

Enhancing users' experience of a learning management system within higher education: Chatbot design principles for service providers

by

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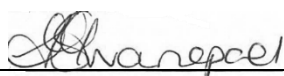
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LIST OF ABBREVIATIONS AND ACRONYMS

AI	Artificial Intelligence
ANT	Actor-network theory
API	Application programming interface
AT	Activity theory
CAGR	Compounded annual growth rate
CCA	Constant comparative analysis
CUE-Model	Components model of user experience
DF	Design feature
DP	Design principle
DSR	Design science research
FAQ	Frequently asked question
HEI	Higher education institution
ICT	Information and communication technology
IS	Information systems
IT	Information technology
LMS	Learning management system
NLU	Natural language understanding
POV	Point of view
SaaS	Software as a service
SQ	Sub-question
STS	Socio-technical systems
UI	User interface
UX	User experience

ABSTRACT

Improving the user experience (UX) of learning management systems (LMS) in higher education institutions (HEIs) poses a significant challenge for service providers. This challenge centres around the limitations of the existing user support mechanisms within LMS platforms. A potential solution to this problem is the implementation of an LMS chatbot. However, an obstacle in deploying such a chatbot lies in the absence of well-defined guidelines and research-based design principles tailored specifically for integration within LMSs. Such design principles are necessary for service providers aspiring to improve the UX within the LMS environment.

The LMS service provider aims to enhance the product delivered to its users. Therefore, the researcher proposes an LMS-integrated chatbot, distinguishing it from existing chatbots that are neither integrated nor based on empirical research. Unlike chatbots functioning as frequently asked question (FAQ) assistants or assuming the role of the lecturer, the proposed chatbot guidelines are designed for LMS service providers to consider the implementation of design principles, ultimately improving the overall UX.

The absence of established LMS chatbot design principles, both in theoretical frameworks and in practical applications, poses a challenge for service providers seeking to offer efficient user support through an integrated chatbot. This gap increases the risk of user dissatisfaction with the LMS platform, potentially leading to frustration. This user dissatisfaction may drive HEIs to explore alternative LMS products or service providers. This study is driven by the need to address the abovementioned challenges and facilitate the effective utilisation of chatbots to ensure an enhanced LMS UX. To build a robust theoretical foundation for the development of design principles, this research employs activity theory (AT) as a framework to understand the diverse user activities within the LMS activity system.

To address this problem, this study employed the design science research (DSR) methodology and incorporated a design thinking workshop approach in the development phase of the DSR. The workshop incorporated a design team comprising 12 team members, who are all active LMS users from diverse HEI environments: four students, four instructors and four LMS administrators. The workshop participants offered valuable insights into what an LMS chatbot should look like, as well as how it should feel and function.

The insights gathered from the workshop, including participant worksheets, participant observations and field notes, formed the foundation for the tentative set of LMS chatbot design principles. These tentative LMS chatbot design principles were further evaluated by four LMS experts to ensure their relevance and effectiveness in enhancing the LMS UX. The resulting design principles offer a structured framework to guide the creation of LMS chatbots to enhance the LMS UX within HEIs, aligning them with existing design features and Peter Morville's UX honeycomb (Morville, 2004).

This study contributes to the body of knowledge in information systems (IS) by presenting a set of design principles grouped according to the categories technical mechanisms, language usage, UX and feedback mechanisms. These design principles aim to enhance the chatbot's effectiveness across various dimensions, including responsive interaction and availability, seamless integration into the LMS platform, natural language understanding (NLU), multilingual support, focused conversation, intelligent error handling, engaging personality, progress tracking, personalised recommendations, transparency on capabilities and limitations, and privacy and data security. Each design principle outlines specific criteria and expectations, providing a comprehensive framework for designing and implementing an LMS chatbot that prioritises UX.

These principles address a gap in LMS chatbot development guidance and have the potential to enhance the overall UX within HEIs. Additionally, this study underscores the crucial role of design principles in advancing knowledge dissemination within the IS research domain. Subsequent research endeavours could explore empirical evaluations of these design principles in real-world LMS implementations, assessing their effectiveness and broader impact on UX.

Keywords: Chatbots, Design Principles, Design Thinking Workshop, Higher Education Institutions (HEIs), Learning Management Systems (LMS), User-Experience (UX)

CHAPTER 1: INTRODUCTION

Learning management systems (LMS) are rapidly becoming an essential part of the learning support provided by higher education institutions (HEIs) to their students and staff members. Consequently, service providers should prioritise the integration of user-friendly interfaces, efficient customer support, cutting-edge features, impeccable system design, well-crafted course design and reliable system maintenance within their LMS software. A user-friendly interface may refer to a design approach in software or systems, such as LMS, that prioritises ease of use, intuitiveness, and engagement for its users (Méndez-Becerra, Rosales-Morales, Alor-Hernández, & Mezura-Godoy, 2022). By doing so, they can foster increased system utilisation and enhance user satisfaction (Chaw & Tang, 2018). This is relevant, as an LMS is an ever-evolving tool that must keep pace with advances in technology, the demands of students, and an ever-changing educational landscape (Jafari, Zhao, & Jafari, 2022).

This study aims to contribute to the existing literature by formulating a set of design principles for service providers and optimising the users' experience of an LMS, using a chatbot within higher education. These design principles can serve as a comprehensive guide for LMS service providers, enabling them to create a more streamlined support system to enhance overall user experience (UX) for end-users. By employing design science research (DSR), this study contributes valuable insights for the design of an information systems (IS) artefact in the format of a set of design principles. This study utilised activity theory (AT) as a framework for the development of an LMS chatbot, aligned to design principles for all user types. The goal is to equip LMS service providers, designers and developers with design principles that will serve as a guide and provide a point of reference when designing the details of their products; and to provide ongoing support to users.

1.1 BACKGROUND AND RATIONALE

This study focuses on the use of IS, which are integral to the core operations of nearly every business function within modern organisations, including HEIs. Moreover, in these institutions, knowledge is accumulated and distributed across many disciplines. HEIs rely on IS for a wide range of operational activities as it is at the forefront of modern economic, social and cultural change (Chaushi & Dika, 2013), thus furthering educational goals. IS

have the capacity to enhance learning through dynamic educational software development. This trend can be illustrated by the widespread and advancing utilisation of LMSs in HEIs.

According to Burtsev (2021), LMS adoption is on the rise and is becoming more sophisticated. Multiple studies (Gamage, Ayres, & Behrend, 2022; Murphy, Eduljee, & Croteau, 2020; Sulaiman, 2023) have indicated that the majority of HEIs worldwide have integrated LMSs into their educational systems.

The primary goal of an LMS is to improve and streamline the learning experience. It achieves this goal by facilitating user-friendly access, supporting mobile and self-directed learning, tracking and reporting student progress, and eliminating manual and repetitive tasks, thereby conserving valuable resources (Wheelhouse, 2022). The appeal of an LMS lies in its ability to seamlessly integrate a range of pedagogical and course administration tools (Loots, Strydom, Meintjes, Posthumus, & Posthumus, 2021), owing to the limitless communication possibilities it offers (Croitoru & Dinu, 2016). One particular benefit is that it facilitates learning, while servicing various users, for example students, instructors and administration staff (Kurata, Bano, & Marcelo, 2018).

LMS platforms have undergone significant advancements over the years to incorporate an array of interactive tools, including blogs, wikis, chatrooms and discussion tools (Holmes & Prieto-Rodriguez, 2018). For HEIs to achieve success, it is imperative that they continuously integrate new trends and knowledge to keep up with the rapidly evolving technology landscape (Chaudhari, 2015). Consequently, evaluating their effectiveness entails considering various contributing factors. These factors encompass institutional support, infrastructure, skills development and, ultimately, the users themselves (Loots et al., 2021).

Ngeze (2016) asserts that the utilisation of LMSs in HEIs holds significance for users, as these systems can effectively save time during various activities. However, to ensure their effectiveness, it is crucial to improve and customise customer support services (Lee & Lee, 2020). Amidst the global COVID-19 pandemic in 2020, HEIs made significant strides in bolstering support systems to assist LMS users to maximise their utilisation of digital platforms, thereby facilitating seamless learning and teaching experiences (Loots et al., 2021). It therefore becomes imperative to regularly enhance LMSs to support a wide array of activities and foster increased interaction among stakeholders.

Service providers develop LMS software that simplifies user support by aiding users with technical issues, as well as addressing routine requests for help such as password resets or course functionality. They further offer technological solutions that allow for the management of teaching and learning through a variety of administrative features. These features include publishing, authoring and administration activities related to teaching and learning, as well as user features that facilitate ease of access to customer support, training programmes and content (Training Industry, 2020). In addition, LMS service providers are responsible for enhancing their product by addressing concerns such as the improvement of system and service quality (Chaw & Tang, 2018), UX (Saleh, Abuaddous, Alansari, & Enaizan, 2022), mobile compatibility (Saroia & Gao, 2019), system integration (Kasim & Khalid, 2016), customisation (Paguirigan, 2023) and technical support (Baleghi-Zadeh, Ayub, Mahmud, & Daud, 2017), to mention a few.

1.1.1 Optimal use of LMSs

To underscore the obstacles hindering the optimal use of LMSs in HEIs, it is important to establish a clear understanding of what “optimal use” entails. Cambridge University Press defines “optimal” as the best or most likely way to bring success or advantage in a particular situation (Cambridge University Press, 2023). Thus, “optimal use” refers to the ideal or most effective manner of leveraging an LMS to attain the best possible outcomes. Holmes and Prieto-Rodriguez (2018) emphasise that this involves not only making full use of all available features and functionalities, but also demonstrating a profound understanding of the system’s capabilities. It implies a deep comprehension of how to maximise the potential benefits and performance of the LMS, which often necessitates a combination of technical proficiency, strategic thinking and a proactive approach to exploring and utilising its various aspects. In essence, LMS users must possess a comprehensive understanding of the capabilities and advantages offered by the LMS platform (Canani & Seymour, 2021; Jain, Kumar, Kota, & Patel, 2018). Furthermore, Rubin, Fernandes, Avgerinou, & Moore (2010) assert that an effective LMS should, at the very least, facilitate active engagement, establish meaningful connections between different course components, enable seamless communication, and provide formative feedback on work presented in class discussions or other platforms.

1.1.2 Customer support to ensure optimal use

Ensuring optimal utilisation involves a key element: effective customer support. The relationship between the quality of customer support and the alignment of services with customer expectations has been well established (Lewis & Booms, 1983). When introducing a new LMS, it is imperative to incorporate several essential components to facilitate its seamless integration. These components encompass clear and effective communication, feedback mechanisms between users and service providers, well-defined management roles, access to skilled technical support and continuous user training (Coleman & Mtshazi, 2017).

Among these essential components, the establishment of open communication channels emerges as a critical facet with far-reaching implications. The significance of open communication channels cannot be overstated, as they play a pivotal role in significantly enhancing the overall quality of customer support (Hardalov, Koychev, & Nakov, 2018). Service providers therefore often extend their assistance to end-users through multiple communication channels as a strategy to augment the quality of customer support (Máchová & Lněnička, 2018). This proactive approach not only enables service providers to accommodate customers in their preferred communication environment, but also endeavours to strengthen overall customer satisfaction.

1.1.3 Chatbots and customer support

To render customer support, communication channels may include traditional media (print) or digital media, such as company web pages, social media, email and chat platforms (Constantinescu-Dobra & Coțiu, 2021). Communicating with customers through live chat interfaces has gained significant popularity as a real-time customer support method in various e-commerce settings (Adam, Wessel, & Benlian, 2021; Følstad, Nordheim, & Bjørkli, 2018). Chatbots have emerged as a powerful tool to enhance communication between customers and service providers. This approach allows businesses to engage with their customers promptly and effectively, addressing their queries and concerns in a timely manner (Mahade, Sayyad, Ramhari, Santosh, & Nanasaheb, 2023).

These advanced systems are specifically engineered to employ Artificial Intelligence (AI) to engage in text-based or chat-based interactions with humans, utilising natural language (Gnewuch, Morana, & Maedche, 2017; Pesonen, 2021; Pfeuffer, Benlian, Gimpel, & Hinz, 2019; Przegalinska, Ciechanowski, Stroz, Gloor, & Mazurek, 2019). Customers utilise chat

services to obtain information, such as product details, or seek assistance in resolving technical issues. It is a convenient platform for customers to obtain the support they require. Chatbots can improve customer service by offering answers synchronously, regardless of time zones (Constantinescu-Dobra & Coțiu, 2021; Rocio & Wesley, 2020). The real-time nature of chat services has transformed customer support, changing it into a dynamic two-way communication channel that yields substantial impacts on trust, satisfaction and repurchase (Isaac, Uloko, & John, 2021; Mero, 2018). In recent years, chat services have become the preferred option for accessing customer support (Adam et al., 2021; Patterson, 2022). The accessibility, cost-effectiveness, and user-friendly nature of chatbots make them an ideal choice for facilitating effective interactions (Chen, Jensen, Albert, Gupta, & Lee, 2023; Przegalinska et al., 2019). Moreover, this mode of customer communication has become prevalent due to its cost- and time-saving attributes (Janssen, Grützner, & Breitner, 2021). In fact, in contemporary scenarios, conversational software agents or chatbots often substitute traditional call centre agents (Li & Zhang, 2023).

Almost 25% of businesses today use chatbots. By 2027, chatbots are expected to become the primary customer service channel (Fokina, 2023). This will ensure and support communication with customers 24 hours a day, seven days a week (24/7). These results suggest that a potential approach to enhancing user satisfaction and improving the quality of UX, and customer support could involve the integration of human service employees with digital technology services like chatbots (Ashfaq, Yun, Yu, & Loureiro, 2020; Israfilzade, 2021).

1.1.4 LMS and UX

The design and evaluation of UX play a pivotal role in determining the success of various technical products. This is because subjective perspectives and emotions can significantly diverge from objective facts, particularly those centred on usability (Lewis & Sauro, 2021). Presently, UX is widely acknowledged as a crucial determinant of the overall quality of a product or service (Cha & Lee, 2021). Multiple definitions exist for the term UX, which are discussed in Section 2.6.1, with the definition of Kuniavsky (2010) attempting to transcend ergonomic, attitudinal and visual metrics. This inclusive definition encompasses all aspects that an individual would consider relevant to their experience.

The intricacies of UX are shaped by a combination of factors, including the user's emotions, the product's usability and the contextual environment in which it is utilised (Law, 2011;

McCarthy & Wright, 2004; Norman, 2004). To thoroughly understand UX, it is essential to delve into an individual's emotional responses to product usage. This exploration encompasses not only the experiential facets, but also the emotional and attitudinal dimensions associated with using the product. Moreover, UX is a holistic concept that incorporates an individual's emotions and attitudes toward the product. The overarching objective of UX design, as highlighted by Christensen, Dickinson, Machac, and Cline (2020), is to meticulously craft seamless, relevant and meaningful experiences for users. This involves considering experiential facets such as affective dimensions, meaningful encounters and the intrinsic value derived from utilising the product (Nakamura, Teixeira de Oliveira & Conte, 2017; Vermeeren et al., 2010; Zaharias & Pappas, 2016). For a more detailed exploration of UX concepts, please refer to Chapter 2.

Alhejaili & Ibrahim (2023) and Ibrahim and Aziz (2022) mentioned that numerous studies in literature have explored the effectiveness of implementing an LMS from the perspectives of both students and instructors (Chaw & Tang, 2018; Rodzi, Kumar, Osman, & Masykuri, 2019). Additionally, research has been conducted on the usability and UX when interacting with LMS platforms (Maslov & Nikou, 2020; Maslov, Nikou, & Hansen, 2021; Nakamura et al., 2017; Saleh et al., 2022). In the realm of e-learning, UX holds particular significance as it can influence students' attitudes towards the utilisation of the LMS (Maslov et al., 2021). Nakamura et al. (2017) discussed the usability and UX evaluation techniques in the context of LMSs. The authors conducted a systematic mapping study, analysing 62 publications to identify the techniques used to evaluate the usability and UX of LMSs. The results showed that there are still gaps in the evaluation techniques, such as the lack of feedback, with suggestions for improvement, within the context of LMSs in HEIs.

Ensuring an optimal UX for the LMS is crucial for service providers. This is because it plays a significant role in customer retention through the provision of accessible support tools, as highlighted in a study by Leopardjo, Harianto, Mas'ud, Ilyas, and Hasanah (2023). The need for effective support tools underscores the motivation to uphold the quality and ease of use of the LMS UX.

Moreover, the importance of the UX extends beyond its role in customer support. It is intrinsically linked to the optimal utilisation of LMSs, directly influencing how users interact with LMS platforms. This aspect makes it another critical factor for service providers to

consider. Recognising the impact of the UX on user interactions emphasises its pivotal role in enhancing the overall effectiveness of LMS platforms.

At the other end of the spectrum, instructors and students use the LMS to publish and access online material (Bradley, 2021). If the LMS is too difficult to master or features an overly complicated user interface, the system will hinder users from filling gaps and improving their task performance (Jordan & Duckett, 2018). Instead, it acts as an obstacle in the teaching and learning journey. All these challenges gradually delay students to grasp and integrate the presented information, leading to avoidable irritation and tension (Méndez-Becerra et al., 2022). Thus, they are simply unable to grasp the key concepts that are necessary to achieve the objectives for their module content.

As mentioned earlier, UX holds great importance and is of critical value to HEIs in acquiring a successful product (Demir, Bruce-Kotey, & Alenezi, 2022). Conversely, an LMS that delivers poor UX has the potential to deplete resources and undermine the overall quality of education offered at the institution (Kim, 2020).

1.1.5 LMS adoption and chatbot integration in HEIs

The LMS has initiated a transformative shift in the global education landscape by providing users with an excess of valuable resources. There is a growing demand worldwide for the adoption of LMSs by HEIs (Raza, Qazi, Khan, & Salam, 2021). As highlighted by Asunka (2008) and Mtebe (2015), LMSs have been designed to offer a single platform that integrates various features and functionalities for delivering content, facilitating communication and conducting assessments. This platform serves as a means of engaging and interacting with students, both in real-time and at their own pace. Mtebe and Raisamo (2014) note that LMS systems equip users, such as instructors, with a variety of tools to present course material. This encompasses audio, video, texts and communication channels like chats, discussion forums, email, whiteboard logs, blogs, wikis and groups (Su, Li, & Chen, 2021), along with assessment mechanisms.

