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A Process for Designing and Developing Interactive Learning Objects for Organisations

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A PROCESS FOR DESIGNING AND DEVELOPING INTERACTIVE LEARNING OBJECTS FOR ORGANISATIONS

Completed Research

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Abstract

Organisations are increasingly adopting e-learning environments for employee and customer training projects. These environments use educational technologies and interactive learning objects (ILOs) to increase the quality of digital training experiences. ILOs are growing in popularity because material is multimodal but even more so, interactive which engages trainees and increases motivation to learn. Several studies have proposed processes and guidelines for improving the usability and user experience (UX) of system applications and websites. However, the processes and guidelines for designing ILOs are limited and the majority of these focus on ILOs adopted in educational institutions. Corporations need to consider additional factors, such as the organisational culture and the disparate profile of users when designing their e-learning environment and the ILOs to be adopted. This paper seeks to answer the research question, "What process should be followed when designing interactive learning objects (ILOs) in a corporate context?". The purpose of this paper is to propose a process for designing and developing ILOs (PDILO) that can be used to increase the UX of these ILOs and ultimately, the usage thereof in an e-learning environment for corporate contexts. A case study approach was adopted and the case was a software development company incorporating e-learning into its management strategy. The design process was used to design ILOs that formed part of a module in the company's new e-learning environment. The proposed process can be used to guide content developers with the design of ILOs in e-learning environments and ultimately improve the success thereof.

Keywords: e-Learning, Interactive Learning Objects, Learning Objects, Interactivity, User Experience, LOs, ILOs.

1 Introduction

With the growing demands of learning in a technologically advanced society, e-learning has emerged as the catalyst for training and education (Alsabswy, Cater-Steel and Soar, 2013; Docimini and Palumbo, 2013; Mohammadi, 2015). e-Learning can be defined as a dynamic and immediate learning environment making use of the Internet to improve the learning process by providing learners with access to resources and related services (Docimini and Palumbo, 2013; Jeong and Hong, 2013; Mohammadi, 2015) and to make the learning process flexible (Masa'deh, Tarhini, Mohammed and Maqableh, 2016). Several types of organisations such as companies, universities and schools are implementing e-learning as a training, learning and professional development tool (Chikh and Berkani, 2010). In the workplace, e-learning is proving itself to be a worthwhile investment as a tool for employees to be trained by means of a flexible, accessible, cost-effective and consistent method (Al-Qahtani, Al-Qahtani and Al-Misehal., 2013). The competitive and high-pressure nature of the environments in which corporations operate has created the need for the realisation of leveraging employee knowledge and skills to the advantage of the company (Weng, Tsai and Weng, 2015). However, it can be difficult to prove the monetary return on e-learning investments and project proposers need to motivate the value of such systems (Govindasamy, 2002). In addition, it has been shown that the information quality in digital training experiences can be a barrier that hinders the use of e-learning systems and this can be mitigated by ensuring that the e-learning content is of a high standard (Esterhuyse and Scholtz, 2015; Stoffregen, Pawlowski and Pirkkalainen, 2015).

A key feature of e-learning is the many types of content that can be provided to learners such as text documents, presentations, multimedia, tasks and combined media (Bartuskova and Krejcar, 2014). A recent trend to make use of learning objects (LOs) due to the reuse capability of these resources has emerged (Gordillo, Barra, Gallego and Quemada., 2013). Digital LOs with interactive properties can be referred to as interactive learning objects (ILOs) and are available in a variety of forms such as flashcards, virtual tours, enriched videos and interactive presentations (Barak and Ziv, 2013). In this study the term ILO will be used. The interactive nature of ILOs is said to enrich education and training by providing high quality resources, so therefore, organisations must design ILOs properly to maintain the quality standards of this technology. The question then arises *"How can we ensure quality standards for designing ILOs?"*

User interface design is undeniably important in many fields, including e-learning (Bartuskova and Krejcar, 2014). There is currently a lack of e-learning design guidelines and expertise available due to the uniqueness of the learning process (Wiklund-Engblom, 2015). Knowledge from the fields of user experience (UX) and web design are used when designing for learning, but due to the uniqueness of the learning process, specialised knowledge is also required (Peters, 2014; Wiklund-Engblom, 2015). Design guidelines can differ according to the context and purpose of the e-learning environment (Bartuskova and Krejcar, 2014). Design is one of many facets of the e-learning domain and can be understood as a complex learning strategy involving the presentation of content in e-learning (Bartuskova and Krejcar, 2014; Pelopidas and Kokkinaki, 2014).

