support observation, artefacts entailed self-created photographs to capture the social reality of participating students regarding the execution of the design principles of HCD and how these actions unfolded in the design process. These photographs were used as evidence to support interpretations and ensure trustworthiness. Approximately 150 photographs were taken during participant observation sessions.

In addition, to obtain the views and feelings of participating students and educators, self-administered, open-ended questionnaires were employed. This data collection method was selected so that participants could express their feelings and views in a way that they deemed fit. At the end of the pilot intervention, 24 hard-copy questionnaires were collected from participating students and electronic questionnaires from the two educators. The questionnaires served a three-fold purpose. Firstly, the student questionnaire aimed at ascertaining the main effects of the HCD approach and the underlying tentative 24 design principles of HCD. Secondly, educator questionnaires aimed at determining the holistic effects of the implementation of an HCD approach to fashion design education. Thirdly, following Babbie and Mouton's (2001, pp. 239, 244) suggestion, the questionnaires served as pre-testing to check if questions were worded correctly and if they would yield accurate data.

To conclude Phase 3, the emerging findings and retrospective analysis paved the way for refinement of pedagogical strategies. More importantly, the tentative design principles of HCD, fashion design praxis and design education pedagogy were refined culminating in 12 for HCD, 19 for fashion design praxis and 19 for design education pedagogy. As noted earlier, this is a meta-research paper focusing on the research design and methodology and not on the findings (results), rationale for refining pedagogical strategies and design principles. Nonetheless, the refined design principles were then used to design the main intervention.

Main intervention

The main intervention addressed Phase 4 (Figure 1) and continued with project-based learning and role-playing where participating students role-played in design teams of two with one

student assuming the role of designer and the other that of user. However, due to an uneven student number, one design team comprised of one designer and two users with autonomy to select their roles. The project aimed at integrating and applying conceptual knowledge regarding the refined design principles of HCD as an underlying design approach and volition within praxis to design, prototype and manufacture a wearable product. The project extended over seven weeks serving as the assessment method using the four assessment instruments of 1) a design journal to document and justify all design process activities, 2) a two-dimensional fashion illustration and technical drawings of the final design solution, 3) a three-dimensional prototype, and 4) and a three-dimensional wearable product.

Addressing Phase 5 (Figure 1), data collection methods for the main intervention included participant observation identically and serving the same purpose as in the case of the pilot intervention. Likewise, artefacts were collected in the form of self-created photographs for the same purpose and in an identical manner as in the pilot intervention with the exception that approximately 276 photographs were taken. Furthermore, open-ended, questionnaires were self-administered by the 23 participating students at the end of the intervention. The questionnaire was refined to serve a two-fold purpose. Firstly, it aimed at ascertaining the main effects of the HCD approach and the underlying, refined 12 design principles of HCD. Secondly, it aimed to explore students' holistic personal experiences regarding implementation of an HCD approach to fashion design education. It was important to obtain information on overall experiences hence student instruments were refined such that they included an overarching question pertaining to participants' holistic experience of an HCD approach to fashion design education.

Regarding the educators, the data collection method changed to individual, face-to-face, semi-structured interviews because the educator questionnaire employed in the pilot intervention did not allow the opportunity to probe for clarification. Moreover, responses were wide-ranging and did not elicit data pertaining to the main effects of each of the design principles implemented as part of an HCD approach. Educator interviews served the same purpose as student questionnaires but from the educators' perspective. A line of inquiry, in the form of an interview guide, with open-ended, semi-structured questions was developed. The first interview lasted approximately 32 minutes and the second approximately 60 minutes until reaching data saturation. These interviews were recorded and transcribed verbatim prior to data analysis.

Data analysis

A constant comparative method of data analysis was employed to analyse all collected empirical data with the application of Atlas.ti. A constant comparative method of data analysis emerged for grounded theory, but Merriam (2009, p. 175) argues that such a method is used in qualitative research even though the research scope might not necessarily involve theory building. Systematic data analysis followed Creswell's (2012; 2014) step-by-step, bottom-up model, as well as Saldaña's (2016, p. 14) 'streamlined codes-to-theory' model. Data collection and coding transpired concurrently because the findings from each phase of the doctoral study informed the next.