Odhiambo, Okeyo, and Cheruiyot (2017) as well as Hwang and Chang (2023) identified the need to integrate chatbots into LMSs to enhance interaction between students and instructors, thus transforming the LMS into a more user-friendly, interactive, engaging and comprehensive platform for a wide range of functions. Additionally, it is worth mentioning that the potential for cost-effective solutions resulting from chatbot integration into LMSs

may serve as a significant factor when HEIs select their preferred LMS platform (Ülker & Yilmaz, 2016). In a recent study by Chang, Lin, Hajian, and Wang (2023), the researchers explored the principles of educational design in the context of AI chatbots to foster self-regulated learning within education. They introduced three essential pedagogical principles: goal setting, feedback provision and personalisation. Their approach combines Zimmerman's self-regulated learning framework (Zimmerman & Moylan, 2009) with the concept of judgment of learning, with the overarching objective of providing design principles for the effective integration of AI in educational settings, including LMSs. The authors advocate for the development of a chatbot that is capable of leveraging trace data collected within LMS platforms to offer personalised guidance to students. This data encompasses various elements, including an analysis of students' time allocation on specific pages, clicking patterns, adherence to instructor-set deadlines, and their initiation of prompts or goals. These data points collectively contribute to the implementation of the three pedagogical principles mentioned.

Furthermore, Bezverhny, Dadteev, Barykin, Nemeshaev, and Klimov (2020) discussed the use of chatbots in LMSs, emphasising their significance in the learning process and classifying them based on their tasks and roles in education. Their article details various methods and approaches to training chatbots within LMSs. Bezverhny et al. (2020) highlighted the benefits of using chatbots to manage educational programs, such as providing reminders, notifications, continuous education, information collection and personalised training. Their research found that integrating chatbots into LMSs can enhance the effectiveness and engagement of the educational process. Shukla and Verma (2019) are of the opinion that the integration of chatbots can play a significant role in enhancing user interaction and exploiting the inherent capabilities of an LMS to the fullest. Leveraging natural language generation and intelligent process automation, chatbots can facilitate functions such as answering questions, assisting with assessments, aiding in searches and supporting teaching activities. Shilowaras and Jusoh (2022) conducted an experiment involving the integration of a chatbot into the Moodle LMS. The primary objective of this chatbot was to deliver academic information and support to students, thereby diminishing the necessity for students to repeatedly approach instructors with their questions. Their study successfully carried out the implementation and testing of this system, resulting in students receiving immediate responses to their queries and fostering increased interaction within the platform.

It is noteworthy that various studies have delved into the integration of chatbots in educational settings, as evidenced in work by Pérez, Daradoumis, and Piug (2020), Jung, Lee, & Park (2020), Kuhail, Alturki, Alramlawi, and Alhejori (2023), Okonkwo and Ade-Ibijola (2021) and Wollny et al. (2021). However, a predominant focus of these studies has been on the intersection of chatbots and education, rather than on the integration of chatbots into LMSs.

A significant gap in the existing literature is apparent, specifically concerning the absence of well-defined guidelines and research-based design principles that are tailored to the integration of chatbots within LMSs. These guidelines are essential to support users in utilising the system effectively to achieve their respective goals. Accordingly, addressing this gap is crucial for advancing understanding of the role and potential benefits of integrating chatbots seamlessly into LMS environments.

Considering that LMS users within HEIs rely on these systems in their everyday lives, investigating LMS chatbot design principles becomes increasingly significant. The positive impact of LMS chatbot technology on the performance of LMS users can ultimately contribute to the overall efficiency and effectiveness of HEI operations. It is important to recognise that the quality of LMS customer support factors significantly shapes user satisfaction and, consequently, the overall UX (Abdallah, Ahlan, & Abdullah, 2019).

1.2 PROBLEM STATEMENT

LMSs are a crucial component of education and have been implemented at HEIs globally to facilitate connections among users without the constraints associated with traditional classrooms (Paschal, Pacho, & Adewoyin, 2022). LMSs are designed and developed to address many issues relating to online learning, such as planning, implementing and assessing a specific learning process. They contain many functionalities and features that optimise the teaching and learning experience (Kilag et al., 2023).

After informal conversations with other LMS users and drawing from first-hand experience as a university instructor, the researcher recognised that users were not making optimal use of the LMS platform. This awareness of the problem aligns with the findings of Al Mansoori et al. (2023), Loots et al. (2021) and Murad, Iskandar, Fernando, Octavia, and Maured (2019). Their studies also revealed that LMS usage was limited to a select few functions, primarily centred around sharing content and posting announcements. This limitation was

furthermore compounded by the fact that the LMS platforms were not available 24/7, lacked real-time responses to student inquiries, and were reliant on instructors' online activity for any form of response. These issues, as mentioned above, hinder the optimal utilisation of the LMS platform and are closely tied to the overall support provided to users.

Currently, the customer support efforts of LMSs are frequently deemed inadequate. Researchers are of the opinion that simply providing access to resources, training and support is insufficient to ensure the optimal utilisation of technology in educational settings (Rana & Rana, 2020; Winter, Costello, O'Brien, & Hickey, 2021). While there is a growing awareness of and concern to improve support (Hennessy, Ruthven, & Brindley, 2005; Howard & Mozejko, 2015; Lawrence & Tar, 2018; Mumtaz, 2000), the potential of LMSs remains largely unexploited (Araka, Maina, Gitonga, Oboko, & Kihoro, 2021; Ghilay, 2019). The latest research by Nhan and Thu (2023) confirmed previous findings of Al-Sharhan, Al-Hunaiyyan, Alhajri, and Al-Huwail (2020), Perri-Moore et al. (2016), who unveiled a minimal utilisation of features within the LMS, confirming that LMSs' functions and features are not optimally used.

Numerous obstacles often stand in the way of realising the full potential of learning technology (Greenhow, Graham, & Koehler, 2022). These obstacles include several key areas, including the need for improved communication between service providers and customers (Such, Ritzhaupt, & Thompson, 2017), potential issues with user-interface design (Méndez-Becerra et al., 2022), a lack of adequate support (Mtebe, 2015), insufficient training (Coleman & Mtshazi, 2017), and a general lack of awareness about hidden or underutilised features and functions (Araka et al., 2021). Realising the unexploited potential of learning technology (Kant, Prasad, & Anjali, 2021) requires strategic enhancements to the technology itself, enabling more effective product utilisation and, in turn, improving the learning environment.

Many contemporary enterprises rely on specialised service providers for the development and upkeep of their business IS (Park, Lee, Lee, & Truex, 2012). In the realm of LMS service providers, the interaction between the service provider and the customer stands out as a pivotal factor that significantly shapes the quality of service and, consequently, influences heightened utilisation of the system.

In their exploration, Park et al. (2012) delved into the ramifications of communication effectiveness on service quality, trust and relationship commitment in information technology (IT) services. Their study introduced a comprehensive model, encompassing four critical

antecedents of relationship commitment: communication effectiveness, technical service quality, functional service quality and trust.

The research of Al-Fraihat, Joy, Masa'deh, and Sinclair (2020) underscores the indispensable role of customer support in moulding overall service quality. To further refine this facet, incorporating features that offer constructive customer support to end-users is recommended.

Expanding on this groundwork, the study of Sharma and Patterson (1999) focused on the precursors of relationship commitment, particularly within the domain of consumer professional services. Their investigation scrutinised the influence of communication effectiveness, service quality and trust on relationship commitment. The outcomes of their research underscored that communication effectiveness emerged as a paramount driver, influencing all antecedent variables and proving to be the most potent determinant of relationship commitment. Sharma and Patterson's (1999) study further highlight the significance of cultivating enduring relationships with customers in the consumer services sector, especially for services characterised by high levels of inherent trust, through the facilitation of effective communication and trust-building. Consequently, for LMS service providers, strategically prioritising and optimising communication effectiveness can serve as a proactive approach to foster trust, elevate service quality and ultimately propel increased utilisation of the system.

Enhancements would involve an LMS capable of providing real-time responses to users' inquiries 24/7 (Sadhu, Burman, & Mandal, 2022), along with delivering relevant information. These two factors underscore the necessity of an interactive LMS support system, such as a chatbot (Murad et al., 2019).

Due to the rapid increase in educational demands, the adoption of smart educational tools and efficient LMSs is important (Iqbal, Parra-Saldivar, Zavala-Yoe, & Ramirez-Mendoza, 2020). Chatbots are increasingly used in modern society. They are becoming an integral part of everything, from serving as personal assistants on mobile devices to offering technical support assistance, enhancing and improving customer support (Serban et al., 2017). According to Shukla and Verma (2019), the incorporation of cost-saving solutions plays a significant role in the decision-making process when selecting which LMS to implement within an organisation. With an LMS adaptable to new technologies, it is possible to implement powerful but low-cost functions, such as a chatbot. Nonetheless, it is not only the cost-saving

solutions involved. Literature indicates that a future trend of LMSs is the improvement of real-time communication between users (Kraleva, Sabani, & Kralev, 2019).

In their research findings, Odhiambo et al. (2017) and Hwang and Chang (2023) identified a gap in the existing literature, stating the necessity for the advancement of chatbots in education. The assumption of the study is that chatbots have the potential to effectively enhance the utilisation of an LMS and improve its UX. Consequently, the implementation of LMS chatbots aims to optimise LMS usage. Therefore, by implementing LMS chatbots, optimal LMS use can be achieved.

Bezverhny et al. (2020), Bisser (2021), Chang et al. (2023), Chaskopoulos et al. (2022), Feine, Adam, Benke, Maedche, and Benlian (2020), Guo et al. (2022), Jung et al. (2020), Kim, Yang, Shin, and Lee (2022) and Tamrakar and Wani (2021) have significantly contributed to understanding chatbot design and development across various contexts. These contexts include making restaurant bookings, ordering food, offering stock recommendations, assisting enterprises and conducting fund diagnostics. Their research offers valuable insights into design principles applied in a wide range of fields. Design principles, in essence, serve as guiding concepts that inform the creation and development of various designs (McKenney & Reeves, 2014).

Despite the valuable contributions made by studies like those of Bisser (2021) and Jung et al. (2020), a noticeable gap exists in the academic literature concerning chatbot design principles specifically tailored for integration into LMSs in HEIs.

Although chatbots have gained popularity in the field of education for their potential to personalise learning experiences and provide immediate support, their design principles are often based on assumptions rather than empirical evidence (Jung et al., 2020). While these studies have significantly enriched understanding of diverse applications, the absence of focused guidelines, informed by empirical evidence for chatbot integration into LMSs, represents a limitation. Addressing this gap is essential for advancing comprehension of effective chatbot utilisation within HEI settings and aligning design principles with the unique requirements of LMSs and their improved UX.

The researcher contends that what is needed is a set of design principles that would allow chatbots to be designed, developed and integrated into an LMS in a manner that will assist in the exploitation of the potential inherent in an LMS. Furthermore, this central study

focusses its attention towards formulating design principles that can serve as comprehensive guidelines for the development of chatbots tailored specifically for LMSs.

The assumption is that when design principles are designed to enhance the UX of LMSs, optimal use will follow more readily (Djamasbi, Strong, Wilson, & Ruiz, 2016). The assertion is that improved LMS UX ultimately leads to optimal use.

1.3 RESEARCH QUESTIONS

The research question is the fundamental core of any study. It focuses the study, directs the literature review, determines the methodology and guides the data analysis and final report. This study is guided by the following main research question:

What are the design principles for the design and development of a chatbot that can be used to enhance the UX of an LMS?

The following sub-questions (SQs) assisted in addressing the main research question:

Sub-question 1 (SQ1): Awareness

How do LMS service providers support LMS users?

This question aims to understand the current methods and strategies used by LMS service providers to support their users, which is crucial for identifying gaps that a chatbot could fill.

Sub-question 2 (SQ2): Awareness

How can the UX of an LMS be improved?

This question seeks to identify key areas of improvement within the LMS UX, providing a foundation for the specific features and functions that a chatbot should offer.

Sub-question 3 (SQ3): Awareness

How are chatbots used to support LMS users?

This question investigates existing uses of chatbots in LMS environments, offering insights into successful implementations and potential enhancements for user support.

Sub-question 4 (SQ4): Suggestion

Drawing from the principles of activity theory, how do various user groups interact with an LMS?

This question applies activity theory to analyse interactions between different user groups and the LMS, helping to tailor the chatbot's design to meet diverse user needs and behaviours.

Sub-question 5 (SQ5): Development

What design principles guide the development of LMS chatbots?

This question explores established design principles for chatbots, ensuring that the development of the LMS chatbot adheres to best practices and effectively addresses user requirements.

Sub-question 6 (SQ6): Development

Which actionable guidelines in the form of design features address LMS user needs and inform the development of a chatbot to enhance LMS UX?

This question focuses on translating user needs into specific, actionable design features that can be incorporated into the chatbot to enhance the LMS UX.

Sub-question 7 (SQ7): Evaluation

To what extent does the set of design principles guide the design of an LMS chatbot to satisfy the UX needs of LMS users?

This question evaluates the effectiveness of the proposed design principles in guiding the development of the chatbot, ensuring that it meets the UX needs of LMS users.

Aligned with the DSR methodology, the four phases of awareness, suggestion, development and evaluation have been systematically mapped to the set of sub-questions to comprehensively address the main research question. This methodical alignment ensures a systematic progression through the DSR phases, enabling a rigorous and holistic investigation into the design and development of a chatbot for enhancing the UX of an LMS.

1.4 AIM AND OBJECTIVES

This study aims to identify and define the design principles for the development of a chatbot that enhances the UX of an LMS. The following objectives were identified from the research questions:

- Understand how LMS service providers support LMS users.
- Explore methods for improving the UX of an LMS.
- Investigate the use of chatbots in supporting LMS users.
- Ascertain the design principles that guide the development of chatbots.
- Analyse how different user groups interact with an LMS, drawing from the principles of activity theory.
- Identify actionable guidelines and design features that address the needs of LMS users and inform the development of a chatbot to enhance LMS UX.
- Evaluate the extent to which the identified design principles guide the design of an LMS chatbot in meeting the UX needs of LMS users.

The aim and objectives served as a roadmap for the research, providing clear direction and focus for the study. The objectives helped in the exploration and understanding of the design principles necessary for developing a chatbot that can enhance the UX within an LMS.

1.5 METHODOLOGY

In this study, the researcher developed a set of design principles associated with users' optimal use of an LMS. To achieve this, a DSR strategy was deemed the most appropriate.

A DSR endeavour has the potential to generate outcomes across various tiers. These outcomes can vary from specific instances, like products and procedures, at the most fundamental level, to moderately broad contributions in the form of emerging design theories, encompassing constructs, design principles, models, methods and technological guidelines, at an intermediary level. At an advanced level, these outcomes may evolve into fully developed design theories that explain the studied phenomena (Gregor & Hevner, 2013). DSR aims to generate prescriptive knowledge about the design of IS artefacts, such as software, methods, models or concepts (Hevner, March, Park, & Ram, 2004).

Design principles play a pivotal role in the field of IS by providing a mechanism to make design knowledge accessible and transferable. Design knowledge involves understanding the relationships between problem and solution spaces (Venable, 2006), as well as ensuring technology reusability across diverse scenarios, users and time points (Chandra Kruse, Seidel, & Puroo, 2016; Möller, Guggenberger, & Otto, 2020; Wache et al., 2022). According to Gregor and Hevner (2013), design knowledge can take various forms, including designed artefacts (Hevner et al., 2004), design principles (Chandra Kruse, Seidel, & Gregor, 2015), or design theories (Gregor & Jones, 2007). However, design principles are regarded as the primary mechanisms for codifying design knowledge in IS research (Wache et al., 2022). They encapsulate insights gained from specific design instances and elevate resulting design knowledge to a more general level with broader applicability (Chandra Kruse & Seidel, 2017).

These principles serve as foundational propositions, aiding designers to effectively translate requirements into design outcomes (Fu, Yang, & Wood, 2015). By providing prescriptive guidelines, design principles support both the process and product of design. It is crucial to acknowledge, however, that these principles cannot be directly applied to any given application context; their application is constrained by boundary conditions set by the intended usage environment and UX. The primary objective of design principles is to assist in the design of artefacts, operating at a higher, “meta” level. These principles can address both the process of developing an artefact (for example, the development process) and its functionalities (for example, the system features).

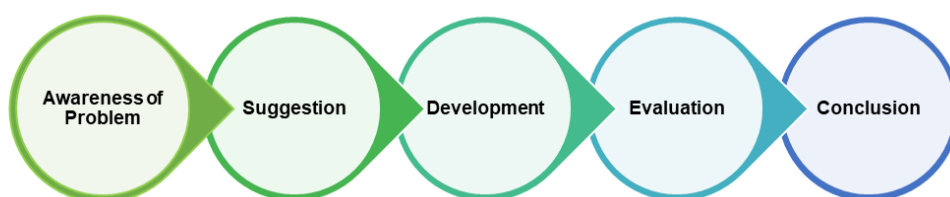


Figure 1.1: DSR process steps or phases adapted from Vaishnavi and Kuechler (2008)

The DSR methodology, as suggested by Vaishnavi and Kuechler (2008), was followed. They suggest the five phases as outlined in Figure 1.1. The DSR methodology employed during the study therefore follows a five-phase iterative process, as prescribed by Hevner et al. (2004), Vaishnavi and Kuechler (2008) and Vaishnavi and Kuechler (2015). The five iterative phases comprise the following:

- **Awareness of the problem.** During Phase 1 of the DSR process, the researcher embarked on a comprehensive exploration to develop an awareness of the research problem, laying the foundation for subsequent research and design endeavours. This phase was characterised by a thorough investigation of the problem, establishing the essential groundwork for subsequent research and design activities. In this phase, the researcher delved into the extensive body of existing literature related to LMSs and chatbots. In this phase, the researcher discerned challenges, and identified gaps and inefficiencies within the existing landscape. The literature review played a crucial role in illuminating a notable void in the field – specifically, the lack of comprehensive guidelines found in empirical research for the design and development of LMS chatbots. Through the analysis of the literature, a well-defined problem statement emerged. This problem statement serves as a guiding compass, directing the subsequent DSR phases of suggestion, development and evaluation. It articulates the core problem that this study aims to address, providing a clear focus for the research journey.
- **Suggestion.** During Phase 2 of the DSR process, the researcher recognised the identified need for a well-designed LMS chatbot in the literature. By drawing upon existing literature and best practices, the researcher suggests a set of LMS chatbot design principles. Activity theory played a role during the suggestion phase of this study. It assisted the researcher in gaining an understanding of the diverse roles undertaken by LMS users within the LMS activity system. Activity theory was employed to interpret the interconnections between the LMS platform and the various users. Activity theory serves as a valuable tool to accentuate the social dimensions that are crucial for a more comprehensive understanding of the community. Further elaboration of this theory can be found in Section 3.6.4.
- **Development.** In Phase 3 of the DSR study, the research journey transitions into the design and development stage, marked by a collaborative and iterative design thinking workshop. The design thinking workshop brought together the facilitator and designated design team members, collaboratively focusing on sharing user needs through lived experiences. Dynamic discussions, brainstorming and design exercises characterised the workshop, fostering a collaborative environment that stimulates the generation of innovative ideas and a holistic understanding of the multifaceted problem. The design team, comprising 12 members, who are active LMS users from HEI environments, included four students, four instructors and four LMS administrators. They effectively

synthesised user needs. Drawing on their diverse perspectives, the team illustrated these needs in the format of a basic prototype chatbot using Figma software during the workshop's informal team collaboration. It is important to clarify that the prototype chatbot served only as a visualisation of a potential LMS chatbot and not the final design artefact. The analysis of the design thinking workshop data revealed several key themes (Table 5.2), along with the data revealed from the participant worksheets (Tables 5.3 to 5.5), forming the foundation for a tentative set of design principles.