With respect to the creation of LOs, design practices have also focused on ILO reusability (Watson, 2010), by ensuring that certain key features are present including (i) ILOs that are designed as building blocks that can be deployed in several courses, (ii) ILOs are self-contained and independent from the specific context of use, (iii) ILOs are created from standardised and separable micro-components and (iv) ILOs that are consistent in size and style.

Whilst interaction design has become an integral part of information systems (IS) design and development, especially for web systems, there is a lack of research related to the design of ILOs, specifically in the corporate context. The purpose of this paper is therefore to investigate and propose a design process that designers can follow when developing ILOs for companies. The structure of the paper is as follows: Section 2 explores existing literature related to interaction design and ILOs and then proposes a set of design guidelines synthesised from theory. In Section 3, the research methodology is described

and then a process for the design and development of ILOs is contributed by the authors, based on the literature review. The case study is described and an analysis of the results is presented in Section 4 and then several conclusions and recommendations are made in Section 5.

2 Literature and Related Work

This section explores general interaction design guidelines and principles that should be considered and followed when developing ILOs. The design of interactive products is discussed first and is followed by an exploration of ILOs. The guidelines for designing components of ILOs is shown and a detailed process of designing ILOs is presented.

2.1 Design of Interactive Products

The process of designing interactive products to support the way in which people communicate in their daily lives is referred to as interaction design (Rogers, Sharp and Preece, 2011). The creative aspect of interaction design can be emphasised by describing it as the art of enabling the interaction between humans and computers (Saffer, 2010). ILOs have inherent multimedia elements and provide immediate feedback to learners and because of this, they have been found to be enjoyable and easy to use when considering the pace of learning (Bradley and Boyle, 2004).

There are four generic activities involved in interaction design (Figure 1) and these activities are intertwined where the output of one activity forms the input of another and activities may overlap (Rogers *et al*., 2011). The first activity involves the establishment of requirements and entails investigating the intended user's needs which will inform subsequent design and development processes. The next activity is where ideas are suggested that could possibly meet the user's needs in the form of conceptual and physical designs. A conceptual design entails an abstraction that models the interaction of the user with the given artefact and the physical design looks at the detail of the artefact such as menu design and colour usage. Prototyping is the next activity and involves the actual design of the interactive artefact which need not necessarily be a working piece of software, it can also be paper-based but should give a sense of the user's interaction with the artefact. The final activity is evaluating and entails establishing the usability and acceptability of the artefact which is measured using a set of criteria.

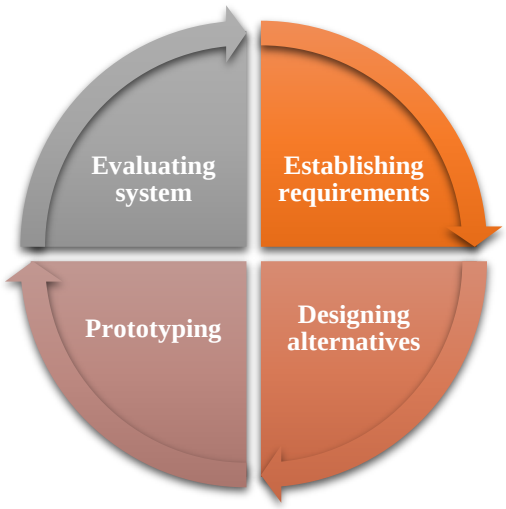

Figure 1. The Process of Interaction Design (Rogers et al. 2011)

When considering interaction design, the UX of the application in question must be accounted for (Rogers *et al*., 2011). UX refers to how a product is used by people and the feelings generated by interacting with that product. There are a number of UX objectives that designers can establish in the form of goals. This should form part of the establishment of the user's requirements. UX goals can be separated into desirable and undesirable aspects which consist of subjective user feelings toward a system. Desirable UX goals can include aspects such as *engagement, cognitively stimulating, motivating, challenging* and *rewarding*. Undesirable UX goals are, for example, *frustrating, childish, patronising, annoying* and *boring*.