Following the guidelines of Saldaña's (2016, pp. 68, 234) coding manual, data analysis unfolded in first and second coding cycles. First coding cycle employed *in vivo*, open coding and simultaneous coding methods to code all data sets. Each data set was read line-by-line simultaneously highlighting fragments of raw data quotations and assigning a code using either *in vivo*, open or simultaneous coding methods. On completion of the first cycle of coding, all codes and quotations were read in context to verify accuracy prior to commencing with the second coding cycle.

Second coding cycle employed axial and selective coding methods that aimed at higher conceptual levels by integrating, linking, synthesising and conceiving categories for thematic interpretation. Axial coding links the dimensions and properties of a category together (Boeije 2010; Charmaz 2014). Selective coding involves looking for connections and integrating categories (Boeije 2010, p. 114). Axial coding involved two techniques. Firstly, to reduce and unclutter code lists, coded quotations were compared and merged based on Friese's (2014, p. 95) recommendation of fusing two or more codes that hold the same meaning. Secondly, codes were compared and linked where attributes and concepts related to the same category and where contradictions were evident. Coding saturation was reached before moving onto selective coding, which manifested in two ways and with a two-fold purpose. With the first purpose, codes were compared and clustered together into categories and sub-categories where applicable.

Similarly, tentative categories were finalised and re-named where necessary. The second purpose grouped categories into main research themes. The following section deliberates on the methods for trustworthiness employed in the doctoral study.

Methods of trustworthiness

Following the guidelines of several scholars (Babbie & Mouton 2001; Creswell 2014; Merriam 2009; Mouton 2001; Van Niekerk, Ankiewicz & De Swardt 2010), Table 3 illustrates the trustworthiness methods and the manner in which they were applied.

Table 3: Methods and application of trustworthiness

Method	Application
Triangulation	Achieved through multiple methods of data collection
	Triangulation of multiple sources of data was achieved by cross-checking participant observation in the pilot and main interventions hence at different times
	Data collected from multiple participant sub-sets allowing for different perspectives
	Through member-checking by granting participants the opportunity to validate the emerging findings and validate accurate interpretation through follow-ups
Peer investigator	Raw data, analysis codes, categories, research themes and emerging findings were externally peer validated by an experienced researcher and design educator
Report on negative responses	The doctoral study included contradictory views derived from raw data
Audit trail	A methodological audit trail was maintained electronically and through self-generated, hand-written journal entries

Table 3 shows that trustworthiness was achieved in a systematic and methodical manner to ensure and maintain quality and academic rigour. Moreover, any research necessitates that a study is conducted in an ethical manner.

Ethical considerations

All participants were invited to participate in the study via a written information disclosure. Given the inclusion of fashion design students, extra care was taken to highlight that their participation was voluntary and would not present any risks nor affect their assessment outcomes or results. Although HCD is traditionally carried out with non-designers as users, participating students were not exposed to any harm or potential risks by simulating practice through a role-playing pedagogical strategy. All participants granted permission by completing a pre-drafted informed consent sheet. Consent was also granted to audio record interviews (where necessary), to observe student activities during the interventions and to capture photographs. All participants were assigned pseudonyms to protect their identity, culture and gender. Although the name of the fashion design department is mentioned, measures were taken to conceal identity by not revealing the urban South African tertiary institution nor its geographical location. In the event of including photographs in the doctoral report, participants' faces were edited to prevent identification.

Conclusion

Shifts elucidate the attempt to bridge knowledge generated from research with that of design practice, hence, DBR under the banner of design research in and for design practice. However, DBR conventionally unified research, design and evaluation of interventions aimed at ameliorating educational practice. Borrowing from Harvey's (2018) doctoral study in a South African tertiary fashion design department, this meta-research paper focused on the research design and methodology to fulfil a two-fold aim. From an educational perspective, the first aim was achieved through theoretical contextualisation of DBR, subsequently mapping out a framework for DBR to align with the doctoral research phases. Thereafter, achieving the second aim of this paper, deliberations shifted to DBR as the research design and methodology executed in the doctoral study to improve fashion design pedagogical practice. Aligning with the characteristics of DBR, Phases 1A, 1B, 1C and 1D reviewed scholarship culminating in a tentative set of design principles comprising of 24 HCD, 34 fashion design praxis, structured around the four modes of volition, design knowledge, design methodology and product, as well as 32 design education pedagogy design principles. In addition, for Phase 1E, empirical data were collected from two Johannesburg-based fashion designers and one actual user, but no additional design principles emerged.