- **Evaluation.** In Phase 4 of the DSR study, the researcher presented a tentative set of design principles to four experts in the domain of LMS design. This phase entailed the evaluation of the design principles and were aligned with the methodology outlined in Chapter 6 of the research. The researcher engaged with the LMS experts by using a structured questionnaire (Appendix H) to obtain their extensive expertise in LMS design by asking them to provide feedback on the tentative set of design principles after they had been exposed to a real-life LMS chatbot. The purpose of the real-life chatbot was to give the participants an idea of the application of some of the design principles, and to make them aware of design principles that were absent in the real-life chatbot. The artefact was subsequently refined, based on the feedback received, to a final set of design principles.
- **Conclusion.** Phase 5 marks the conclusion of the study. The researcher undertook the crucial task of communicating the research's findings in the format of a final set of design principles and insights through the publication of an academic paper in a reputable journal. This contribution not only expands the existing knowledge base within the IS discipline, but also provides actionable guidance for practitioners in the field of LMS design. The thesis provides empirically supported insights and innovative design practices, thereby enriching the IS discipline by offering both theoretical advancement and practical utility.

The visual representation of the DSR process cycles is illustrated in Figure 1.2, aligning it with the chapters of the study. The purpose of this illustration is to offer a clear and organised overview of how each phase of the DSR process corresponds with the various chapters. In Phase 1, titled "Awareness of the problem", the discussion unfolds in Chapter 2 through a comprehensive literature review. Moving on to Phase 2, titled "Suggestion", Chapter 3 explores the literature review, demonstrating the absence of a clear solution. Here, the

researcher identifies the necessity for chatbot guidelines specifically tailored for LMSs and proposes a set of design principles. Chapter 4 (not illustrated in Figure 1.2) discusses the methodology applied in the study, such as the research approach, research design, research paradigm, sampling technique, as well as the employed data collection and analysis methods. In Chapter 5, Phase 3, titled "Development," was explored. The chapter elaborated on the design thinking workshop and the development of a tentative set of design principles, along with the analysis of collected data and the creation of the artifact. Progressing to Phase 4, titled "Evaluation," Chapter 6 detailed the exploration and discussion of the evaluation process. A tentative set of design principles were assessed by four LMS experts through a structured questionnaire after exposure to a working LMS chatbot. This evaluation process articulated the final set of design principles. In Chapter 7, Phase 5 was discussed. The researcher reported on the findings, expressing both the practical and theoretical added value of the study. The limitations and suggestions for future research were also highlighted in this chapter.

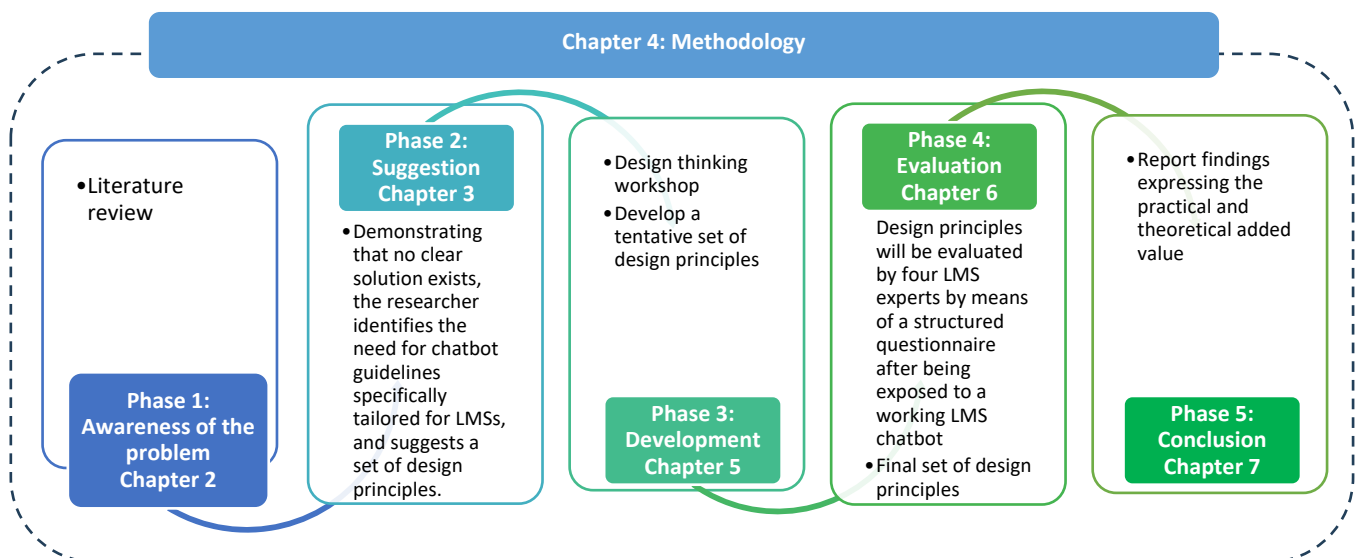


Figure 1.2: Steps for this study's DSR process cycle (adapted from Vaishnavi and Kuechler, 2008)

1.6 ASSUMPTIONS

From a service provider point of view, this study focused on LMS users who are actively using an LMS platform at an HEI. The underlying assumptions of this study are that the participants have experience in working on an LMS. A design thinking workshop was conducted where it was assumed that the participants answered the questions honestly. It's important to emphasise that the primary objective is to enhance the functionality of a support chatbot within an HEI context, rather than focusing on an educational chatbot. This effort is aimed at improving the UX of an LMS. The experts were exposed to a free chatbot version available in Blackboard Learn for software as a service (SaaS) client only in North America, who have enabled the Base Navigation. This implies that users outside this geographical and client scope do not have access to the mentioned chatbot. The assumption is that the free chatbot version is exclusively available for SaaS clients and not for clients using other deployment methods.

The purpose of the real-life chatbot was to give the participants an idea of what the application of some of the design principles might look like and to identify design principles that were lacking in the real-life chatbot. The assumption was therefore that exposure to an LMS chatbot will enable participants to understand the application of design principles in a working LMS chatbot. They can then use this understanding to make informed recommendations for the design principles of an LMS chatbot.

1.7 BRIEF CHAPTER OVERVIEW

The thesis comprises seven chapters, as outlined in Table 1.1, with each chapter contributing to a comprehensive exploration of the research problem and its solution. This structured approach ensures a systematic and in-depth analysis of the research problem and its resolution.

Table 1.1: Brief chapter overview

Chapter	Chapter heading	Chapter outcome
1.	Introduction	This chapter serves as an introduction to the research problem, methodology, purpose and focus of the study. It also provides background information, research questions, assumptions and limitations. Within HEIs, the significance of LMSs is discussed, emphasising the need for user-friendly interfaces, efficient customer support and advanced features. Additionally, it delves into the barriers that hinder the optimal utilisation of LMSs and explores the role of chatbots in enhancing customer support. It further stresses the importance of LMS UX and highlights the impact an LMS has on students' learning experience.

Chapter	Chapter heading	Chapter outcome
2.	Literature review (Phase 1)	This chapter presents a literature review that delves into core topics, with a specific focus on the development of a set of design principles for a chatbot within an LMS. The goal is to enhance the UX in this context. LMSs have become indispensable in HEIs, particularly after the COVID-19 pandemic. However, the implementation of LMSs often falls short, and there are numerous challenges associated with effectively utilising them. While LMSs offer advantages such as convenience, accessibility and collaboration, they also come with several disadvantages. Therefore, it is imperative to conduct further investigation into the implementation of chatbots in LMSs within HEIs. SQ1 to SQ3 are addressed in Chapter 2.
3.	Suggestion (Phase 2)	This chapter signifies the transition to the suggestion phase, where the emphasis shifts from identifying problems to proposing design solutions, building upon the foundation established in Phase 1. The suggestion is to develop design principles for LMS chatbots to enhance UX. To do this, a thorough understanding is needed of the LMS activities of different users. The LMS is therefore considered a socio-technical system, and activity theory is used to identify the various roles played by the different LMS users. Additionally, this chapter address SQ4. Literature on design principles and design features are also considered, as well as guidelines for the design of design principles.
4.	Methodology	This chapter focuses on the methodology employed, serving as the foundational framework for this research. Within this chapter, the researcher explains the rationale underpinning the philosophical paradigm, research approach and methodology selected to guide this investigation. Specifically, this study adheres to a qualitative research approach, more precisely, the DSR approach, which is grounded in pragmatic philosophy. It is imperative to underscore that all data gathered is qualitative in nature. Within this chapter, the researcher delves into the various components that shape the methodological approach, including axiological, epistemological and ontological assumptions, research strategy, the distinct phases of DSR, the employed sampling method, as well as the data collection techniques and procedures, which encompass the utilisation of a design thinking workshop and LMS expert evaluation questionnaires. The data analysis technique and quality measure are also discussed, along with ethical considerations.
5.	Development (Phase 3)	In the development phase of DSR, the focus shifts to developing and implementing the designed solution. This phase addresses SQ5 and SQ6, which involves creating a tentative set of design principles by analysing the data collected from the design thinking workshop and identifying tentative design principles.
6.	Evaluation (Phase 4)	This chapter delves into the evaluation of the design principles. Structured questionnaires were emailed to four LMS experts, which they completed. The questionnaire included questions on each of the tentative design principles. To assist the experts in evaluating the design principles, access was given to an existing LMS chatbot, which illustrates some of the design principles.
7.	Conclusion (Phase 5)	This concluding chapter represents the culmination of the study, effectively consolidating the outcomes derived from the data analysis, the conclusions drawn, recommendations made and subsequent implications for future research.

The next chapter presents the existing literature on which the design suggestion is based.

CHAPTER 2: LITERATURE REVIEW

The literature review serves an important role in establishing a theoretical foundation for this study, synthesising relevant theories and models that underpin the research, with a specific focus on UX frameworks and their applicability within the LMS context. The primary objective of this chapter is to provide a comprehensive review of existing literature pertinent to the research problem. This literature review represents the foundational step in the research process, enabling the identification of gaps, challenges and opportunities that can be addressed through the design and development of an artefact.

This chapter aligns with Phase 1: Awareness of the problem and Phase 2: Suggestion. Here, the researcher delves into scholarly work, theoretical frameworks and empirical studies concerning central themes, concepts and issues surrounding LMSs, and their features and functionalities. The literature review in this chapter summarises prior research directly relevant to the research problem, encompassing studies, theories and methodologies that address similar or related issues within the realm of LMSs, customer support for LMS users, and the UX of LMS platforms. The overarching aim is to address SQ1, SQ2 and SQ3. SQ 1 seeks to understand how current LMS service providers support users, SQ2 aims to identify ways to improve the UX of an LMS, and SQ3 explores the use of chatbots to support customers, ultimately benefiting LMS users.

Considering that chatbots are traditionally viewed as a support mechanism integrated into the technology by the service provider, concepts related to customer support and UX are explored. This exploration is followed by an examination of how chatbots have emerged as virtual agents, providing an “intelligent” conversational interface between computer technology and customers using natural language. LMS service providers disseminate this technology to HEIs. These providers are not only responsible for technology development and its distribution, but also for offering training and technical support to their customers (Alshammari, Ali, & Rosli, 2016; Sakala & Chigona, 2020).

2.1 LMS FEATURES AND FUNCTIONALITIES

LMSs play a crucial role in modern educational and corporate settings, offering a wide range of features and functionalities that redefine the landscape of teaching and learning. As defined by Bervell and Umar (2017), an LMS functions as a server-based software program that stores

information about users, courses and content. This software creates a flexible learning and teaching environment that transcends the constraints of time and location, as highlighted by Saleh et al. (2022) and Ain, Kaur, and Waheed (2016).

Research by Khalaf et al. (2022) offers an overview of the major features of an LMS, which includes communication, content delivery, evaluation, application and integration, providing valuable insights into what contributes to an effective LMS. These insights draw from the work of Anand and Eswaran (2018) and explain how LMS platforms distribute content, facilitate communication, seamlessly integrate with various applications and support course administration, ultimately enhancing the overall learning experience within HEIs. Anand & Eswaran (2018) are of the opinion that the abovementioned are important features expected of any basic LMS. Moreover, an LMS inherently fosters positive motivation among students, as observed in research conducted by Bradley (2021), while Araka et al. (2021) confirmed that students' academic achievement is positively influenced by the level of engagement in an LMS.

LMSs have garnered recognition in both corporate organisations and academic institutions (Al-Busaidi & Al-Shihi, 2012; Bakar & Jalil, 2017; Bezverhny et al., 2020; Shurygin et al., 2021). The global demand for LMSs within academic institutions continues to rise, with a multitude of LMS service providers available, including well-known names such as Blackboard, Moodle, WebCT, Instructure Canvas and Desire2Learn Brightspace, as mentioned by Saleh et al. (2022).

LMSs excel in centralising and automating administrative tasks, supporting self-directed learning opportunities, efficiently collecting and delivering learning materials, personalising content and fostering training efforts through a user-friendly web platform (Al-Handhali, Al-Rasbi, & Sherimon, 2020). These platforms ensure content portability, adhere to standards, conduct quizzes and facilitate the creation of transcripts, and notifications for various student activities, as noted by Asamoah (2021) and Carvus and Alhih (2014). Learning analytics and reporting offer insights into student progress, informing teaching and learning strategies, as highlighted by Abari and Akintoye (2021) and Qazdar et al. (2022). LMS reliability ensures uninterrupted access, as noted by Ghosh, Nafalski, Nedic, and Wibawa (2019), Kaewsaiha (2019) and Krалеva et al. (2019). Mobile-friendliness and accessibility across devices are crucial for meeting the diverse needs of students, ensuring not only their access but also their overall experience (Aldiab, Chowdhury, Kootsookos, & Alam, 2019; Berking & Gallagher,

2013; Chaubey & Bhattacharya, 2015; Epping, 2010; Kasim & Khalid, 2016; Yilmaz & Yilmaz, 2022).

Moreover, LMS platforms cultivate an environment that is conducive to active participation and academic success. This enables students to enrol in courses, complete and submit assignments, engage in online evaluations, track their academic progress and stay updated about course-related announcements, as emphasised by Al-Fraihat et al. (2020), Bezverhny et al. (2020) and Ghazal, Al-Samarraie, and Aldowah (2018). LMS integration capabilities allow for integration with other platforms and systems, as observed by Kasim and Khalid (2016) and Khalaf et al. (2022). Data migration supports the seamless transfer of existing data into the system, as discussed by Ilyas, Kadirand Adnan (2017) and Twakyondo and Munaku (2012). To ensure data security, LMSs implement advanced safety protocols and encryption, as demonstrated by Asenahabi, Peters and Nambiro (2022), Belda-Medina and Calvo-Ferrer (2022), Guo et al. (2022), Kooli (2023), Mkpojiogu, Okeke-Uzodike, and Emmanuel (2021) and Ochoa-Orihuel, Marticorena-Sanchez, and Saiz-Manzanares (2020). Dynamic rules for populating groups and automatic course enrolments enhance administrative efficiency, as highlighted by Menemencioglu, Sen, Atasoy, and Sonuc (2012). Evaluation and assessment tools, including examinations, assignments and feedback mechanisms, aid in measuring student progress and performance, as noted by Asenahabi et al. (2022), Brandtzaeg, Haugestveit, Luders, and Følstad (2015), Demir et al. (2022) and Ghilay (2019).

Automated alerts, reminders and notifications, as mentioned by Al-Hunaiyyan, Alhajri, Alzayed, and Al-Sharrah (2022), Bradley (2021) and Torrisi-Steele and Atkinson (2020), ensure timely communication and engagement. Users can access the LMS through both cloud-based and installation-based options, each offering its own set of advantages, as highlighted by Musyaffi, Rosnidah, and Muna (2021).

Communication and collaboration tools, including forums, chats, messaging and groupwork, facilitate interaction among LMS users, as outlined by Anand and Eswaran (2018), Kahu, Thomas, and Heinrich (2022) and Khalaf et al. (2022). Course creation and management features empower instructors to design and organise their courses effectively (Arora, Bhardwaj, & Garg, 2022; Singh, 2022), while customisation and branding options allow institutions to tailor the LMS to their unique needs and identity (Heng, Yuen, Fui, & Muniandy, 2022).

An LMS can be either open source or commercially licensed, depending on the software's type and source. An open-source LMS is available under free licenses, and anyone can contribute to its design and coding. In contrast, a commercially licensed LMS is privately coded and typically comes with subscription-based licensing. An open-source LMS is known for its customisability and flexibility, since it allows contributions from anyone. However, it may also demand more technical expertise and ongoing maintenance compared to a commercially licensed LMS. Commercially licensed LMSs, in contrast, tend to be more restrictive, but offer enhanced security. However, they may come at higher costs and may be less flexible to customise to specific needs (Hasan, 2019; Lima, Brito & Caldeira, 2019; Oron-Gilad & Hancock, 2017).

For both open-source and commercially licensed LMS, features such as single sign-in for ease and convenience, smart scheduling or calendar tools, and social learning tool integration with platforms like Facebook, Twitter, Instagram and WhatsApp enhance the LMS UX, as mentioned by Brandtzaeg et al. (2015), Mei (2016), Spirin, Vakaliuk, Ievdokymov and Sydorenko (2022) and Yilmaz and Yilmaz (2022).

According to a study by Ranveera, Kesharwani, and Kumari (2021), it is essential to provide robust user support to leverage the potential of an LMS and effectively capitalise on its advantages and unique features. Support features, such as online chatbots, provide assistance, while webinar functions and virtual classrooms with recording and video conferencing capabilities enable interactive online teaching and learning, as noted by Fabito et al. (2021) and Nimasari et al. (2023).

To provide a comprehensive overview of the common features and functionalities found in an LMS, Table 2.1 has been included. This table presents a summary of each feature, accompanied by relevant citations from studies that have explored these aspects in the context of LMS design and usage. These features play a pivotal role in shaping the learning experience and enhancing administrative efficiency within HEIs. This compilation serves as a valuable resource, offering insights into the multifaceted nature of modern LMS platforms.