It is imperative that designers also consider the user cognition involved with interaction. There are two distinct modes of cognition which are experiential and reflective according to Norman (1993). Experiential cognition involves being in a mindset where we effectively and effortlessly perceive, act and react to events surrounding us. Reflective cognition consists of thinking, associating, comparing and making decisions. The modes of cognition require different technological support and can be accounted for by considering the cognitive processes of people (Rogers *et al*., 2011).

Attention is a cognitive process which involves the method of choosing which items to concentrate on from a set of available items, at a point in time. The way in which information is presented can either positively or negatively affect peoples' attention. Perception is another cognitive process which refers to the way in which information is retrieved by people through the sensory organs, such as through sight, touch and sound, and then transformed into experiences of objects (Roth, 1986). Information should be presented in a way that can be perceived in the intended manner. A third cognitive process is memory which entails recalling knowledge of varying types that enables people to react in an appropriate way (Rogers *et al*., 2011). Learning is another cognitive process which can be described in the field of IS as either the process of learning to use a computer-based system or using a computer-based system to learn to understand certain subject matter. The cognitive processes of reading, speaking and listening are forms of language processing which need to be considered when designing interactive technologies. Finally, the reflective set of cognitive process which are problem-solving, planning, reasoning and decision making, involve thinking about a subject, considering the available options, evaluating the consequences of possible decisions and then choosing the most favourable option. It is best practice to design for the six cognitive processes in interactive systems and content, such as ILOs. According to Rogers *et al*. (2011), there are several design implications linked to the cognitive processes that could be considered as guidelines for designing interactive products (Table 1).

Cognitive Process	**Design Implication Example**
Attention	Use techniques like animated graphics, colour, underlining, hierarchy and structure of items, ordering of related information and spacing of items to highlight information.
Perception	Text should be legible and distinguishable which can be ensured by using light text on dark backgrounds or vice versa.
Memory	Design interfaces that promote recognition rather than recall by using menus, familiar icons and consistently placed items.
Learning	Encourage exploration with interface design.
Reading, Speaking and Listening	Provide options for enlarging the text on a screen without compromising on formatting.
Problem Solving, Planning, Reasoning and Decision Making	Provide supplementary concealed information or tips that is easily accessed for users who want to know more about carrying out tasks more efficiently.

Table 1. Design Implications for Interactive Products (Adapted from Rogers et al., 2011)

Since the early days of LO design, clear benefits were identified for both developers and instructors, including (i) the use of interoperable and reusable building blocks of e-learning content adhering to widely shared specifications, (ii) improved collaboration amongst developers, (iii) unlimited combinations leading to the construction of collections in the form of lessons, modules, courses and other curricula structures, (iv) increased productivity in the form of e-learning content development and course design and (v) reduced time and cost overheads associated with the development of e-learning content (Clyde, 2004; Parrish, 2004). The design implications for interactive products (Table 1) provide an excellent framework for designing and creating interactive products. These guidelines should be used in line with four goals for the implementation of LOs in educational environments (De Salas and Ellis, 2006). These goals are:

- **Reusability** – the goal is to create manageable units of instruction that can be assembled and reassembled as needed. The proposed guidelines ensure the simplicity of the implementation practice.
- **Interoperability** – the goal is to create learning components that can be used together without any restrictions from the virtual learning environment or learning management system used. Therefore, the design guidelines are created around the learning paradigm and underlying pedagogies rather than the technologies used.
- **Durability** – the goal is to ensure that LOs do not become obsolete due to changes in the way information is presented and delivered or any other shifts in technology. Therefore, the way interactive content that is created is independent of technology and tools used in all design guideline categories.
- **Accessibility** – the goal is to make learning content available anywhere, anytime, in ways that can be discovered and reused. Interactive content from all design classifications should be available for the creation of ILO in various contexts.