The tentative design principles were then used to design a pilot intervention for implementation with first-year fashion design students at an urban South African tertiary institution. Data collected from participant observation, student, as well as educator semi-structured, self-administered questionnaires, were analysed. From the findings and researcher retrospective analysis, pedagogical strategies, as well as the tentative design principles were refined to culminate in 12 for HCD, 19 for fashion design praxis and 19 for design education pedagogy. These refined design principles and pedagogical strategies set the backdrop to design the main intervention.

The main intervention was designed for the same group of students. Data collected through participant observation, student self-administered, semi-structured questionnaires and individual, face-to-face, semi-structured interviews with educators were analysed. From the findings, the design principles were further refined to include nine HCD, 16 fashion design praxis, organised around the four modes of volition, design knowledge, design methodology and product, and 16 design education pedagogy principles as a theoretical contribution of the doctoral study. However, given the aim and scope of this meta-research paper, which focused on the research design and methodology, the limitation is that the design principles of HCD, fashion design praxis and design education pedagogy are not presented nor are the findings

(results) that emerged from the doctoral study deliberated on. Nevertheless, it is evident that from the doctoral study, DBR holds affordances to contribute principally to discourse around research designs for postgraduate studies in design education thus aligning with the conference sub-themes of 1) design-based research, and 2) postgraduate design education. These affordances include opportunity to: 1) design interventions that are guided by design principles derived from theory and practice, 2) refine design principles, 3) design and implement multiple cycles of interventions to improve pedagogical practice, 4) integrate both theory and pedagogical practice, and 5) put forward design principles as a theoretical contribution to guide further research. However, the affordances of DBR are not exclusive to fashion design education but to design education in general. As a secondary contribution, mapping DBR from an educational perspective holds affordances to offer insights for design research in terms of 'research on design', as well as 'research through design'.

References

- Amiel, T & Reeves, TC 2008, 'Design-based research and educational technology: rethinking technology and the research agenda', *Educational Technology & Society*, vol. 11, no. 4, pp. 29-40.
- Anderson, T & Shattuck, J 2012, 'Design-based research: a decade of progress in educational research', *Educational Research*, vol. 41, no. 16, pp. 16-25.
- Ankiewicz, P, De Swardt, E & De Vries, M 2006, 'Some implications of the philosophy of technology for science, technology and society (STS) studies', *International Journal of Technology and Design Education*, vol. 16, no. 2, pp. 117-141.
- Babbie, E & Mouton, J 2001, *The practice of social research, South African ed.*, Oxford University Press Southern Africa, Cape Town.
- Babbie, E 2008, *The basics of social research*, 4th ed., Thomson Wadsworth, United States.
- Banks, M 2018, *Using visual data in qualitative research*, 2nd ed., U Flick (ed.), SAGE Publications Ltd, London, SAGE.
- Barab, S & Squire, K 2004, 'Design-based research: putting a stake in the ground', *The Journal of the Learning Sciences*, vol. 13, no. 1, pp. 1-14.
- Boeije, H 2010, *Analysis in qualitative research*, SAGE Publications, London.
- Burns, RB 2000, *Introduction to research methods*, 4th ed., SAGE Publications, London.
- Charmaz, K 2014, *Constructing grounded theory*, 2nd ed., SAGE Publications, Thousand Oaks.
- Christensen, K & West, RE 2017, 'The development of design-based research', in RE West (ed.), *Foundations of learning and instructional design technology*, 1st ed., Pressbooks, viewed 1 July 2018, <<https://lidtfoundations.pressbooks.com/chapter/design-based-research/>>.
- Collins, A, Joseph, D & Bielaczyc, K 2004, 'Design research: theoretical and methodological issues', *The Journal of the Learning Sciences*, vol. 13, no. 1, pp. 15-42.
- Creswell, JW 2012, *Educational research: planning, conducting and evaluating quantitative and qualitative research*, 4th ed., Pearson Education, Boston.
- Creswell, JW 2014, *Research design: qualitative, quantitative and mixed methods approaches*, 4th ed., SAGE, Washington DC.
- Cross, N 2018, 'Developing design as a discipline', *Journal of Engineering Design*, vol. 29, no. 12, pp. 691-708.
- Durrant, AC, Vines, J, Wallace, J & Yee, JSR 2017, 'Research through design: TWENTY-first century makers and materialities', *Design Issues*, vol. 33, no. 3, pp. 3-11.