Table 2.1: Overview of LMSs' features and functionalities

LMSs' features and functionalities	References
Automated alerts, reminders and notifications	Al-Fraihat et al. (2020); Perri-Moore et al. (2016); Bradley (2021); Torrisi-Steele & Atkinson (2020)
Cloud-based vs installation	Musyaffi et al. (2021); Vakaliuk (2017); Wang, Chen, & Kahn (2014)
Communication and collaboration	Anand & Eswaran (2018); Kahu et al. (2022); Khalaf et al. (2022)
Content and course creation and management	Arora et al. (2022), Khalaf et al. (2022); Singh (2022)
Customisation, personalisation and branding	Hancock, Pepe, & Murphy (2005); Heng et al. (2022); Lima et al. (2019); Oron-Gilad & Hancock (2017)
Data analytics, tracking and reporting	Abari & Akintoye (2021); Qazdar et al. (2022)
Data migration	Ilyas et al. (2017); Twakyondo & Munaku (2012)
Data security protocols, advanced safety protocols, cryptography	Asenahabi et al. (2022); Kooli (2023); Mkpojiogu et al. (2021); Ochoa-Orihuel et al. (2022)
Dynamic rules: populating groups and automatic course enrolments	Menemencioglu et al. (2012)
Evaluation and assessment tools	Asenahabi et al. (2022); Brandtzaeg et al. (2015); Demir et al. (2022); Ghilay (2019); Khalaf et al. (2022)
Gamification	Farooqui (2023)
LMS reliability	Ghosh et al. (2019); Kaewsaiha (2019); Krалеva et al. (2019)
LMSs integrate with other systems, software and collaboration with other platforms	Kasim & Khalid (2016); Khalaf et al. (2022)
Open-source and commercial use	Hasan (2019)
Single sign-in, ease, speed and convenience	Brandtzaeg et al. (2015)
Smart scheduling, calendar tools	Mei, 2016; Spirin et al. (2022)
Social learning tool integration: Facebook, Twitter, Instagram and WhatsApp	Yilmaz & Yilmaz (2022)
Support: online/chatbot	Fabito et al. (2021); Moraes Neto & Fernandes (2019)
Variety of device-friendliness	Aldiab et al. (2019); Berking & Gallagher (2013); Chaubey & Bhattacharya (2015); Epping (2010); Kasim & Khalid (2016); Yilmaz & Yilmaz (2022)
Webinar functions, virtual classroom: recording, video conferencing	Nimasari et al. (2023)

2.2 ADVANTAGES OF AN LMS

LMSs offer a multitude of advantages that set them apart from traditional learning systems. Notably, they provide unparalleled ease of access by creating a centralised system for institutions to manage educational resources, eliminating the need for physical classroom presence, as highlighted by Wicaksono et al. (2020). Furthermore, LMSs effectively address

the challenge of limited academic staff and resources, allowing instructors to efficiently oversee multiple courses within a virtual setting (Avilés, Bermúdez, Lara, & Robalino, 2023). The positive impact of LMSs on engagement is undeniable, as highlighted by Pinã (2013), who stressed their role in enhancing engagement and interactivity in learning. This statement is confirmed by Araka et al. (2021), who also found that engagement in academic activities in an LMS plays a vital role in contributing to its academic success.

One of the most significant advantages of an LMS is its time-saving capabilities, enabling management, instructors and students to access their accounts online and work from virtually anywhere in the world (Anand & Eswaran, 2018; Annamalai, Ramayah, Kumar & Osman, 2021; Yawisah et al., 2022). This flexibility has changed the way education is delivered and received. LMSs also excel in user management, simplifying roles and course administration, all while facilitating report generation. This streamlines administrative processes and enhances overall institutional efficiency (Kadir & Aziz, 2016).

Demir et al. (2022) underscore the significance of LMS functionality. They emphasise that LMS functionality should be enriched with specific features that cater for the diverse needs of all LMS users, such as gamification elements (Baloch, Naz, & Naqvi, 2023; Farooqui, 2023; Somova & Gachkova, 2022), mobile app support (Bai, 2022), content authoring tools (Hussain, 2019), integration with external applications (Bulut, 2023) (for example, video conferencing platforms, plagiarism checkers) and analytics for personalised learning paths (Cardenas, Castano, & Guzman, 2022).

Alhazmi, Imtiaz, Al-Hammadi, and Kaed (2021) have identified the advantages of LMSs through an extensive literature review, which has been further corroborated and enhanced by experts in the e-learning domain. The positive aspects that came to light in their research included single sign-on, content management, learning management, integration, student learning tracking, group management and security. Another significant advantage of LMSs lies in their content reusability, as course materials can be easily adapted for future use, minimising the effort required for the next cohort (Kostiuchenko, 2017; Wicaksono et al., 2020). Additionally, LMSs empower instructors to facilitate discussions, plan online activities, set learning expectations, and assist in problem-solving and decision-making processes (Bradley, 2021). LMSs also foster an inclusive learning environment by supporting online collaborative groupings, professional training, discussions, and communication among users (Bradley, 2021).

Demir et al. (2022) elaborated on this point, asserting that their research identified communication as the key function within LMSs. This perspective aligns with the findings of Prahani et al. (2022), who also identified robust communication capabilities and advanced tracking features as the primary advantages of LMSs.

2.3 DISADVANTAGES OF AN LMS

Despite the widespread adoption of LMSs and the generally positive feedback regarding their most-used features, there is a growing sense of dissatisfaction with the perceived role of the LMS as a tool, and the prevailing LMS-centred model in HEIs (Yawisah et al., 2022). Literature often contains unflattering depictions of the LMS as a rigid, administrative tool (Chen, 2019; Hill, 2015; Morris, 2017).

Some critics even suggest that its very creation was a mistake (Morris, 2017). These critics argue that other web-based spaces are better suited for fostering student-centred practices that are aligned with critical pedagogy and transformative praxis (Chen, 2019; Strommel, 2017). These critics emphasise the limited utilisation of interactive, engaging functionalities within the LMS and advocate for a paradigm shift (Brown, 2017; Galanek, Gierdowski, & Brooks, 2018; Pomerantz & Brooks, 2017). While LMSs offer potential benefits, their use necessitates strategies that can accommodate diverse learning requirements and styles, which, as Thah and Latif (2020) pointed out, places additional responsibility on instructors to foster a meaningful learning experience.

Effective and continued training is essential for users engaged with an LMS, as highlighted by Sakala and Chigona (2020), Ülker and Yilmaz (2016) and Yawisah et al. (2022), as the system's optimal operation and efficiency rely on it. Inadequate maintenance of the LMS infrastructure can result in significant expenses (Lamo, Perales, & De-la-Fuente, 2022). Due to its limited human and social interaction, an LMS can impact users' learning curve (Camilleri & Camilleri, 2022). Camilleri and Camilleri (2022) are of the opinion that the absence of social interaction within the LMS may give rise to a sense of self-isolation among users. Yawisah et al. (2022) highlighted the importance of stable internet connectivity. Issues with network connectivity or insufficient bandwidth can lead to system complications and consequently a negative UX. Furthermore, although LMSs are complete and useful as course management tools, they are too rigid in terms of communication flow, limiting participants' interaction capabilities too much. For this reason, LMS users tend to

complement e-learning platforms with other tools, such as WhatsApp groups, thereby creating personal learning networks (Gros & García-Peñalvo, 2016; Kraveva et al., 2019). Al-Handhali et al. (2020) stress that managing an institution-wide LMS requires a high level of technical expertise, often residing with management or specialised IT personnel who may lack a deep understanding of the pedagogical implications. Not all LMS users possess the same level of computer and information literacy, and adapting to LMSs may require significant training and a critical perspective on integration. Lastly, another challenge highlighted by Al-Handhali et al. (2020) is the need for instructors to design a diverse set of learning activities that cater to students' unique needs, while aligning with their own teaching skills and institutional technical capacities. Achieving this balance involves a nuanced understanding of technology, pedagogy and student needs, all working in harmony to create an effective learning experience.

2.4 IDENTIFIED SHORTCOMINGS IN AN LMS

Empirical evidence has unveiled that students often perceive LMS usage as constraining their ability to independently explore the available learning resources. This observation underscores certain shortcomings in fostering independent communication and exploration (Viberg & Grönlund, 2017). Furthermore, the LMS falls short in serving as an effective platform for communication and interaction, as noted by Gros and García-Peñalvo (2016), thereby hindering its potential as a collaborative tool (Fleischmann, 2021). While an LMS incorporates a variety of communication tools designed to facilitate interactions between instructors and students, according to Mundir and Umiarso (2022), its limitations in this regard persist. It is therefore regarded as crucial to integrate advanced communication and content-sharing features (Alhazmi et al., 2021).

Kumar and Ritzhaupt (2017) and Al-Sharhan et al. (2020) have expressed concern over the infrequent use of mobile devices to access LMS activities. This usage pattern is potentially linked to the limited availability of features when accessing the LMS through mobile devices. Lee, Shon, and Kim (2015) further emphasise the necessity for an LMS that can seamlessly operate across various mobile devices. Acknowledging this shortcoming and recognising the escalating use of smartphones and other mobile devices for educational purposes, enhancing LMS support for mobile-friendly interfaces is essential for fostering anytime, anywhere learning, and lifelong learning (Az-zahra, Nurhayati, & Herlambang, 2023).

Notwithstanding these perceived and tangible shortcomings, it is imperative to recognise that the LMS has emerged as a prominent and deeply integrated component of the higher education landscape (Green & Chewning, 2020).

2.5 SUPPORT FOR LMS CUSTOMERS

Lalonde and Zinszer (1976) define customer support as activities that occur between the customer and the company, which enhance or facilitate the sale and use of the company's products and services. Customer support has become one of the most important communication tools used by companies to provide before- and after-sales services to customers (Ranveera et al., 2021).

From the LMS service provider's point of view, customer support is an essential element in the successful marketing and implementation of systems. Consequently, service providers need to establish and maintain reliable and high-quality customer support as part of their own operations via technology interventions or by means of third parties. In fact, the delivery of high-quality service and support is essential for any type of retailer, since this is of great importance to improve UX and customer satisfaction. The number of satisfied customers who continue to purchase and use a service provider's product will consequently increase its profitability (Saricam, 2022).

The development and success of a company depends on how well it maintains its customers' satisfaction through good service, which results in an increase in customer retention and loyalty (Suciptawati, Paramita, & Aristayasa, 2019). Customer satisfaction will thus positively influence a customer's loyalty to a service provider. However, the increasing use of new technologies requires new service designs with an increased focus on customer support, developing user-friendly customer support interfaces and infrastructure to improve customer support experiences.

From an end-user perspective, optimal customer support may contribute to an improved UX of the product (Adam et al., 2021). For service providers to deliver exceptional customer support, they are expected to invest in a continuous process of assessing and improving service quality (Parasuraman, 2000). As a result, the contentment of customers with a company's offerings is frequently perceived as the cornerstone of achievement and sustained competitive advantage (Nuruzzaman & Hussain, 2018). Service providers are also expected to ensure that appropriate customer support is available.

Recent research has greatly contributed to understanding customer research, with a primary emphasis on operational aspects such as defining, measuring and addressing challenges, and assessing importance (Sheth, Jain, & Ambika, 2020). However, Sheth et al. (2020) highlighted a significant gap in the existing literature, where a comprehensive perspective on the effective delivery and management of customer support, with the aim to unleash the full potential of a product or service, is noticeably lacking.

Researchers are therefore exploring ways to support service providers by reducing the implementation threats posed, especially due to end-user resistance. Reducing these threats will ensure optimal use, positive UX, sustained usage and, ultimately, customer retention (Ekuase-Anwansedo, Craig, & Noguera, 2018). This, in turn, will strengthen users' commitment to the continued use of the LMS, which is considered an important aspect for LMS service providers in a competitive market (Chang & Farha, 2021). Danish et al. (2018) and Janssen et al. (2021) highlighted that, in today's competitive market, the customer occupies a central place in business. A satisfied customer may even be prepared to pay more for a service or product. In contrast new customers will be attracted by the original pricing. Therefore, a customer's satisfaction with a company's services is often seen as the key to success and long-term competitiveness (Nuruzzaman & Hussain, 2018). According to Danish et al. (2018), customer satisfaction and service quality are related and considered a crucial aspect in business. The long-term cost-saving possibilities involved in incorporating chatbots into an organisation or institution may become one of the key reasons for an HEI to decide which LMS to use (Iqbal, Hassan, & Habibah, 2018; Shukla & Verma, 2019).

When considering the usefulness and value of implementing an LMS platform, student achievement is understandably also a predominant consideration for HEIs. The complexity of some computer systems, such as LMSs, necessitates that service providers offer comprehensive training to all users (Sackstein, Coleman, & Ndobe, 2019). According to Bagarukayo and Kalema (2015), well-trained LMS instructors who receive constant support from the service provider or institution may feel encouraged to make use of the system, whereas instructors lacking these skills may not voluntarily make use of the LMS.

Goffin (1999) highlighted that user training, among other prerequisites, is considered an important factor to improve customer support. However, training costs are quite high, and companies must invest significant amounts of money to train their employees in the efficient use of computer systems (Govinnage & Sachitra, 2019). For simpler functions of products,

training is not considered necessary, because support can be given via self-help, video tutorials or chatbots.

Incorporating an LMS platform into teaching and learning is not as straightforward as substituting the print version for the digital one. It is of paramount importance that instructors receive adequate training and ongoing professional customer support to ensure the successful integration and, ultimately, optimal utilisation of an LMS platform (Mouakket & Bettayeb, 2016). It can be concluded that effective customer support plays a pivotal role in the utilisation of complex LMS technology by users. Ashfaq et al. (2020) and Israfilzade (2021) suggest that a potential approach to enhance user satisfaction and improve the overall quality of the UX, including customer support, may involve integrating human service personnel with digital technology services like chatbots. Nguyen (2019), however, advised that chatbots should handle only simple tasks. The best course of action would be to contact the specific LMS customer support team. Most LMSs have a dedicated customer support team that can assist the user with any issues or questions they may have. Information on how to contact the customer support team is available on the LMS's website or by accessing the help or support section within the LMS platform itself.

2.6 UX

UX design is a multifaceted and intricate field that encompasses various domains, including science, social studies, and creative disciplines. It includes several branches, such as interaction design, information architecture, usability, human-computer interaction, and user interface design, among others (Interaction Design Foundation, 2016). Jakob Nielsen, a pioneer in UX research, and Don Norman, a prominent figure in the field, have made significant contributions by emphasising the importance of usability and user-centered design principles (Nielsen, Molich, Snyder, & Farrell, 2000; Norman, 2004). Their work has underscored the need for intuitive interfaces and efficient interactions, shaping the way designers' approach UX within various contexts, including LMS. To comprehend the ever evolving and complex nature of UX within the context of an LMS, it becomes imperative to establish a clear definition of UX as a concept. This definition serves as a foundation for comprehending the existing constructs of UX and facilitates a deeper understanding of its complexities.

2.6.1 What is UX?

UX is recognised as an emerging field of study that is still in the early stages of development (Caglar, Roto, & Vainio, 2022). It has gained relevance in different fields of knowledge, such as education, marketing and health (Rico-Olarte, López, & Kepplinger, 2018). The concept of UX can be traced back to the 1990s, but a universally shared definition of UX remains indefinable (Berni & Borgianni, 2021). Nevertheless, several definitions of UX exist, each reflecting the individual backgrounds and interests of their respective authors. Hassenzahl (2008:12) defines UX as follows:

A momentary, primarily evaluative feeling (good-bad) while interacting with a product or service. Good UX is the consequence of fulfilling the human needs for autonomy, competency, stimulation (self-oriented), relatedness, and popularity (others-oriented) through interacting with the product or service (i.e. hedonic quality).

This definition significantly advanced the understanding of what UX is and how positive UX is attained (Zeiner et al., 2018). This contrasts with the broad definition of the International Organisation for Standardization (ISO) (2010). According to Mirnig et al. (2015), the international standard on the ergonomics of human-system interaction, ISO 9241-210, defines UX as:

A person's perceptions and responses that result from the use or anticipated use of a product, system or service.

Hassenzahl's (2008) definition clearly focuses on the user's emotion and the fulfilment of psychological needs. In contrast, the ISO definition summarises somehow what is stated by the literature, including all the users' emotions, beliefs, preferences, perceptions, physical and psychological responses, behaviour and accomplishments that happen before, during and after the experience (Berni & Borgianni, 2021).

The induction of positive UX is a vital aspect of the design and development of software technologies. Existing approaches aim to engineer good UX to make the applications more enjoyable and pleasurable to use. Particularly in business applications, employees need to be motivated to perform their tasks to increase efficiency and effectiveness. Negative UX, however, decreases both user acceptance and motivation (Magin, Maier, & Hess, 2015). This has an overall negative impact on the product offered by service providers.

UX essentially refers to the quality of experience that an individual encounter when interacting with a specific design (Hartson & Pyla, 2018). It encompasses the overall experience of a person when using a product, system or service. This includes the user's perceptions and responses that arise from the actual use or the anticipation of using the product, system or service (Hasan, 2021). In simpler terms, UX revolves around how a person feels during their interaction with a product or service. Effective UX design strives to create products that are user-friendly, efficient and enjoyable to use. In software systems, UX is a quality that provides value to its intended users (Trendowicz et al., 2023).

Additionally, it refers to the end-users' subjective experience, which is formed while interacting with the technology (Olsson, 1992). The interaction with the artefact is a result of a brand's image, presentation and functionality, the productivity of a system, interactive behaviour, and additional capacity of a system, product or service. It is also the result of internal and physical conditions of the user, which result from the user's previous experience, attitude and skills within the context of usage (Vlasenko et al., 2022). It represents a component of the fifth generation within the human-computer interaction realm, which has shifted its focus since the 2000s toward the design and assessment of UX (Mkpojiogu et al., 2021).

UX is dynamic, context-dependent and subjective. The dynamic character of UX suggests that the experience of an interactive system, such as an LMS, may change over time as users grow accustomed to the system, encounter difficulties or simply lose interest. Hence, it is important that interactive systems continually provide users with useful or pleasurable episodes of use (Følstad & Brandtzaeg, 2020). The context-dependent character of UX points toward users' perceptions of their interaction with the interactive system, which depends on factors that are partly beyond the control of the system developer. Such factors, as explained by Bradley and Dunlop (2005), encompass the task, physical, social, temporal and cognitive context. The subjective character of UX focuses on feelings of relatedness, social support, enjoyment, pleasure and convenience, and is not immediately observable to developers and service providers. As such, UX represents the methodological challenge of gaining access to users' internal perceptions, emotions and reflections (Hassenzahl, 2008).