2.2 Learning Objects and Interactive Learning Objects

A LO can be defined as an entity which can be digital or non-digital that is used for learning, educational or training purposes according to the official learning object metadata (LOM) standard (IEEE, 2002). Conversely, this definition cannot be considered universal due to the several definitions of LOs observed which depend on the context of the content (Verbert and Duval, 2008). The reason behind creating learning resources in the form of LOs is because of the ability to reuse them instead of having to create new learning resources each time they are needed (Wiley, 2000). The smaller the size or granularity of the LOs, the larger the potential is for reuse (Duval and Hodgins, 2003). LOs can also be grouped to form complex hierarchies, commonly referred to as authoring by aggregation, or combined in a sequence to represent the learning process (Duval and Hodgins, 2003; Gordillo *et al*., 2013). The benefits of reusing LOs reduces the time and the cost associated with developing these learning resources and ILOs, specifically, have the ability to enhance the quality of learning (Mohan and Brooks, 2003; Wiley, 2000). ILOs can be described as web-based tools that support the process of learning by enhancing, strengthening and guiding the cognitive processes of learners by interactive means (Barak and Ziv, 2013; Kay and Knaack, 2008). Since they are by their very nature, interactive, the design implications proposed in Table 1 for interactive products can apply to ILOs. ILOs also need to include explicit objectives and built-in assessment methods as this has become best practice (Barak and Ziv, 2013). AlfredoSanchez, Perez-Lezama and Starostenko (2015) add that ILOs should consist of six components, which are the outputs of the design and development process. The components are:

- The learning objectives;
- The skills or competencies that are acquired after interacting with the ILO;
- Prerequisite knowledge of the learner required before using the ILO;
- The digital educational content;

- A set of practice tasks to be completed by the learner; and
- An evaluation/assessment mechanism to measure learner competency.

The learning objectives describe that which learners must accomplish or knowledge that should be obtained after using the ILO. The goal is the purpose toward which efforts are directed and can consist of several learning objectives. Competencies or skills are the abilities, attitudes and values acquired after interacting with the ILO. Prerequisites refer to the knowledge or competencies the learner should have acquired previously in order to be able to take full advantage of the ILO.

e-Learning often incorporates visual elements, yet the visual design element of e-learning is often overlooked or seen as a minor cosmetic feature (Horton, 2006). Bartuskova and Krejcar (2014) proposed a set of design attributes and requirements for e-learning in general from a synthesis of literature. The five main design requirements concern legibility, design consistency, visual presentation, content arrangement and content adjustment (Table 2). Legibility concerns the ability for learners to read text and recognise pictures and is significantly more important in e-learning due to it being more difficult reading a computer screen than paper (Weinschenk, 2011; Bartuskova and Krejcar, 2014). Visual presentation can help in generating positive attitudes towards the given artefact and entails the use of colour, graphics and the visual hierarchy of content (Bartuskova and Krejcar, 2014). Design consistency refers to two implications of consistency, one concerning the consistency of style and appearance and the other concerning the consistency of meaning and action (Fee, 2009; Lidwell, Holden and Butler., 2010; Bartuskova and Krejcar, 2014). Content arrangement is the organisation and structural positioning of various multimedia content (Bartuskova and Krejcar, 2014). Content adjustment entails the division or grouping of content into logical units as well as the emphasis of important content to aid in the processing of information by the learner.

Requirement	Attributes
Legibility	Typeface, type/font size, tonal contrast, spacing, alignment, line length, media legibility
Visual presentation	Aesthetic design, colour, colour contrast, relevant graphics, supportive graphics, visual hierarchy
Design consistency	Functional consistency, aesthetic consistency, consistency in layout and structure
Content arrangement	Layout, organisation, navigation mechanism, multiple presentation media
Content adjustment	Chunking, white space, emphasis mechanisms, noise reduction

Table 2. Design Attributes and Requirements (Bartuskova and Krejcar, 2014)

The set of design requirements and attributes specified by Bartuskova and Krejcar (2014) were sourced from research based on general design principles, e-learning systems and web design. There is a strong focus on the aesthetics of e-learning with influencing elements of graphic design. The design attributes and requirements are appropriate for ILO design as aspects such as consistency, colour usage and spacing are addressed, which are important in the design of ILOs.

A framework for evaluating m-learning artefacts, which included ILOs, was proposed by Harpur and de Villiers (2015). This framework is for evaluating M-learning environments, emphasising the Usability and User eXperience encountered in mobile Educational contexts (MUUX-E), and is a customisable template that is underpinned by theoretical principles and focuses on the evaluation of m-learning applications. The MUUX-E framework consists of the following five categories of criteria: general interface usability, web-based learning, educational usability, m-learning features and UX.