- Faste, T & Faste, H 2012, 'Demystifying "design research": design is not research, research is design', *Proceedings of the 2012 IDSA Educational symposium, Boston*, viewed 1 July 2019, <<https://pdfs.semanticscholar.org/6961/5f9130a93c129fa2f3acbb8ff2f145b49660.pdf>>.
- Flick, U 2014, *An introduction to qualitative research*, SAGE, Los Angeles.
- Friese, S 2014, *Qualitative data analysis with ATLAS.ti*, 2nd ed., SAGE, London.
- Gaver, W 2012, 'What should we expect from research through design?', *Proceedings of the SIGCHI Conference on Human Factors in Computing Systems*, held 5-10 May, Austin, Texas.
- Harvey, RN 2018, 'A Human-centered design approach to fashion design education', Doctoral thesis, University of Johannesburg, Johannesburg, viewed 18 August 2019, <https://ujcontent.uj.ac.za/vital/access/manager/Repository/uj:32308?site_name=GlobalView>.
- Harvey, N, Ankiewicz, P & Van As, F 2019, 'Fashion design education: effects of users as design core and inspirational source', *Proceedings of Pupils' Attitude Toward Technology (PATT) 37 Conference*, held 3-6 June, Malta, pp. 203-211.
- Hallström, J & Ankiewicz, P 2019, 'Laying down the "T" and "E" in STEM education: design as the basis of an integrated STEM philosophy', *Proceedings of Pupils' Attitude Toward Technology (PATT) 37 conference*, held 3-6 June, Malta, pp. 187-194.
- Joseph, D 2004, 'The practice of design-based research: uncovering the interplay between design, research and the real-world context', *Educational Psychologist*, vol. 39, no. 4, pp. 235-242.
- Love, T 2000, 'Philosophy of design: a meta-theoretical structure for design theory', *Design Studies*, vol. 21, no. 3, pp. 293-313.
- Margolin, V 2010, 'Doctoral education in design: problems and prospects', *Design Issues*, vol. 26, no. 3, pp. 70-78.
- Mitcham, C 1994, *Thinking through technology: the path between engineering and Philosophy*, The University of Chicago Press, Chicago.
- Morgan, DL, Ataie, J, Carder, P & Hoffman, K 2013, 'Introducing dyadic interviews as a method of collecting qualitative data', *Qualitative Health Research*, vol. 23, no. 9, pp. 1276-1284.
- Mouton, J 2001, *How to succeed in your master's & doctoral studies: a South African guide and resource book*, Van Schaik, Pretoria.
- Merriam, SB 2009, *Qualitative research: a guide to design and implementation*, San Jossey-Bass, Francisco.
- Plomp, T 2010, 'Educational design research: an introduction', in T Plomp & N Nieveen (eds), *An Introduction to Educational Design Research, seminar proceedings, East China Normal University*, Shanghai.
- Prosser, T 2011, 'Visual methodology: towards a more seeing research', in NK Denzin & YS Lincoln (eds), *The SAGE handbook of qualitative research*, 4th ed., SAGE, Los Angeles.
- Reeves, T 2006, 'Design research from a technology perspective', in JVD Akker, S Gravemeijer, S McKenny & N Nieveen, *Educational Design Research*, Routledge, New York.
- Saldaña, J 2016, *The coding manual for qualitative researchers*, 3rd ed., SAGE, London.
- Silverman, D 2014, *Interpreting qualitative data*, 5th ed., SAGE, London.
- The Design-Based Research Collective 2003, 'Design-based research: an emerging paradigm for educational inquiry', *Educational Researcher*, vol. 32, no. 1, pp. 5-8.

- Van Niekerk, E, Ankiewicz, P & De Swardt, E 2010, 'A process-based assessment framework for technology education: a case study', *International Journal of Technology and Design Education*, vol. 20, no. 2, pp. 191-215.
- Wang, F & Hannafin, MJ 2005, 'Design-based research and technology-enhanced learning environments', *Educational Technology Research and Development*, vol. 53, no. 4, pp. 5-24.
- Yin, RK 2011, *Qualitative research from start to finish*, The Guilford Press, New York.
- Zimmerman, J, Forlizzi, J & Evenson, S 2007, 'Research through design as a method for interaction design research in HCD', *Proceedings of the CHI conference*, held 28 April– 3 May, San Jose, pp. 493-502.
- Zimmerman, J, Stolterman, E & Forlizzi, J 2010, 'An analysis and critique of Research through Design: towards a formalisation of a research approach', *Proceedings of the DIS conference*, held 16-20 August, Aarhus, Denmark, pp. 310-319.