UX can be viewed as an extension of the usability concept, which primarily concerns itself with user cognition and performance. This is achieved by adopting a more comprehensive approach that considers the user's emotions and the entirety of their experience when interacting with an

interface (Sonderegger & Sauer, 2019). Hassenzahl (2008) argues that UX also delves into users' motivations and emotions, which can encompass both negative and positive expressions. Users' motivations and emotions are tied to their perception of the product, system or service they are using. These constructs play a role in shaping the emotional outcomes of their UX, which can be influenced by the system's ease of use (Hassenzahl, 2008). According to Alben (1996), UX is concerned with all the aspects of how people use and interact with a product, system or service. For example, this comprises how well they understand how the product works, how they feel about it while they are using it, how well it serves their purposes, and how well it fits into the entire context in which they are using it.

UX plays a pivotal role in enhancing product usability and interactivity, as emphasised by Abbas, Ghauth, and Ting (2022a). A robust UX is crucial, contributing to heightened productivity by not only boosting customer satisfaction and loyalty, but also improving the efficiency and effectiveness of product usage. According to Olaleye, Sanusi, and Oyelere (2017), prioritising UX in design can significantly reduce user complaints, mitigate the risk of brand switching and alleviate customer dissatisfaction.

Conversely, neglecting UX may hinder growth and sustainability. Recognising this impact, companies frequently enlist the services of UX designers to enhance the UX of their products, as highlighted by Gray (2016).

2.6.2 Factors influencing UX

The UX of a product, system, or service is shaped by a multitude of factors, spanning from accessibility and aesthetics to functionality and personalisation. Grasping these elements is essential for designers and developers aiming to create a positive UX. While some factors enhance the overall UX, others pose potential challenges. Below are the positive factors that enhance UX, followed by the negative factors:

Positive factors influencing UX:

- **Accessibility:** A product, system or service that is accessible to users with disabilities, limited abilities or resources can greatly improve the UX (Cozlov & Zadorojnii, 2022; Fleming, 2023; Oswal & Meloncon, 2014).
- **Aesthetics:** A visually appealing product, system or service can improve the UX (Al-Mahmood, 2012).

- **Ease of use:** A product, system or service that is easy to use, navigate and understand will generally have a positive impact on the UX (Demir et al., 2022).
- **Functionality:** A product, system or service that performs tasks without difficulty and uses them as intended will generally have a positive impact on the UX (Wenzel & Moreno, 2022).
- **Personalisation:** A product, system or service that meets the individual's needs and preferences will enhance the UX (Heng et al., 2022; Lima et al., 2019).

Negative factors influencing UX:

- **Complexity:** A product, system or service that is overly complicated (Vandeyar, 2020) or difficult to use can negatively impact the UX (Ramesh, Vermette, & Chilana, 2021).
- **Lack of accessibility:** A product, system or service that is not accessible to users with disabilities can greatly negatively impact the UX (Acosta-Vargas, Salvador-Ullauri, & Luján-Mora, 2019; Cozlov & Zadorojnii, 2022; Liu et al., 2022).
- **Poor aesthetics:** A visually unappealing product, system or service, with confusing features, pages that are too busy, inconsistent layout design, unrecognisable hyperlinks or buttons, and ambiguous or undefined features, can negatively impact the user's experience (Lim, Ayesha, & Chee, 2013).
- **System instability and unreliability:** A product, system or service that is prone to errors or crashes can negatively impact the UX (Vandeyar, 2020).

2.6.3 UX and the LMS

In recent years, the significance of UX has witnessed a rapid increase, with a pronounced emphasis on its application in the development of systems, products and services. The broad utilisation of UX extends across various industries, encompassing services, products, processes, society and culture. Consequently, if the UX falls short of expectations, it is likely to have a direct negative impact on the associated system, product or service. Failure to thoroughly analyse UX can lead to substantial damage to the project, potentially resulting in project failure, necessitating redevelopment, or even contract termination (Kim, 2020).

As the focus of LMS design transitions from being technology-centric to user-centric, developers must prioritise UX to enhance their LMSs (Saleh et al., 2022). Gunawan, Anthony, Tanudjaja, and Anggreainy (2021), along with Maslov et al. (2021), underscore the

importance of maintaining a user-friendly interface with straightforward navigation and intuitive features that facilitate users achieving their objectives. Furthermore, it is essential to consider UX during the design and implementation of an LMS, as poor UX can lead to frustration and reduced user acceptance of the platform.

Technological advances, internet growth and user demands have led to the development of education platforms, such as an LMS. This has caused a transition from a traditional learning environment to a digital one.

Simultaneously, in many software development companies, usability and UX are either neglected or not properly considered (Maslov et al., 2021). Krawczyk, Topolewski and Pallot (2017) echo Krishnamurthy and O'Connor's (2013) view that the identification and evaluation of the UX elements addressed during the software development of LMSs are crucial for innovation. The LMS, as part of an e-learning system, could benefit from UX research to measure ease of use and user satisfaction. Many academic institutions around the world prefer to use their own customised LMSs (Saleh et al., 2022). Therefore, UX evaluation and measurement is important for LMS service providers.

With most undergraduate students today being avid users of smartphones (Annamalai & Kumar, 2020; Okonkwo & Ade-Ibijola, 2021), the unavailability of quick mobile access and unresponsive design tends to negatively affect the success of an LMS platform (Abdul Lasi, 2021; Annamalai et al., 2021; Kumar, Bervell, & Osman, 2020; Kumar & Al-Samarraie, 2018). It is clear that older versions of LMSs were mainly designed for desktop-based interaction, while not supporting the accessibility of different mobile devices such as smartphones, tablets and laptops (Turnbull, Chugh, & Luck, 2023), which had a negative impact on the UX (Viberg & Grönlund, 2017). Moreover, due to this need, factors relating to resources such as the internet, devices and access have played a crucial role in the intention to use an information system, such as an LMS (Zwain, 2019). Furthermore, Annamalai et al. (2021) and Thah and Latif (2020) also found that other types of resources in learning, such as online communication strategies, quality of content, interaction and accessibility to video streaming platforms are some of the factors that influence the use of LMSs.

Information and communication technology (ICT) infrastructure was also identified as one of the main factors in the successful implementation of an LMS, especially in HEIs (Legarde, 2022; Sobaih, Moustafa, Ghandforoush, & Khan et al., 2016). It is recommended that

policymakers should anchor their decisions on the findings of Legarde's (2022) study, most especially on the procurement of various educational technologies and ICT infrastructure at their institutions.

During the software development of LMSs, usability and user acceptance are considered significant, as these systems are used by people with varied skill sets (administrators, students and instructors) (Krishnamurthy & O'Connor, 2013). With increased awareness comes the evolving challenge within the UX community, comprised of students, administrators, instructors, practitioners, service providers, content providers, scholars, and clients, who often interpret the field in diverse ways (Pretorius, Hobbs, & Fenn, 2015).

In an early study by Machado and Tao (2007), the researchers compared the UX of two widely used LMSs: Blackboard and Moodle. Utilising a survey instrument, they gathered data from 232 students who had experience with both systems across various courses. The UX was evaluated across five dimensions: usability, satisfaction, individual differences, system aspects and instructor issues. The findings revealed that Moodle outperformed Blackboard in overall UX score. Significantly divergent results were identified between the two systems concerning usability, satisfaction and system aspects. Moreover, the study identified gender, age and computer experience as factors influencing the UX within the LMS. Conclusively, Machado and Tao (2007) determined that Moodle demonstrated superior user-friendliness, flexibility and interactivity compared to Blackboard. The results emphasised the importance of prioritising UX as a pivotal factor for LMS designers striving to enhance their online learning environments.

Ibrahim and Aziz (2022) discuss the UX of an HEI's LMS. The study recommended enhancing the attractiveness, efficiency, stimulation and dependability of the LMS platform for future improvement. Their research emphasises the importance of UX in online learning and suggests that a positive UX can lead to better user satisfaction and loyalty.

Moodle is widely regarded as the most extensively used LMS in academic and business organisations worldwide (Gamage et al., 2022; Saleh et al., 2022). It has 352 million users in 242 countries (Moodle, 2023). Although reasonable improvements to Moodle's UX were released as early as the end of 2019, Hasan (2019) discovered UX problems in Moodle's user interface (UI) that prohibited users from engaging with it properly (Hasan, 2019). As competition for Moodle, within the context of HEIs, Blackboard is a well-designed product, and

is seen to be at the forefront of contemporary technological advances. Several leading HEIs have adopted Blackboard as an LMS for their students (Williams, 2022). Maslov et al.'s (2021) findings show that the UX depends on how HEIs design and maintain an LMS. If an LMS is designed by experts and professionals, the UX might be evaluated positively, but in contrast, if it is designed by amateurs and maintained improperly (for example, hosted on bad servers), the UX will also suffer. This can be supported by findings that confirm that providing a positive UX can increase user satisfaction and loyalty, and as a result, promote the commercial success of the company. For products that are unable to offer good UX, UX measurement feedback can assist design and development teams to fix their experiential problems, therefore improving the UX quality of the product (Feng & Wei, 2019).

To conclude, in the context of an LMS, UX refers to how users engage with the learning tool. Every aspect of the LMS factors into the UX equation, from the intuitiveness of the user interface to its ability to scale and adapt to ever-changing online needs (Pappas & Zaharias, 2018). An LMS that offers the complete package delivers a top-notch LMS UX that enables virtually anyone to utilise the tool with ease. Such a top-notch LMS UX often emerges because of adhering to specific design principles that play a crucial role in shaping the way users interact with the LMS.

2.6.4 An affective model for an LMS

Hussain, Mkpojiogu, and Puteh (2021) developed a theoretical affective model for the design and evaluation of the affective experiences of LMS users on LMS platforms. Their study highlighted a gap in existing models tailored for assessing the emotional aspects of LMS UX, prompting the need to design such a model. Subsequently, the researchers integrated the affective component (domain) of Bloom's taxonomy of learning into their conceptual model and pinpointed pertinent quality facets or dimensions that impact and enrich the model's effectiveness. This UX model (Figure 2.1) is particularly suitable for the design and evaluation of the affectivity of LMS platforms, providing a comprehensive framework to understand the affective experiences of users (Hussain et al., 2021).

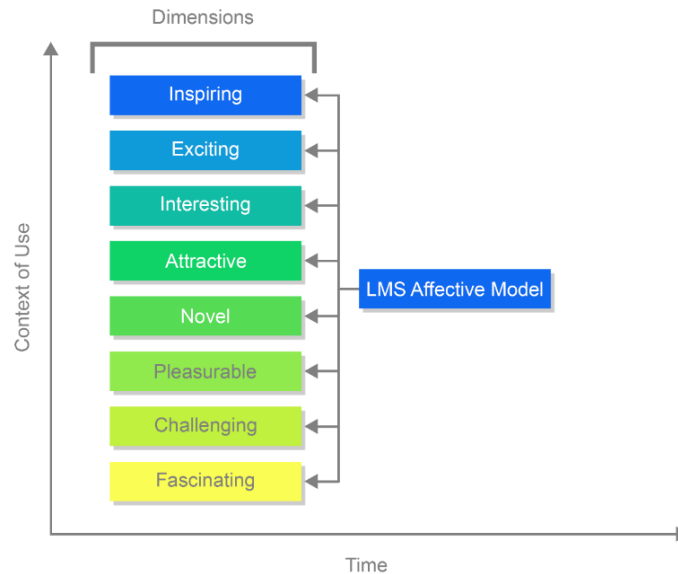


Figure 2.1: An LMS affective model (Hussain et al., 2021)

There are nine attributes that stimulate users' affective state on the LMS platform (Hussain et al., 2021). They are the following:

Inspiring: This attribute elucidates how motivating an LMS platform can be for users. When users are inspired by the learning activities of an LMS, they become more engaged and invested in the process. Consequently, the inspirational level of an LMS has a direct impact on the affective model of the platform (Sucipto, Efendi, Hanif, & Budiyanto, 2017).

Exciting: This quality defines how enthusiastic LMS users are while engaging with the platform. An exciting LMS captivates users in their learning activities, thus having a positive effect on their emotional state. An engaging LMS can significantly enhance the UX, making learning more enjoyable and stimulating (Minge, Thuring, Wagner, & Kuhr, 2016).

Interesting: An engaging LMS can extend and maintain the focus and interactive activities of its users. Students tend to be more actively engaged on platforms they find interesting, thus influencing users' emotional state (Green & Batool, 2017). Instructors are increasingly recognising the immense value of incorporating chatbots into educational environments to provide students with an engaged experience (Clarizia et al., 2018; Hobert, Følstad, & Lai-Chong Law, 2023)

Novel: A cutting-edge LMS with fresh content and creative interfaces is the delight of its users. Users are drawn to interact with learning platforms they perceive as novel, original, unique and innovative, thus having a positive impact on their engagement (Yulianandra et al., 2017).

Attractive: Attractive aesthetics have an impact on the emotional state of users on an LMS. When the platform is visually appealing, users are more likely to be stimulated and captivated to learn and interact with it. This attribute encourages users to learn with joy, interest and enthusiasm (Bhandari, Neben, & Chang, 2015).

Pleasurable: A pleasurable LMS is an engaging platform for learning that encourages users to have fun while they learn. It provides an enjoyable experience that keeps users engaged and motivated, making the learning process both entertaining and rewarding (Minge et al., 2016).

Challenging: This attribute defines the degree to which an LMS platform encourages users to learn despite any difficulties they may face. Difficulties in learning are seen as conquerable and the tensions encountered are courageously and enjoyably embraced. Challenge has an impact on the affective model of LMS platforms, inspiring users to push their boundaries and strive for success (Ertemel, 2017).

Fascinating: A fascinating LMS is a platform that entices, intrigues and mesmerises users, drawing them in and capturing their attention. This quality encourages users to be actively engaged in learning activities as they are drawn in by the allure of the platform. This quality influences users' emotional states (Minge et al., 2016).

2.7 UX FRAMEWORKS

UX frameworks are sets of guidelines, best practices and pre-designed elements that help designers create user interfaces that are consistent, efficient and effective. These frameworks provide a structure within which designers can work, allowing them to focus on creating a user-friendly experience rather than starting from scratch. These frameworks typically include pre-designed UI elements such as buttons, forms and menus, as well as guidelines for typography, colour schemes and layout. By using a UX framework, designers can save time and ensure that their designs are consistent and effective. Despite the expanding use of UX by practitioners and academia, and because of its extensive breadth, there is no agreement on a common theoretical framework for UX (Zarour & Alharbi, 2017).

Table 2.2 presents a list of UX frameworks documented in literature, sorted in ascending order according to dates, which provides a theoretical background for a thorough understanding of UX. Researchers synthesise their UX research findings in a UX framework, which focuses on certain UX dimensions and aspects based on selective literature. These models address the key issues of UX, including its highly situated and dynamic nature, its context-dependent character, as well as the subjective factors leading to UX. The seven frameworks highlighted in blue in Table 2.2 are discussed beneath the table because the researcher deems them relevant to the scope of this study. Following these discussions, the researcher explains the rationale behind selecting a specific UX framework, deeming it valuable for the study.

Table 2.2: UX frameworks documented in literature (Zarour & Alharbi, 2017)

Framework	Author	Year
Venn diagram of information architecture	Morville & Rosenfeld	2006
UX honeycomb	Morville	2004
APEC: A framework for designing experience	Vyas & Van der Veer	2005
A simplified model of UX for practical application	Jetter & Gerken	2006
CUE-Model (Components model of UX)	Mahlke & Thüring	2007
Analysis framework for UX studies	Kort, Vermeeren, & Fokker	2007
A taxonomy of quality of service and quality of experience of multimodal human-machine interaction	Möller et al.	2009
A framework to measure UX of interactive online products	Schulze and Krömker	2010
Core metrics UX metrics for m-health	Ouma, Herselman, & Van Greunen	2010
Elements of UX	Garrett	2011
LMS affective model	Hussain et al.	2021
Optimised honeycomb model	Karagianni	2023

The landscape of UX research is fragmented and complicated by diverse theoretical models with different foci, such as pragmatism, emotion, affect, experience, value, pleasure, beauty and hedonic quality (Law et al., 2009). However, all these models have a specified degree of shared interests or characteristics: they focus on well-being and not performance as an outcome of human-product interaction (Hassenzahl, 2008).

2.7.1 Venn diagram of information architecture for UX

Peter Morville and Louis Rosenfeld's Venn Diagram of Information Architecture, developed in 2002 (Morville & Rosenfeld, 2006), stands as a foundational framework, which is intimately intertwined with the field of UX. The Venn Diagram of Information Architecture (Figure 2.2) serves as a valuable tool in UX design by providing a visual representation of the intricate relationships between users, content and context. It serves as the cornerstone for crafting impactful information architecture designs, also known as "information ecology", a construct composed of users, content and context. This conceptual ecosystem serves as a channel to address the intricate dependencies that weave through this landscape. In the sphere of UX, this diagram highlights the significance of holistic design thinking, emphasising the importance of accounting for all three components when shaping effective information architecture.

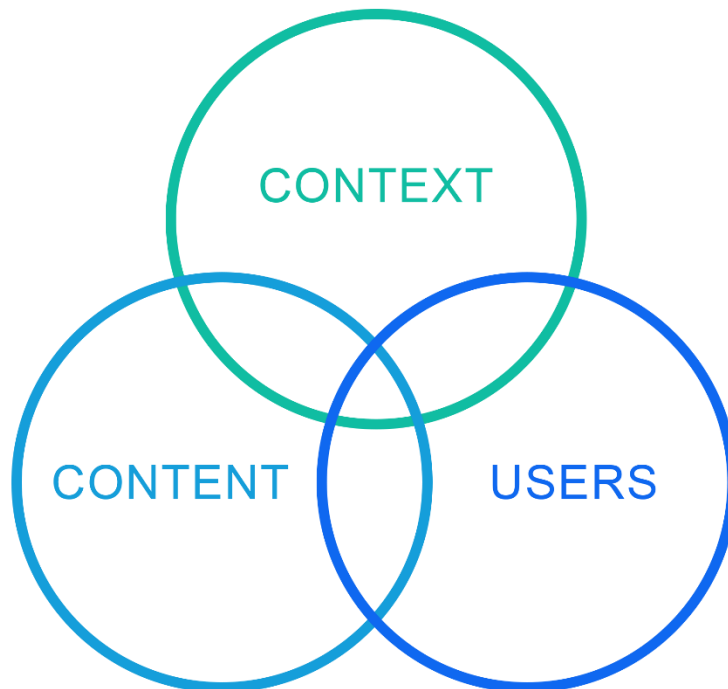


Figure 2.2: Peter Morville and Louis Rosenfeld's Venn Diagram of Information Architecture (Morville & Rosenfeld, 2006)

Users: Users are the audience that consumes the content. Their behaviour in seeking, consuming and manipulating information within a given system, the tasks they wish to complete and their overall experience of seeking, retrieving, manipulating and completing tasks is what the information architect designs for. Without users, no design can be successful, which is why user research is so essential. It is recommended that UX designers

gain a comprehensive understanding of their target audience and prioritise their needs throughout the design process to create a successful design (Satterfield & Fabri, 2017).