The general interface usability criteria were derived from Nielsen's classic heuristics for interface usability and emphasises the design of a system that is consistent and meets learner needs (Nielsen, 2005). The second category, web-based learning, concerns the navigation, organisation and format of the system as well as its suitability for the learning process (Harpur and de Villiers, 2015). Educational usability

emphasises learning-specific use and the incorporation of learning objectives or outcomes based on a learning theory. The fourth category is specific to m-learning and entails the affordance of contextual requirements and user-centricity. The m-learning category can be adapted for e-learning purposes since m-learning evolved from the concept of e-learning (Whale, Scholtz and Calitz, 2015; Kumar, 2013) with some additional constraints such as screen size. The last evaluation category is UX which involves measuring the extent to which a user has positive feelings towards the given system. The MUUX-E framework evaluates some elements of the interactive nature of artefacts and also considers the learning element. Since m-learning is a subset of e-learning, the majority of criteria are applicable to other e-learning products, except for those that relate to handheld devices. The five categories of the MUUX-E framework are therefore suitable for designing and evaluating e-learning systems and specifically, ILOs.

3 Research Methodology

The main research question of this study is:

RQ_M: What process should be followed when designing interactive learning objects (ILOs) in a corporate context?

The aim of this study is to propose a process and guidelines that can be used by practitioners and researchers alike for the design of ILOs in the corporate context. In order to answer and address the research question of this study, the following supporting research objectives are identified:

RO_1: To propose a comprehensive process for designing and developing ILOs for corporate usage.

RO_2: To apply this process to the design of ILOs in a real-world e-learning context (case study).

The first research objective (RO_1) was answered by conducting an in-depth literature review. From a synthesis of the literature, a comprehensive Process for Designing and Developing ILOs (PDILO) is proposed by the authors, which was based on the four activities involved in the interaction design process (Figure 1 and Section 2.1) and applied to ILOs (Figure 2). The first activity of interaction design and in PDILO relates to the establishment of requirements whereby learning objectives, competencies or skills and the required learning prerequisites are established. During this activity, desirable and undesirable UX goals should be identified and the design guidelines as well as corporate culture and context should be considered. The second activity is the design phase where alternative designs for the ILOs are constructed. The third activity is prototyping, where various interactive artefacts or ILOs are created and the output of this activity is the ILO content.

ILO content consists of the digital resources that make up the ILO, including sequencing and the navigational information on such resources (Rogers *et al*., 2011). It is during the activities of designing and prototyping that designers need to consider four sets of design guidelines and heuristics:

- Organisational considerations and guidelines,
- Interactive design guidelines for cognitive processes,
- e-Learning design attributes and requirements, and
- e-Learning (MUUX-E) heuristics.

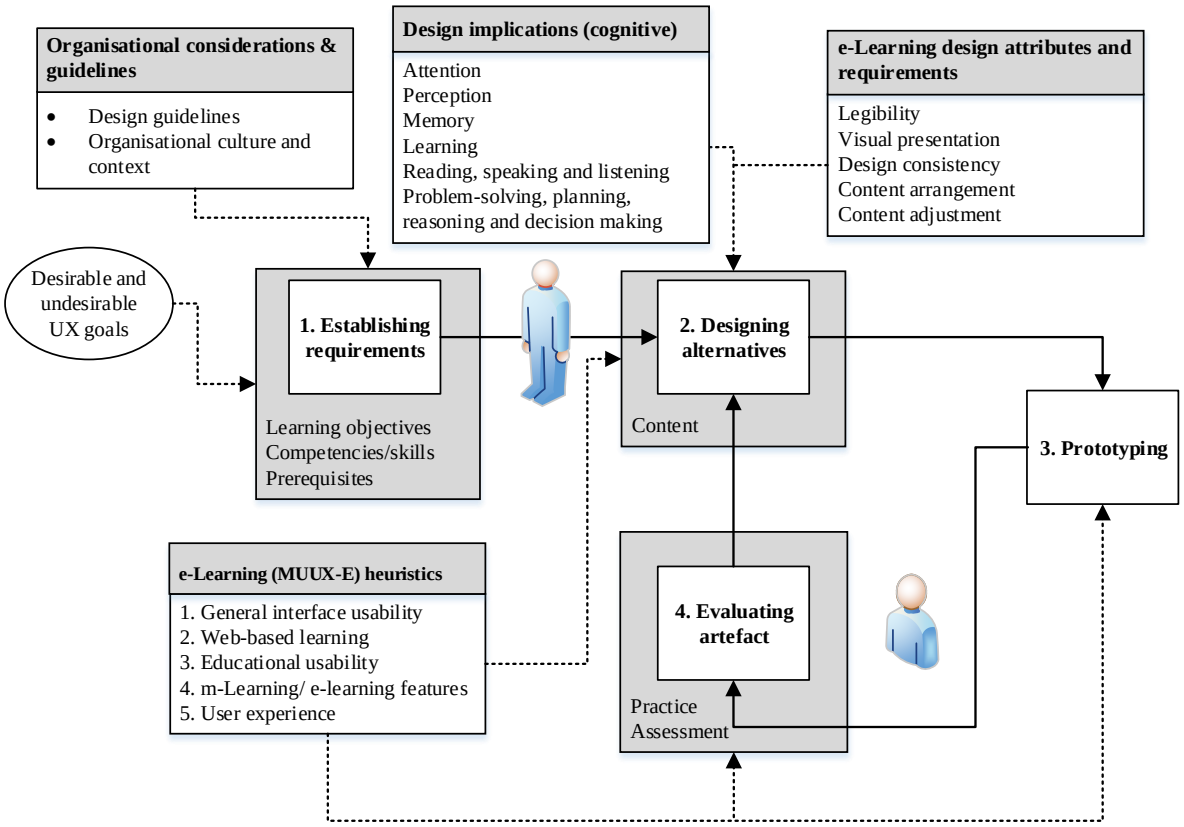

Figure 2. Process for Designing and Developing ILOs (PDILO) - (Author's own contribution)

Organisational culture has been found to be crucial in the way that e-learning is designed and utilised (Czerniewicz and Brown, 2009; Tarhini, Hone and Liu, 2013; Tarhini, Hone, Liu and Tarhini, 2016). Technology in the form of e-learning can be made available in the workplace, however, benefits will not be realised by companies if employees are not willing to adopt such systems (Yoo and Huang, 2015). A learning organisation can be conceptualised as the sharing of knowledge and the provision of growth opportunities at an individual and organisational level (Yoo and Huang, 2015). A learning organisation can be fostered with the use of e-learning and will therefore cultivate an organisational culture which is based on knowledge sharing. The allocation of goals, values and resources in the form of policies can contribute to successful e-learning institutional adoption (Czerniewicz and Brown, 2009). Companies must ensure that the strategic positioning of e-learning is aligned with the learning and development policies of the company (Yoo and Huang, 2015). When designing e-learning systems and content for the workplace, the intended learner's profile in terms of gender, age and computer skills must be considered (Al-Qahtani *et al*., 2013). Guidelines for designing ILOs therefore need to consider the organisational context and culture.

In the final activity, the artefact is evaluated. During the practice activity, the learner practices tasks using the artefact and is then assessed during the assessment activity to measure the knowledge attained through interacting with the ILO. It is important to note that this process is iterative involving continuous improvement in each of the activities of designing alternatives, prototyping and evaluating.

In order to meet the second research objective (RO_2), a case study research strategy was utilised and the guidelines derived from the literature were applied to the case study. The case study strategy can be described as contextualising a phenomenon which typically relies on inductive reasoning and highlights the reader's understanding of the phenomenon being focused on in the study (White, Drew and Hay, 2009; Willis, 2007). According to Willis (2007), a case study research strategy can enable researchers

to gather rich, detailed data in authentic settings. Case study research also enables the understanding of human behaviour which can be interpreted in a social context as a lived experience.

4 Application of Design and Development Process

The case study used for this research is a South African software development company, specialising in the development of software products for the South African property industry. For purposes of anonymity, the company will be referred to as TechDisrupt. The company's vision for e-learning is for it to form an integral part of customers' interaction with their software after purchasing. Prior to the implementation of e-learning at TechDisrupt, customers were trained to use the software products that they had purchased by means of traditional face-to-face courses. TechDisrupt's objective was to transfer these courses to an online environment, in the form of e-learning, in order to reduce costs and to introduce a more effective knowledge acquisition process that is also convenient for customers. At the start of this study, some of the courses were partially available online but usage rates of the courses were low and learning content was made up of documents in the form of instruction manuals. One of TechDisrupt's goals is therefore to improve the quality of the e-learning content and the UX of users that are using the system and interact with the ILOs. In order to do this, a design process is needed so that content developers at TechDisrupt can create ILOs in a standardised way by following this process and the associated guidelines.