Content: Morville and Rosenfeld (2006) describe the content of information architecture, which encompasses all data, documents, texts, images, code and other information organised by an information architect. Structures such as navigation, search systems, labelling and tagging, and the categorisation of information are applied to create a comprehensive design process, including login screens, micro-interactions and aesthetic elements. By organising and structuring this information, an information architect can create a user-friendly and efficient experience.

Context: The context of information architecture refers to the objectives and strategies of the design, placing it in its real-world context. It can be understood from two perspectives: the environment in which users interact with the design, and the background of the design itself. The former determines the UX, while the latter ensures that the organisation's goals are met. By understanding the context of information architecture, designers can create a user-friendly experience that meets the needs of the organisation (Morville & Rosenfeld, 2006).

2.7.2 Components Model of UX

Grounded in a comprehensive UX framework, the Components Model of UX, developed by Mahlke and Thüring (2007), presents an integrated perspective. This model, abbreviated as the CUE-Model, intricately weaves together interaction characteristics, perceptions of both instrumental and non-instrumental qualities, emotional user reactions and the holistic appraisal of system quality, quality perceptions, emotional user reactions and overall judgments of system quality. The CUE-Model integrates various dimensions, including interaction attributes, instrumental and non-instrumental quality perceptions, the emotional responses of users, and holistic assessments of system quality. Within this framework, instrumental qualities encompass vital elements such as system support and usability, encompassing facets like system controllability and functional efficiency. In contrast, non-instrumental qualities encompass the more subjective and experiential dimensions, focusing on the aesthetic and emotional aspects of the system. This holistic approach allows for a better understanding of the user's experience, embracing both the tangible and intangible facets that contribute to overall system quality.

It further integrates several theories and approaches, making a clear distinction between the perceptions of instrumental and non-instrumental attributes. Crucially, it posits that emotions play a pivotal role, acting as mediators between these two types of perceptions, shaping the outcomes of usage. These outcomes encompass a spectrum ranging from overall judgments and acceptance to the intention to engage with the system. The CUE-Model is shown in Figure 2.3.

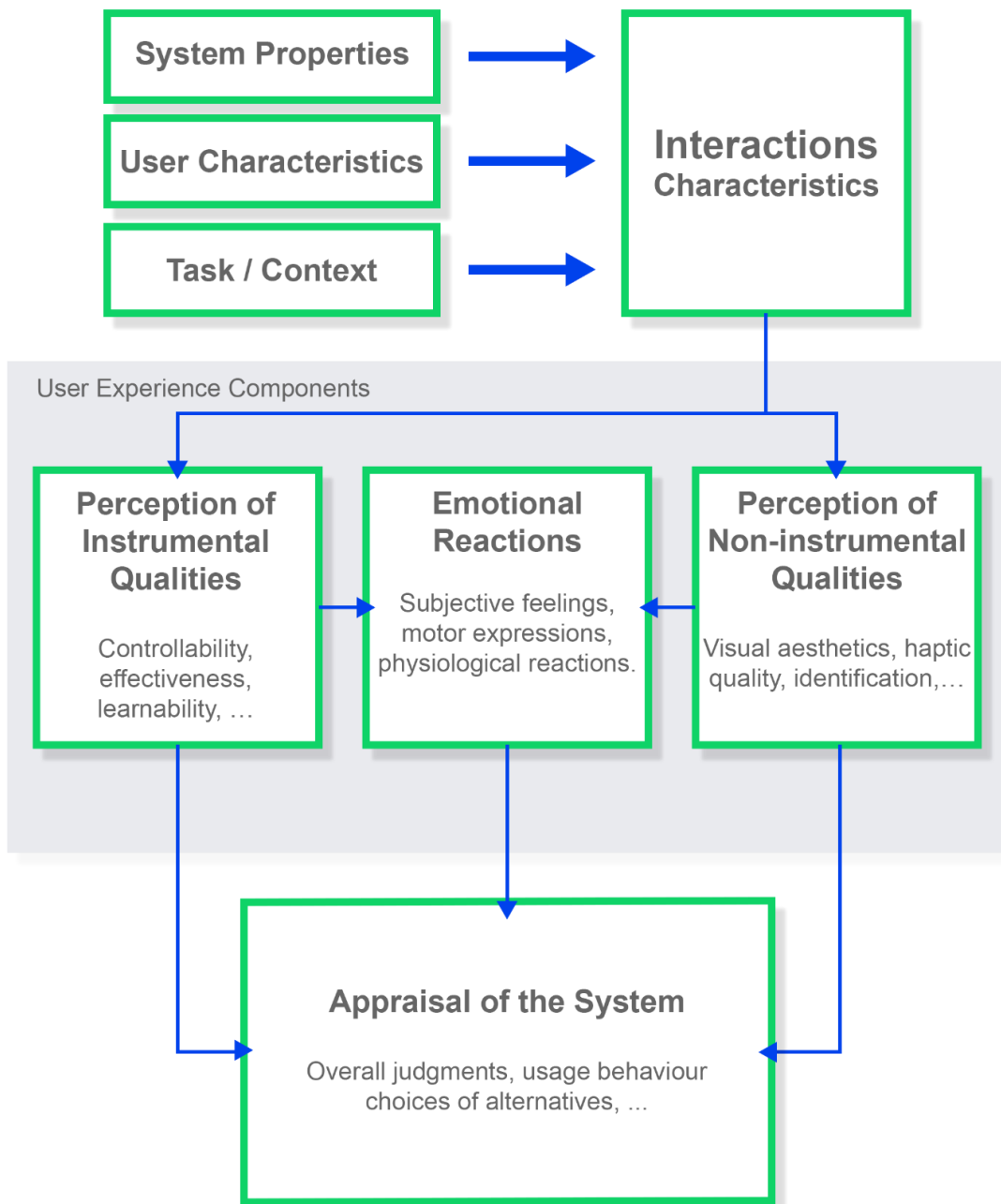


Figure 2.3: The components model of UX of Mahike and Thüring (2007)

Drawing from Scherer's (1984) work, the CUE-Model offers a unique perspective on emotions. It identifies emotions as distinct occurrences of personal feelings, entwined with specific physiological responses and outward expressions. These occurrences can repeat, significantly influencing users' emotional connections with a product across time.

2.7.3 Honeycomb Model of UX

Morville (2004) claimed that evaluating a system should be moved beyond usability only, and that other facets that affect the UX also need to be considered. The "honeycomb" model of UX is a concept developed by Morville (2004) and is viewed as a valuable tool to qualitatively measure the kind of experience a product or service offers users.

The UX honeycomb model underscores the importance of factoring in and harmonising the various elements mentioned to achieve a successful and gratifying UX (Desmet & Hekkert, 2007; Kim, 2020). This model is particularly valuable in the initial stages of the design process, as it serves as a tool to identify any overlooked aspects in the tentative design. According to literature, it was suggested that the researcher mapped the tentative design principles to the UX honeycomb (Kim, 2020). Additionally, it functions as a checklist that designers can employ to establish priorities that are aligned with these objectives (Desmet & Hekkert, 2007; Kim, 2020). By comparing different cases, it facilitates the development of practical guidelines that help meet user expectations and cultivate positive experiences (Lee & Kim, 2017).

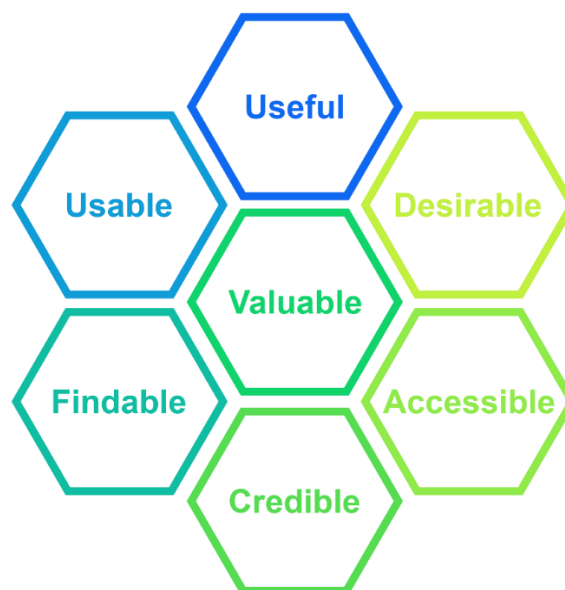


Figure 2.4: The "honeycomb" model of UX of Morville (2004)

The UX honeycomb (Morville, 2004), as illustrated in Figure 2.4, is a framework consisting of seven interconnected hexagons that represent essential dimensions of the UX. This model has found widespread application in guiding the design of applications, websites, products and services (Desmet & Hekkert, 2007; Kim, Jung, & Ryu, 2020). Each UX dimension is discussed in the following paragraphs. It is important to recognise that the application of these UX dimensions may vary based on contextual factors, such as the product's purpose, the user's task, and the intended audience. Understanding these dimensions allows designers and developers to design for a UX that is not only functional, but also engaging, trustworthy and accessible to a broad range of users (Preece, Rogers, & Sharp, 2002).

Usefulness: At the core of the UX honeycomb lies “usefulness”. This pertains to the product's ability to serve a purpose and provide value to users. A product's relevance to user needs and its capacity to achieve its intended goals are critical (Isnainiyah, Zaidiah, Yulnelly, & Widiastiw, 2021).

Desirability: Desirability encompasses the appeal that a product holds for users. Through elements such as branding, aesthetics, emotional design and identity, a product should captivate users' interest and cultivate a desire to engage with it. The greater a product's desirability, the more likely users are to share their positive experiences and incite interest in others (Isnainiyah et al., 2021).

Usability: Usability is concerned with enabling users to achieve their objective easily, effectively and efficiently with a product (Isnainiyah et al., 2021).

Findability: Findability refers to the product's accessibility and the ease with which users can locate, navigate and access the information or features they require. When a product is challenging to locate, users are less likely to engage with it (Isnainiyah et al., 2021).

Credibility: Credibility relates to the ability of the user to trust in the product or service that was provided. Not just that it does the job that it is supposed to do, but that the information provided with it is accurate and fit-for-purpose. It is nearly impossible to deliver a UX if the user is of the opinion that the product creator and information provided is not credible (Isnainiyah et al., 2021).

Accessibility: Accessibility is a term for which there is a range of definitions. It usually refers to the use of e-systems by people with special needs, particularly those with disabilities and

older people. According to Lima et al. (2020), the international standard ISO 9241-171 of the International Organisation for Standardisation (ISO) (2008) defines accessibility as:

...the usability of a product, service, environment or facility by people with the widest range of capabilities.

Accessibility is therefore one of the UX design principles that all designers need to take into consideration (Tasnim & Munteanu, 2023). This means that all users are given equal importance, and the needs of all the target customers are prioritised, irrespective of their physical and/or cognitive disabilities (Cozlov & Zadorojnii, 2022; Elias, 2010). Accessibility is about providing an experience that can be accessed by users of a full range of abilities. This includes those who are disabled in some respect, such as those with hearing loss, impaired vision, the motion impaired or the learning impaired (Brito & Dias, 2020). In certain situations, accessibility can also refer to various device compatibilities.

Valuable: “Value” underscores the necessity for a product to deliver meaningful benefits to both users and the entities that offer it. A product should align with user needs and interests, while also offering value to the business or individual that develops or markets it. Recognising the importance of value in driving purchasing decisions underscores the significance of this dimension. However, as far as interactive products are concerned, it is not feasible to apply all the usability goals and UX goals to every product that is developed (Isnainiyah et al., 2021).

2.7.4 Optimised Honeycomb Model

Several modifications have been made to the original UX honeycomb model. One such example is that of Karagianni (2023), who made small amendments to the original model to raise its practical use. The optimised honeycomb model (Figure 2.5) was created to demonstrate the practical aspects of the model, illustrating useful connections between the unrelated parts of the UX honeycomb model (Morville, 2004) to convey how users use products, in addition to how they think and feel about them. The facets were grouped into three variables based on areas of impact (Dalli, 2023), reasoning about how the user “feel, think and use” the product by making a connection between the seven facets (Karagianni, 2023). To facilitate comprehension of the optimised honeycomb model, it was reorganised and colour-coded to visualise the relation between the facets (Månsson et al., 2020). The three variables can be explained as follows: *Feel* is a form of feeling that arises when

someone uses a product or application. *Think* is defined as a form of thought that arises from a person towards a given product, while *use* is a form of use of a product or application by a user to solve their needs (Kusuma, Sudarmaningtyas, & Supriyanto, 2022).

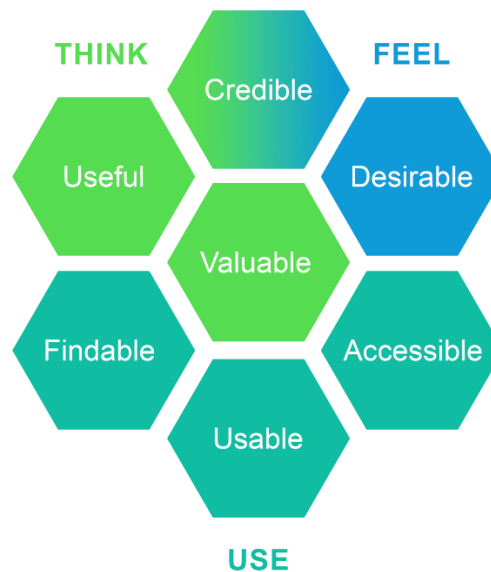


Figure 2.5: The optimised honeycomb model (Karagianni, 2023)

2.7.5 A framework to measure the UX of interactive online products

In the study “A framework to measure the UX of interactive online products” by Schulze and Krömker (2010), a comprehensive framework is presented that offers valuable insights into evaluating the UX of interactive online products (Figure 2.6). This framework provides a structured approach for understanding and analysing the multifaceted aspects that contribute to users’ interactions with digital products (Sim, Zaman, & Horton, 2017).

The researchers emphasise the importance of considering multiple dimensions to holistically capture the essence of the UX. By delineating key factors that influence users’ perceptions and interactions, this framework goes beyond surface-level evaluations and delves into the intricate layers that shape user engagement. In Eriksson and Ferwerda (2021), Schulze and Krömker (2010) mention that basic human factors influence the UX of software products. In their proposed evaluation framework, they mention the product factors that influence UX as utility, usability, visual attraction and hedonic quality. These facets collectively contribute to users’ overall satisfaction and engagement with interactive online products. Usability, for

instance, focuses on ease of interaction and task accomplishment, whereas aesthetics delves into the visual and sensory aspects that draw users in.

Furthermore, the framework acknowledges the emotional component of UX, recognising that emotions play a pivotal role in shaping users' perceptions and long-term engagement. By acknowledging the impact of emotions, the framework provides a deeper understanding of how users connect with online products on a fundamental level. One of the notable strengths of this framework lies in its applicability across various online product types, ranging from websites to applications. This adaptability ensures that the framework remains relevant in an ever-evolving digital landscape. Additionally, the framework's emphasis on user-centredness aligns well with contemporary UX design principles. By putting the user at the center of evaluation, it underscores the importance of creating products that resonate with users' needs, preferences, and goals.

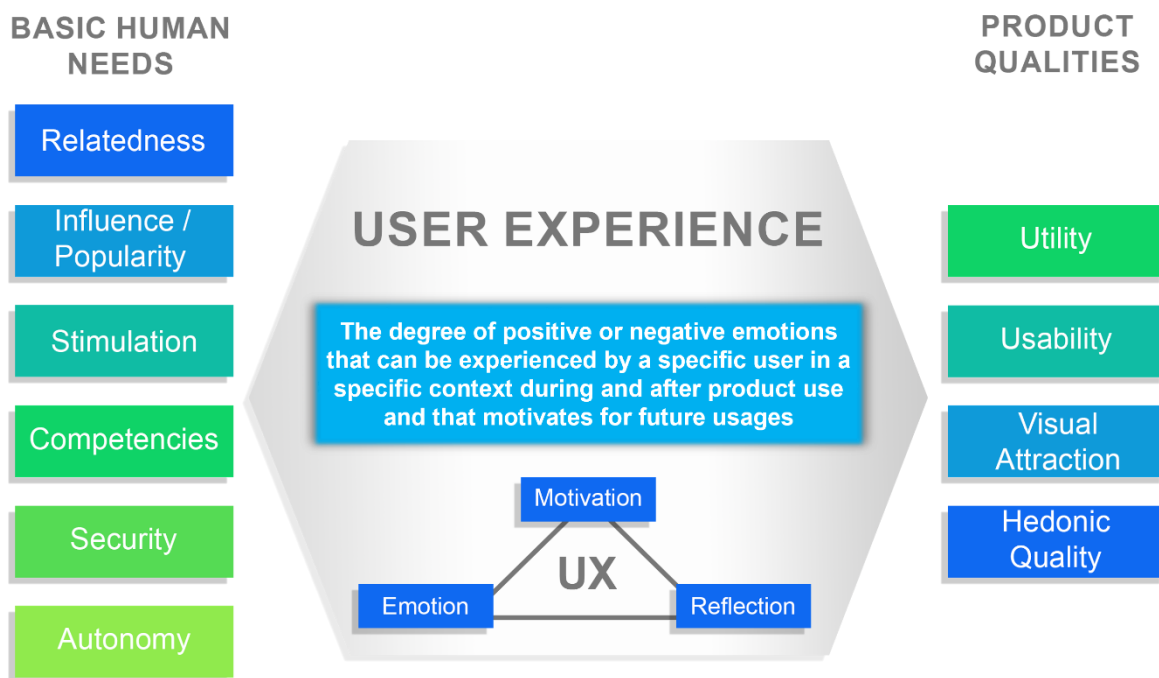


Figure 2.6: A framework to measure the UX of interactive online products (Schulze & Krömker, 2010)

2.7.6 Elements of UX

To further explain UX, Garrett (2011) posits that considering the UX ensures that all user needs and activities are accounted for in the design process. Garrett (2011) thus contends that the UX is composed of various elements when constructing web pages. These elements

can be divided into five distinct planes: strategy, scope, structure, skeleton and surface. By using a website as an example, the author explains that, when discussing UX, two primary factors must be taken into consideration: the tasks of the user, and the information that the user must access. The tasks that the application should enable are placed on the left, while the information that the user must access among the five planes is placed on the right. This creates various subcomponents, as shown in Figure 2.7:

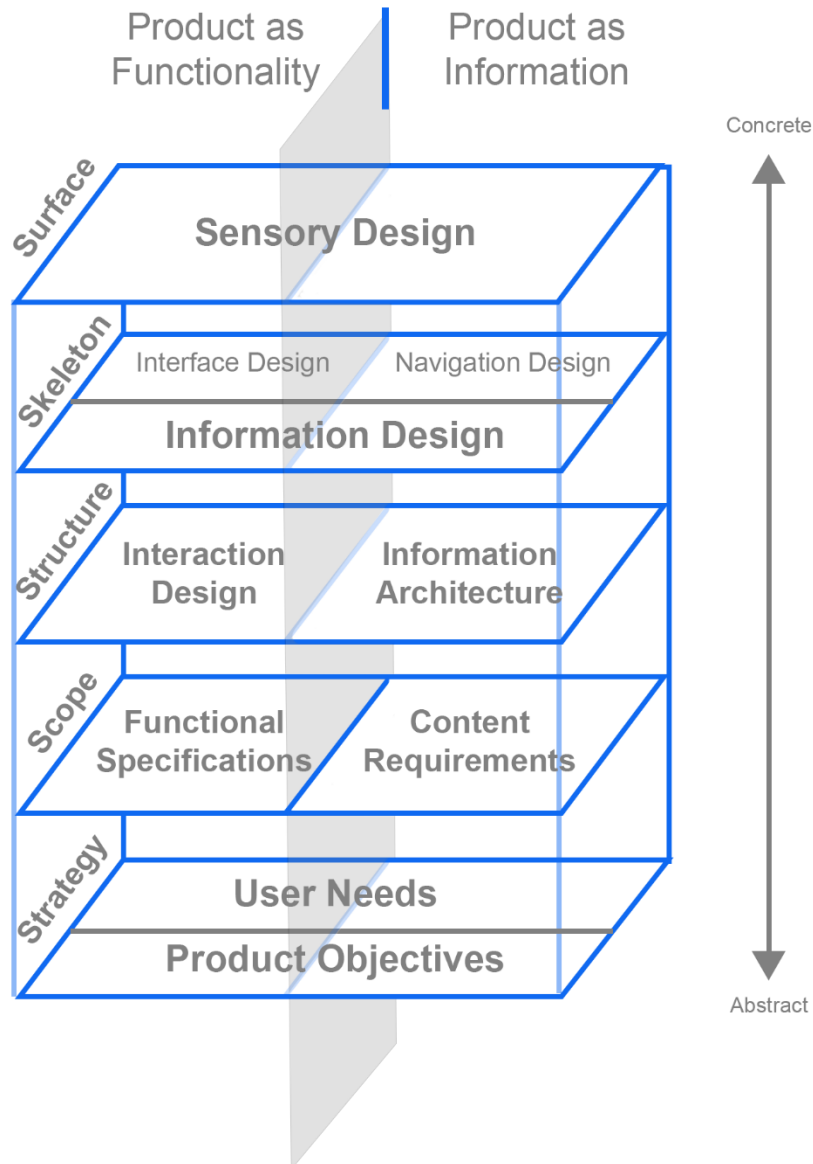


Figure 2.7: The five planes of UX (Garrett, 2011)

As illustrated in Figure 2.7, the five elements of UX exist on five distinct planes, each building up from the previous one to form a cohesive outline of the process UX teams can follow for each new project. From bottom to top, these planes are strategy, scope, structure, skeleton

and surface (Agusdin, Salsabila, & Putri, 2021). As the project progresses from abstract to increasingly concrete, each plane requires meeting different goals and completing different tasks. In other words, the model provides a roadmap for UX teams to follow, ensuring that each step is taken in the right order and with the right objectives in mind. Each plane can be described as follows:

Strategy: The base layer of the Elements of UX Model is strategy. As the most abstract and least restrictive aspect of the project, this is where decisions should be made regarding the objectives the product should be designed to achieve. These objectives should encompass the goals of both the clients and stakeholders behind the product, as well as the goals of the users, who will ultimately rely on the product to solve their specific problems. To ensure that users are drawn to the product for information, their needs must be met. This entails understanding the goals users have when utilising the product, which can be uncovered through user research (Pan & Wang, 2019).

Scope: After determining the strategy, the scope of the product can be precisely outlined. This is where all the product's features are determined, including the information users can access and the functionality they can interact with. At this stage, the UX team will create a set of functional specifications that identify and describe each feature of the product and a list of content requirements that identify each piece of content that was included (Pan & Wang, 2019).

Structure: Once the scope of the product has been outlined, the structure is constructed. This is where the navigation elements are determined, including where each page is located within the product and where users can go after arriving at a given page. This involves defining the product's interaction design and information architecture (Pan & Wang, 2019).

On the interaction design side, it is necessary to decide how users will interact with the site and how the system will respond, including what will happen if errors are made. This can be conveyed through conceptual models that explain each part of the user interface – usually in a flow chart format – that defines what users can do and how the product will react to each potential choice the user makes.

On the information architecture side, it is essential to structure the content the product offers in a way that makes it easy for users to find what they are looking for. This can be conveyed

through documents like site maps that outline the hierarchy and pattern of each part of the product.

Furthermore, it is important to create a user flow that outlines how the system responds after a user enters information. This will help ensure that users have a smooth and intuitive experience while navigating the product.

Skeleton: This composition combines both interface design and information design on the left. The interface element focuses on the arrangement of various components to facilitate the UX. On the right, the presentation of the information is also considered, ensuring that the user can easily access and understand the data. Additionally, the navigation design is included, which helps users intuitively navigate the provided information architecture (Pan & Wang, 2019).

The surface plane: This presentation showcases the finalised product, featuring its navigational components, text and graphics. It provides a comprehensive overview of the project's completion, allowing viewers to gain a better understanding of the product's features (Pan & Wang, 2019).

2.7.7 Facets of UX

Hassenzahl and Tractinsky (2006) delve into the concept of UX within the domains of human-computer interaction and interaction design. They explore three pivotal perspectives in UX research (Figure 2.8):

- **Addressing human needs beyond the instrumental:** Emphasising the importance of going beyond merely fulfilling users' functional needs and considering their broader, non-instrumental needs. This perspective focuses on creating experiences that cater to emotional, psychological, and social needs.
- **Considering emotional and affective aspects of interaction:** Shedding light on the significant role of emotions and affect in the realm of UX. It is suggested that understanding and designing for users' emotional responses are critical in the creation of satisfying and meaningful interactions.
- **Understanding the nature of experience:** Further delving into the philosophical dimension of experience, aiming to grasp the fundamental nature of UX, which involves an exploration of the subjective and holistic nature of user interactions with technology.

Furthermore, Hassenzahl and Tractinsky (2006) pose research questions related to these three perspectives, such as how to study and fulfil non-instrumental needs, how emotions impact the overall product quality, and how to analyse the nature of experience within the context of human-computer interaction and design. In conclusion, the authors underscore the necessity of gaining a comprehensive understanding of UX, encompassing its emotional and non-functional aspects, to craft technology interactions that truly enrich and satisfy users.

Each perspective contributes a facet to understanding users' interactions with technology, while sharing commonalities and arguments with the other perspectives.

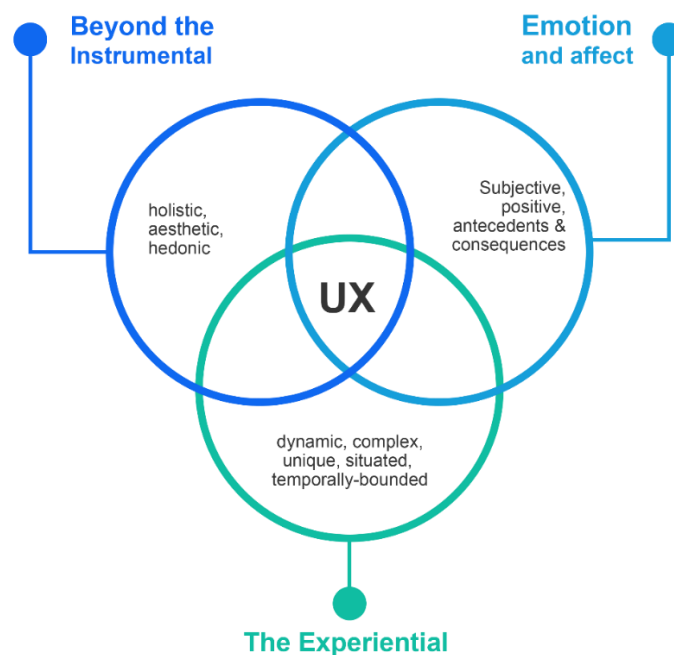


Figure 2.8: Facets of UX (Hassenzahl & Tractinsky, 2006)

2.7.8 Summary of UX frameworks

Collectively, these discussed UX frameworks and models contributed to a deeper and more comprehensive understanding of what constitutes a positive and satisfying UX. Table 2.3, titled “Comparison of UX frameworks: evaluating elements for enhanced UX”, provides a comprehensive overview of the discussed UX frameworks, elucidating their distinctive aspects and criteria for evaluating UX. Within this comparative analysis, key elements such as content, context, emotional reactions, aesthetics, usability and other critical attributes are explored, shedding light on the multifaceted dimensions that shape a user’s interaction with digital systems.

Table 2.3: Comparison of UX frameworks: evaluating elements for an enhanced UX (Author's construct)

Framework	Content	Context	Users	System properties/ functionalities	Emotional reactions	Aesthetics	Usefulness	Desirability	Accessibility	Value	Credibility	Usability	Findability	Branding	Relatedness	Popularity	Stimulation	Autonomy	Desirability	Integration	Sustainability	Security	
Venn Diagram	✓	✓	✓																				
CUE-Model		✓	✓	✓	✓	✓																	
Honeycomb							✓	✓	✓	✓	✓	✓	✓										
Measure UX					✓	✓	✓					✓			✓	✓	✓	✓					
Elements of UX	✓		✓	✓		✓																	
LMS Affective Model					✓																		
Optimised Honeycomb					✓		✓	✓	✓	✓	✓	✓	✓										

Recognising and acknowledging the important role of customer service in the context of educational technology, especially the LMS, the researcher aims to explore the potential of chatbots as a possible valuable tool to enhance the UX of an LMS in HEIs. Within this intricate relationship between LMS service provider and LMS end-user, a noticeable gap in the existing literature becomes more evident, emphasising the need for a comprehensive, user-centric approach that harmonises these elements. In the following sections, the researcher focuses on chatbots as a promising solution to the research problem.

2.8 WHAT IS A CHATBOT?

Chatbots are computer programs designed to replicate human conversation, predominantly utilised over the internet (Abdul-Kader & Woods, 2015; Følstad & Brandtzaeg, 2017; Shukla & Verma, 2019; Slater, 2022). Although the term “chatbots” is a relatively recent development, computer systems that engage in natural language interactions (text or voice-based) with users have been in existence since the 1960s (Natale, 2021). The technology behind chatbots has been referred to by various names, such as “chatterbot”, “talkbot”, “IM bot”, “dialog system”, “machine conversation system”, “virtual agent”, “interactive agent”, “conversational agent”, “pedagogical agent” and “dialogue system” (Savin-Baden, Thombs, & Bhakta, 2015; Shawar & Atwell, 2007; Tamayo et al., 2020).

The concept of chatbots as conversational agents was first developed in the 1950s by Alan Turing. Turing was intrigued by the idea of creating a computer program that could communicate with people without them realising that they were talking to an artificial entity (Adamopoulou & Moussiades, 2020). Since then, chatbots have come a long way. Basic chatbots emerged in the 1960s. The Massachusetts Institute of Technology created a chatbot called ELIZA in 1966 (Weizenbaum, 1966). This was followed by PARRY in 1972, Jabberwacky in 1988, TINYMUD in 1991, ALICE in 1995, SmartChild in 2001, Siri in 2010, Watson in 2011, Google Now in 2012, Alexa in 2014, Cortana in 2014, and finally, Google Assistant in 2016. Each of these chatbots represented a more advanced version compared to its predecessors. The emergence of the “second wave of AI” (Launchbury, 2023) has sparked renewed interest and commitment to chatbot technology. This wave has paved the way for systems that are

capable of human-like interactions (Gnewuch et al., 2017; Maedche, Gregor, Morana, & Feine, 2019; Pfeuffer et al., 2019).

The evolution of chatbots has been a captivating journey, commencing with Turing's initial curiosity, and culminating in the development of increasingly sophisticated conversational agents. With advancements in AI, chatbots have grown more proficient in simulating human interactions, igniting a heightened interest in their potential applications (Sharma, Goyal, & Malik, 2017). Chatbots not only excel at problem solving and providing accurate information; they also offer valuable data analytics and tools for companies. The emergence of advanced systems capable of engaging in interactions closely resembling human-like conversations has been witnessed (Gnewuch et al., 2017; Maedche et al., 2019; Pfeuffer et al., 2019). They have proven their effectiveness in resolving issues and delivering precise and accurate information to users (Shukla & Verma, 2019). Simultaneously, they provide significant data analytics capabilities and tools that hold substantial value for businesses.

In the realm of natural language conversations, chatbots have traditionally been designed with a script-based approach, relying on text-based interactions or scripted speech (Hettige & Karunananda, 2015; Ahmed & Singh, 2015; Veletsiano, Heller, Overmyer, & Procter, 2010; Weizenbaum, 1966). These conventional chatbots typically engage users through internet-based text exchanges or voice interactions (Xu et al., 2017). They possess the versatility to adapt to multiple languages (Rocio & Wesley, 2020) and their evolving capabilities can even infuse humour to enhance the overall learning experience (Xie, Liang, Zhou, & Jiang, 2024). Moreover, they can integrate with widely used platforms such as Facebook's instant messaging, catering to smartphone users (Merelo, et al., 2023).

However, it is essential to acknowledge the rapid advancement in generative AI and chatbot technology. Innovative solutions, such as ChatGPT, have expanded the horizons of chatbots by enabling them to comprehend and respond to a wide array of inputs, including text, audio and visual information. These next generation chatbots can read, see and hear, fundamentally transforming their potential (OpenAI, 2023). Moreover, looking ahead, the emergence of technologies like Google Gemini promises to redefine the landscape of chatbots (Perera & Lankathilake, 2023). The integration

of such advanced capabilities into chatbot design raises intriguing possibilities for the future of user interaction and support in the educational technology context.

2.8.1 Where are chatbots used?

Chaskopoulos et al. (2022) stated that it is worth mentioning the wide spectrum of chatbot usage, such as in education, health, e-commerce and productivity, to name a few. Chatbots find application in diverse contexts, serving various purposes, such as online customer service, messaging apps, social media platforms and the health domain (Giansanti, 2023; Sujata, Nikita, & Shubham, 2019). The integration of IS with public services has also gained prominence. Digital public services are described by various terms, including e-government service, e-service, public e-service, digital service, e-public service and website channel (Lindgren, Madsen, Hofmann, & Melin, 2019). With the advent of chatbots, government departments have explored their implementation to address citizen inquiries in certain areas of public service (Aoki, 2020). Apart from customer service, some chatbots are task-led, while others engage in more open-ended conversations with users (Haugeland, Følstad, Taylor, & Bjørkli, 2022). The versatility of chatbots allows for numerous other applications, with their use cases continually evolving alongside technological advancements.

A substantial body of research exists on chatbots' utilisation in customer service (Følstad & Skjuve, 2019), education (Okonkwo & Ade-Ibijola, 2021; Wollny et al., 2021), as well as user behaviour and UX with chatbots (Følstad & Brandtzaeg, 2017). Additionally, numerous studies have been conducted on the successful implementation of chatbots in various domains (Zhang, Følstad, & Bjørkli, 2023; Maroengsit et al., 2019), their role as system guides (Mendoza et al., 2022), to provide customer service (Santirattanaphakdi, 2018) and even in diagnosing diseases (Phiri & Munoriyarwa, 2023). While certain functions may remain consistent across different settings, it is essential to acknowledge the unique needs of HEI users and consider these factors when integrating chatbots into LMSs.

Various reviews of chatbot-related studies have been conducted across diverse research fields. For instance, Abd-Alrazaq et al. (2021) undertook a review of studies related to chatbots in mental health care. An increasing number of chatbots have recently been developed to offer mental health support (Pesonen, 2021; Viduani, Cosenza, Araújo, &

Kieling, 2023), engaging with users through spoken, written and visual languages. In most cases, mental health chatbots serve therapeutic and training purposes, for instance helping patients with autism enhance their social skills (Ail et al., 2020).

With a variety of tools available for creating and deploying chatbots (Deshpande & Chandak, 2022; Shilowaras & Jusoh, 2022), their integration into customer support systems offers businesses efficient and scalable solutions for engaging with their clientele. In the following section, we delve into the implications of chatbots in customer support contexts.

2.8.2 Chatbots and customer support

Customer service has always been key to service providers (Nicolescu & Tudorache, 2022). To provide efficient customer service, while meeting customers through their preferred communication channels, customer services are offered through a wide range of channels. These communication channels are divided into two categories: traditional media (print, broadcast and radio), and digital media (in particular, company web pages, social media, email and chat) (Fill & Jamieson, 2011). Customer service through chat is increasingly prioritised (Følstad et al., 2018), with service providers using the internet to engage with their prospects, customers and suppliers.

Automated customer service can refer to the use of technology to handle customer enquiries and requests without the need for human intervention. With the rising trend of interactive communication processes (Vlachopoulos & Makri, 2019), an innovative digital communication channel has emerged over the past decade: conversational bots, commonly known as chatbots (Wahde & Virgolin, 2022). Chatbots represent one of the technologies that can provide automated customer service for companies, a trend encountered in recent years (Nicolescu & Tudorache, 2022). This can be achieved using chatbots, which are computer programs designed to simulate conversation with human users or using AI and machine learning algorithms to analyse and respond to customer enquiries. Automated customer service can be used to handle a wide variety of customer inquiries, including questions about products or services, technical support and billing. Automation, such as using a chatbot, is beneficial for companies when associated with a positive customer experience, such as to improve efficiency and reduce the workload on customer support staff. It is,

however, important for designers and developers to ensure that the automated responses are accurate and helpful to customers, ensuring customer satisfaction (Sujata et al., 2019). Chatbots are therefore considered beneficial for the ease of both end-users and service providers due to their accessibility, flexibility and low cost (Adamopoulou & Moussiades, 2020; Przegalinska et al., 2019). For this reason, almost 25% of businesses today use or plan to incorporate chatbots soon (Fokina, 2023) to communicate with their users 24/7 (Adamopoulou & Moussiades, 2020; Wadhawan, Jain, & Galhotra, 2023). The findings imply that digital technology services, such as chatbots, can be combined with human service employees to satisfy digital users (Ashfaq et al., 2020). The purpose of using chatbots for customer service is to encourage the positive development of interaction with customers by making use of the chatbots' benefits (Grewal, Herhausen, Ludwig, & Ordenes, 2022).