The theoretical PDILO framework derived from the literature review (Figure 2) was used to guide the four activities of designing and developing the ILOs for one learning module for TechDisrupt's "Transfers Course" (Table 3, Table 4 and Table 5). As part of establishing requirements, a preliminary study was undertaken where a focus group (Esterhuyse and Scholtz, 2015) and survey (Esterhuyse and Scholtz, 2016) were used to identify the needs and profile of TechDisrupt's customer base. The focus group and survey indicated that their customers' intention to use e-learning was positive. When designing ILOs for TechDisrupt, it was important to obtain feedback from relevant company stakeholders iteratively in order to ensure that the designs adhered to the company's brand, culture and policies. After the ILOs were designed, the wireframes were presented to TechDisrupt where constructive feedback was gathered and implemented, after which a final design of the ILOs was shown to the company again.

Activity 1: Establishing requirements	
Component	**Examples of application to case study**

Learning objectives	• **Interviews** were conducted with management and the users to determine company-specific policies, standards and learning objectives.
	• **Company-specific requirements** were elicited from TechDisrupt by specifying that the company needed ILOs developed for conveyancing software.
	• **Observations** of existing face-to-face course was undertaken**.**
	• **A focus group** was conducted to determine requirements of users and their profiles. Key findings were that customers of TechDisrupt who had never used e-learning before, are open to the idea of using e-learning but significant barriers to e-learning exist (Esterhuyse and Scholtz, 2015).
	• The two main learning objectives were identified as:
	  o The ability to open a new Transfer file using the conveyancing software.
	  o Learn new methods to complete tasks more efficiently.
	• **Desirable UX goals:** engaging, challenging, cognitively stimulating and rewarding
	• **Undesirable UX goals:** patronising, boring, gimmicky and frustrating

Competencies or skills	A **survey** was conducted to get more detail on the user profile (Esterhuyse and Scholtz, 2016): Key findings were that customers of TechDisrupt have positive intentions to use e-learning due to high enjoyment and self-efficacy ratings, and low computer anxiety ratings. The skills needed that were identified from the interviews and observations were: • Entering transactions in the Transfer conveyancing software. • Problem solving skills • Low dependence on help mechanisms (e.g. call centres, live chats, colleagues or face-to-face training) will be established.
Prerequisites	The learner should have some knowledge of conveyancing processes regarding transfers as well as intermediate computer experience in terms of being comfortable using a computer and using computers regularly.

Table 3. Application of design process to case study – Activity 1 (Establishing requirements)

Activity 2: Designing alternatives	
Component	**Examples of application to case study**
Content	Each learning module designed consisted of three units: **Show Me:** The software is demonstrated to the learner (learning and attention cognitive processes involved) **Try Me:** The learner attempts to use the software (perception and problem solving cognitive processes involved) **Test Me:** The learner is assessed based on their knowledge of the given module (memory cognitive process involved)
The following MUUX-E categories were used as heuristics to design alternatives of learning modules and ILOs: **General interface usability:** *Aesthetics and minimalism in design* **Web-based learning:** *Suitable course content of a high quality*, *Relevant pedagogical site content* and *high quality video and digital media*	

Table 4. Application of design process to case study – Activity 2 (Designing alternatives)

Activity 3 and 4: Prototyping and evaluating	
Component	**Example of application to case study**
Practice/tasks	The learners practice the tasks using the Try Me unit.
Evaluation mechanism	A quiz is administered in the Test Me units to measure the knowledge acquired from the ILOs by the learner. A mark is awarded to the learner.
The following MUUX-E categories were used for both prototyping and evaluating, specifically the criteria involving: **Educational usability:** *Feedback, guidance and assessment* **e-Learning features:** *Interactivity (Navigational fidelity; multimedia components with high quality lessons and exercises; synchronous and asynchronous communication and collaboration; simple and easy to use system)* **UX:** *Appeal (new impressions; curiosity; insights; visual power; aesthetic factors)* and s*atisfaction (pleasure; cognitive likeability; trust; achievements; motivation; goals)*	

Table 5. Application of design process to case study – Activity 3 and 4 (Prototyping and evaluating)

5 Discussion and Reflection

A novel process for designing ILOs for the corporate context, namely PDILO, is presented in this paper and a set of guidelines are proposed. The theoretical framework and design process were generated from the literature, grounding this research as a theoretical contribution to the bodies of knowledge on e-learning and design. This research has a significant contribution to the design bodies of knowledge by introducing an approach to designing ILOs for corporate usage. The research question "What process should be followed when designing interactive learning objects (ILOs) in a corporate context?" was answered by achieving two research objectives, one of which involved proposing a comprehensive process for designing ILOs for corporate needs and the other involved applying this process and the associated guidelines to a real-world corporate context.

Upon reflection, the application of the PDILO framework in the design of the ILOs for TechDisrupt was successful. Factors that may not otherwise have been considered, such as the organisational culture of TechDisrupt and the varying profiles of the customer base, enabled the designers to take an all-inclusive and user-centric approach to design. The iterative nature of the ILO design process enabled a set of ILOs to be designed that were of a high quality and therefore appropriate for the highly competitive nature of the industry in which TechDisrupt operates. A possible limitation of using the PDILO is that it was implemented in only two cases. Since the PDILO was proposed by the authors of this paper, it has not been established if this process is used often enough to be considered best practice, which could be substantiated by empirical results.

It is important to state that although in this paper, the creation of ILOs for corporate scenarios is the primary focus, PDILO is applicable to other educational contexts. The activities proposed by PDILO were followed in higher education settings and addressed the different needs of students. An example from previous work (Saleeb and Dafoulas, 2016) relates to the design of learning experiences in virtual worlds and in particular the creation of learning spaces with emphasis on the activities that must be supported. The Show me, Try me, Test me approach (Activity 2) was applied to the use of virtual worlds for learning activities and helped in the adjustments of architectural features to fit learning needs. This work applied the activities of PDILO and focused both on establishing requirements through the evaluation of the learning experiences of the students and on designing alternatives through the creation of architectural spaces that would support different cognitive processes (for example, team brainstorming versus individual self-assessment).

Furthermore, the application of PDILO in different learning settings has established that it can be applied across a wide range of learning scenarios and educational contexts. The proposed activities and guidelines were used while building learning spaces in 3D virtual worlds, creating interactive learning opportunities in social learning networks (for example, Facebook) and incorporating Optical Head Mounted Devices (OHMD) in the provision of feedback to student presentation and evaluating tutor support (Dafoulas, Maia and Loomes, 2016). The activities were also followed while creating interactive learning scenarios with the use of social learning networks and in particular while using Facebook for facilitating student learning in further and higher education institutions. Previous work of Shokri and Dafoulas (2016) of the use of social media in learning used both cognitive guidelines and UX criteria. The cognitive guidelines were used in a qualitative analysis of learners' contributions, whereas the UX criteria were used in a quantitative analysis of how social media features were used. The results were used to propose design alternatives, thereby leading to enhanced prototypes. Finally, the prototyping and evaluating steps (Activity 3 and 4) were followed in the use of OHMD for the provision of feedback to students delivering presentations, as well as mentoring academics who provided formative assessment feedback to learners.

This study promotes quality standards and best practice for improving ILOs used in corporate e-learning environments. The design process and guidelines proposed can be applied to the corporate context and can also be adapted to suit industries other than corporates. The process is supported by theoretical

principles that can be used when designing ILOs and for quality assurance of such products that are included in e-learning environments. The management strategies of companies wanting to implement and maintain successful e-learning systems should encourage the adherence to the design process and guidelines presented in this paper. It is important that ILOs are aligned with the organisation culture and accommodate the diverse profiles of intended users. Future research could entail the application of the design process to other fields and contexts such as agricultural or government environments. The design process could be extended to include additional factors related to the corporate context or could be standardised for general use. Future research could also investigate relationships between the ILOs designed using the guidelines from this study and the extent to which users enjoy learning using the ILOs and the success of the e-learning initiative.

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