Understanding how users interact with chatbots in customer service is crucial for unlocking the full potential of this technology (Haugeland et al., 2022). Researchers and practitioners emphasise the potential advantages of customer self-service, including increased time-efficiency, reduced costs and enhanced customer experience (Meuter, Bitner, Ostrom, & Brown, 2005). Communicating with customers through live chat interfaces has become an increasingly popular means to provide real-time customer support in many e-commerce settings. Today, call centre agents are often replaced by conversational software agents or chatbots, because human resources are costly (Gnewuch et al., 2017; Li & Zhang, 2023; Pfeuffer et al., 2019). However, cost- and time-saving opportunities have triggered the widespread implementation of chatbots. The global chatbot market has experienced substantial growth, with projections indicating it will reach \$1.23 billion by 2024, showcasing a compounded annual growth rate (CAGR) of 22.6% (Energias Market Research, 2018). However, an alternative study by Kaczorowska-Spychalska (2019) estimated the global chatbot market size to reach \$1.23 billion only by 2025.

Customers utilise chat services to obtain information, ranging from product specifics to seeking help with tasks like troubleshooting technical problems (Adam et al., 2021). The real-time characteristics of chat services have redefined customer support, evolving it into a dynamic, two-way communication channel that profoundly influences trust, satisfaction and the likelihood of repeat business (Følstad et al., 2018; Mero,

2018). Consequently, over the past decade, chat services have emerged as the preferred choice for seeking assistance (Adam et al., 2021; Pesonen, 2021).

The main benefit of chatbots for customer support is the opportunity for fast and accessible help and information, including the rapid response of chatbots (Følstad et al., 2018; Gnewuch, Morana, Adam, & Maedche, 2022). Factors like technology advancements, increasing global competition and other changes in the business environment contribute to corporations evaluating the way in which they develop and train their staff (Bezverhny et al., 2020; Wong & Lee, 2017). The goal of using a chatbot is to stimulate a dialogue that will ideally lead to a succession of purchases and complete engagement, ensuring continuous usage. In contrast to the benefits listed, users often experience challenges related to chatbots' interpretations of the questions posed, emphasising the chatbots' inability to interpret the user's request correctly. That is, the chatbot does not always understand what the customer intends to ask or does not allow for the answering of complex questions (Følstad et al., 2018). Another concern is security and privacy, which are important to users (Asenahabi et al., 2022). Privacy controls are important to ensure that sensitive information is made available to the intended recipient only (Turnbull, Chugh, and Luck, 2022). The design and dialogue of the chatbot should make it clear that security and privacy are also top priorities, and that this channel is just as secure as other online services (Nicolescu & Tudorache, 2022).

2.8.3 Chatbots in education

The integration of chatbots into the educational context represents a significant stride towards cultivating a personalised learning experience (Kuhail et al., 2023). In recent years, HEIs have witnessed a transformative shift in the delivery of education, owing to the application of chatbots (Cunningham-Nelson, Boles, Trouton, & Margerison, 2019; Wadhawan et al., 2023). These intelligent conversational agents play a pivotal role in reshaping the educational landscape. They have evolved from being just customer service models to assuming multifaceted roles as tutors and teaching assistants, much like the renowned example of Jill Watson (Alordiah, 2023).

This transformation has far-reaching implications, as chatbots not only support the learning process but infuse it with elements of interest, engagement and enjoyment,

as noted by Elsholz, Chamberlain, & Kruschwitz (2019). The literature indicates that HEIs can utilise chatbots to provide an interactive e-learning environment for students and sometimes make learning fun (Bii, 2013; Hobert et al., 2023; Kowalski, Pavlovska, & Goldstein, 2013). Students can now refresh their memory and reinforce their understanding by leveraging chatbots for knowledge recall and revision. The beauty of chatbots lies in their ability to provide timely and efficient assistance, stoking students' motivation and curiosity through entertainment, social interaction and relational factors (Jei, Al-Rahili, & Al-Farani, 2024).

Furthermore, chatbots can play the role of a teaching assistant throughout the learning process (Kuo & Chen, 2023; Leavitt et al., 2022). Chatbots have a wide range of functions in obtaining information, sharing knowledge and enhancing their own understanding with uninterrupted availability. If learning through a chatbot technology is properly designed, all the above can be realised. Instructors can also use the questions posed to the chatbot to collect data, modify a knowledge base and expand existing knowledge by using chatbot technology to look for questions and add additional answers to the chatbot's knowledge base. Most students prefer using chatbot technology because chatbots can give direct answers instead of links for further searching, like using search- and sort-based tools (Shawar & Atwell, 2007). Chatbots also assist in freeing up instructors from responding to repetitive questions; and thus, act as a virtual assistant or tutor for students (Karyotaki, Bakola, Drigas, & Skianis, 2022).

Whether undergoing training on campus, from home, or even while travelling, chatbots allow the user access to online courses on a variety of mobile devices, be it smartphones or tablets (Al-Sharhan et al., 2020). This caters to on-demand training, while improving learning reinforcements and overall training impact. The main advantage of a chatbot is that it is available 24/7 to provide the necessary support required by users (Rocio & Wesley, 2020; Wadhawan et al., 2023). Another advantage is the low cost in implementing a chatbot as there are often free versions available, and coding knowledge is not required to set up a basic model of the chatbot (Pérez-Soler, Juárez-Puerta, Guerra, & De Lara, 2021; Rocio & Wesley, 2020;).

In their systematic literature review, Kuhail et al. (2023) identified numerous challenges and limitations that hinder the effective use of educational chatbots. These

limitations encompass various aspects. The foremost limitation consistently observed across multiple studies pertains to an insufficient or inadequate training dataset for chatbots. This deficiency can hamper their ability to provide meaningful interactions and support (Kuhail et al., 2023). Some studies highlighted the challenge of limited student involvement in the chatbot design process. Involving students in the design stages can ensure that the chatbots align more closely with their needs and preferences. Except for a single study, most reviewed articles reported that educational chatbots were used for relatively brief periods. Longitudinal studies, like the one by Fryer et al. (2017), noted a decline in students' interest in communicating with chatbots over time. This suggested the need for sustained engagement strategies.

A study by Labadze, Grigolia, and Machaidze (2023) examined the role of AI chatbots in education and highlighted the benefits of using chatbots, such as immediate support, personalised learning and improved pedagogy. However, it also identified challenges and concerns, including reliability, accuracy and ethical considerations. The researchers state that chatbots have the potential to transform education but call for further research in this area. Jung et al. (2020) studied design principles for educational chatbots based on empirical studies on human-chatbot interaction. They examined the incorporation of chatbots in educational contexts. The study aimed to promote the development of educational chatbots by providing guidelines for their design.

Kuhail et al. (2023) conducted a systematic review of 36 papers on the use of chatbots in education. This study evaluated the design techniques and effectiveness of chatbots in engaging students, personalising learning activities and supporting instructors. The results show that chatbots are mainly used in computer science, language and general education fields, with teaching agents being the most common role. Results indicate improved learning and subjective satisfaction. The use of chatbots has been consistently on the rise because of their interactive learning approach and the flexibility they provide in freeing users from constraints related to time and location (Zhou, Gao, Li, & Shum, 2020). It is advised to consider the inclusion of chatbot functionality as part of the selection process when selecting an appropriate LMS for an institution (Aldahwan & Alsaeed, 2020). Chatbots are widely regarded as one of the trendiest learning technologies utilising AI (Vanichvasin, 2021). In recent years, numerous

studies have delved into the methods and effects of chatbot applications in education (Hwang & Chang, 2023). These studies have shed light on the benefits of incorporating chatbots in the education setting, such as providing users with a delightful learning experience through real-time interaction (Kuhail et al., 2023), fostering collaboration between students and instructors by improving communication skills (Kim, Cha, & Kim, 2019), and enhancing users' learning efficiency (Sandu & Gide, 2019).

Feedback is a critical element for effective learning in various contexts. It helps students identify gaps in their understanding and supports their knowledge and skill development. Chatbots often lack a comprehensive feedback mechanism, which hinders their effectiveness (Villegas-Ch, Arias-Naverrete, & Palacios-Pacheco, 2020). Feedback can significantly enhance the learning experience and students' ability to self-regulate their learning (Chou & Zou, 2020).

Usability stresses the importance of user interfaces that prioritise essential elements and avoid distracting users from pertinent information (Haugeland et al., 2022). In the context of educational chatbots, this implies that design should focus on the core interactions between chatbots and students. Qin, Huang, and Hew (2020) identified external links and pop-ups as potential distractions, highlighting the need for the thoughtful use of such elements.

As previously noted, there is a limited number of studies addressing the principles guiding the design of educational chatbots and their appropriate application based on specific roles. Jung et al. (2020) suggested that future research efforts should actively explore this area, necessitating investigations into suitable design principles aligned with the purpose and role of each chatbot.

2.8.4 The use of chatbots in LMS

In the realm of LMSs, chatbots serve distinct functions, ranging from chatbots that may supplement the role of the instructor (Chen et al., 2023), acting as a digital tutor (Hobert & Berens, 2023), to facilitating self-paced learning (Ifelebuegu, Kulume, & Cherukut, 2023). FAQ bots also play a pivotal role in addressing common queries and providing information. It is worth noting that chatbots, like OpenAI's ChatGPT, predominantly exist outside the LMS, whereas the proposed chatbot design principles

in this study serve an internal function, aiding LMS users in navigating and optimizing their experience within the platform.

Integrating chatbots into LMSs is considered a crucial step towards establishing a more systematic and user-friendly environment, enabling users to access real-time information through natural language interactions (Aldahwan & Alsaeed, 2020). Odhiambo et al. (2017) and Hwang and Chang (2023) underscore the importance of integrating chatbots into LMSs to enhance student-instructor interactions, thereby transforming the LMS into a comprehensive and interactive platform. Additionally, Ülker and Yilmaz (2016) highlighted the potential for budget-friendly solutions through the integration of chatbots into LMSs. This was supported by Kant et al. (2021), who reported that cost-effectiveness plays a pivotal role in the decision-making process for HEIs when selecting their preferred LMS platform.

Classifying chatbots based on tasks and roles in education, Bezverhny et al. (2020) emphasised their significance and provided methods for training within LMSs. Shukla and Verma (2019) highlighted the role of chatbots in enhancing user interaction and maximising LMS capabilities. Shilowaras and Jusoh (2022) successfully experimented with a Moodle LMS-integrated chatbot, demonstrating its efficacy in delivering academic support and fostering increased student interaction. Aldahwan and Alsaeed (2020) provided a comprehensive discussion on the use of AI in LMSs through a systematic literature review, addressing social learning, individual tutoring and collaborative learning support. The article outlined the benefits and challenges of implementing AI in LMSs, guiding factors for selecting an LMS, and offered an overview of the role of AI in enhancing educational content delivery.

Chang et al. (2023) proposed educational design principles for AI chatbots, aiming to integrate Zimmerman's self-regulated learning framework (Zimmerman & Moylan, 2009) into the concept of judgment of learning. Their approach provides design principles to effectively integrate AI into educational settings, including LMSs. The authors argue that chatbot designers should incorporate key pedagogical principles such as goal setting, planning, self-assessment and personalisation into chatbots to enhance their effectiveness. They propose that a well-designed chatbot could offer personalised feedback, foster reflection on learning processes, and be aligned with educational goals. The paper underscores the importance of aligning chatbots with

pedagogical functions to complement instruction, and discusses successful implementation, emphasising their potential benefits for personalised and interactive learning experiences. The authors advocate for chatbots to leverage trace data within LMSs, enabling them to provide personalised guidance based on elements such as time allocation, clicking patterns, deadline adherence and prompt initiation.

Ait Baha, El Hajji, Es-Saady, and Fadili (2023) contribute to the understanding of the impact of using an educational chatbot on student learning experiences. Their study reveals that employing chatbots significantly enhances students' learning experiences, allowing for self-paced study, time saving and increased motivation. The integration of chatbots into a smart classroom environment creates a supportive learning environment, ultimately improving academic outcomes.

Despite the multitude of studies exploring the intersection of chatbots and education, a notable gap exists in literature concerning well-defined guidelines and research-based design principles that are specifically tailored to chatbot integration within LMSs (Bezverhny et al., 2020; Chaskopoulos et al., 2022). While the use of LMSs alone enhances the effectiveness and efficiency of the educational process (Hasan, 2019; Onacan & Erturk, 2016), the integration of chatbots into LMSs has the potential to elevate this process to new heights, increasing users' involvement and making learning more dynamic (Bezverhny et al., 2020).

2.9 THE POTENTIAL OF CHATBOTS IN LMS

In contemplating the future of chatbot integration in LMSs, an LMS should provide specific features that resonate with its users. However, it is crucial to note that the function of chatbots is complementary to human instructors, focusing on addressing routine queries and facilitating a smoother learning process rather than replacing human support (Kooli, 2023).

Bezverhny et al. (2020) find that chatbots can address both simple organisational issues and more complex ones, evolving into fully developed or trained programs. They can send notifications, answer questions, collect feedback and analyse student activity to tailor individual learning paths with suitable materials. The study indicates that chatbots have the potential to collect feedback from almost 70% of users, twice as many as traditional methods.

Winkler and Söllner's (2018) study underscores the transformative potential of chatbots in changing how students learn and search for information, especially when implemented directly within tasks, such as in LMSs. Chatbots could address the challenge of providing individual student support, particularly in large-scale learning scenarios. The rise of chatbots in instant messengers has led to the messaging-as-an-interface user interaction paradigm. In future, chatbots may replace classic search engines and social networks, offering a more user-friendly and customisable experience (Bezverhny et al., 2020). As AI and natural language processing technologies improve, chatbots will likely become more sophisticated in understanding and responding to students' needs, leading to more effective and engaging learning experiences (Bezverhny et al., 2020).

Social chatbots provide emotional support to students, maintaining their interest in learning. Laeeq and Memon's (2019) study confirm that a social chatbot positively impacts students' motivation to complete learning tasks in an LMS. Lin's (2023) recent study introduces another type of chatbot, such as ChatGPT, that can offer emotional support to students facing challenges like stress, anxiety and feelings of isolation while utilising an LMS, specifically Moodle. The chatbot creates a secure and private platform for students to discuss their emotions openly, contributing to the cultivation of a nurturing and positive learning environment. Moreover, it can provide students with helpful resources and guidance, and connect them with further support when necessary.

Alshahrani (2023) asserts that one of the main potentials of using external chatbots, such as ChatGPT, in education is their ability to provide instant feedback and support to users. This, in turn, can improve engagement, motivation and retention rates among students. Furthermore, chatbots can be programmed to adapt to individual learning styles and preferences, thereby enhancing their educational effectiveness. As technology advances and more research is conducted in this field, one can expect to see even more innovative applications of chatbots in the future.

The effectiveness of customer service operations is intricately linked to UX (Goodman, 2009). Inadequate customer service is likely to result in dissatisfied users and diminished customer loyalty (Dixon, Freeman, & Toman, 2010). Service providers

have, for an extended period, aimed to minimise customer service costs by leveraging automation and self-service technologies (Chan & Petrikat, 2022).

The integration of chatbots into various systems is recognised as a promising strategy for enhancing UX (Abbas et al., 2022a; Følstad & Brandtzaeg; 2020). Ashfaq et al. (2020) proposed a strategy to improve overall UX quality, including customer support, by integrating human service personnel with digital technology services such as chatbots. This integration aims to optimise information and service quality, thereby positively impacting user satisfaction across different systems.

Examining factors that influence user satisfaction and the intention to continue using chatbot-based customer service, Ashfaq et al. (2020) identified that information quality and service quality play pivotal roles. Additionally, perceived usefulness, perceived enjoyment and perceived ease of use emerged as predictors of continuance intention. The study underscores the significance of the interaction with a human service employee in moderating the effects of perceived ease of use and perceived usefulness on satisfaction.

Extending this argument to the realm of LMSs, where effective communication is crucial (Demir et al., 2022), the potential role of chatbots in enhancing UX becomes evident. LMSs serve as centralised platforms that integrate components for content delivery, communication and assessment (Asunka, 2008; Mtebe, 2015). The need for effective communication within LMSs emphasises the value of well-designed chatbots that are tailored to the unique learning environment.

Recognised as a nascent feature in education, chatbots are acknowledged for their potential in enhancing interaction between users and data (Al-Abdullatif, Al-Dokhny, & Drwish, 2023). This interaction, facilitated through natural language generation and intelligent process automation, aligns with the objectives of LMS platforms. The AI features of chatbots, including their ability to curate relevant training material, analyse individual needs and provide personalised training experiences, align with the goals of LMSs in facilitating effective learning (Cardenas et al., 2022; Kuhail et al., 2023; Vanichvasin, 2021).

While research on the integration of chatbots in education is still evolving, literature suggested that chatbots have the potential to enhance the learning and teaching processes, especially within higher education (Al-Abdullatif et al., 2023). However, it is crucial to acknowledge the limitations and not overestimate the potential of chatbots, as they may not completely replace human agents, especially in nuanced areas of customer support (Nguyen, 2019).

The argument that chatbots can improve UX extends beyond general systems to the specific context of LMSs. Literature on chatbots' positive impact on UX in various systems provides a foundation for considering their potential to optimise the learning experience within LMSs, with the acknowledgment that the unique characteristics of education may require tailored approaches.

2.10 SUMMARY OF CHAPTER 2: AWARENESS OF THE PROBLEM

There is currently inadequate and insufficient customer support provided to LMS users (Section 2.4). This problem has been consistently observed in literature (Rana & Rana, 2020; Winter et al., 2021). The existing state of customer support often falls short of ensuring optimal use of LMSs.

In Section 2.6.1, Abbas et al. (2022a) emphasise the pivotal role of UX in elevating product usability and interactivity. Building on this, Section 2.6.3, as presented by Machado and Tao (2007), underscores the significance of enhanced UX in optimising the utilisation of LMSs. Furthermore, in Section 2.9.1, it is contended that the incorporation of chatbots can also contribute to enhancing the UX of systems, with examples provided by Følstad and Brandtzaeg (2020), Følstad and Skjuve (2019) and Nguyen (2019), particularly within the context of LMSs.

In addition, in Section 2.8.4. Shukla and Verma (2019) suggest that chatbots can overcome some of the challenges of customer support in LMSs. Literature also shows that the use of chatbots can improve the utilisation of LMSs (Murad et al., 2019; Villegas-Ch et al., 2020). Several researchers report on the inclusion of chatbots into LMSs (Bezverhny et al., 2020; Shilowaras & Jusoh, 2022). However, there is a lack of guidelines for the design of such chatbots, especially those informed by empirical evidence (Jung et al., 2020). None of these studies link the chatbots with improved UX.

The researcher justified the significance and relevance of the research problem to be addressed in this DSR study, ensuring that the study builds upon and extends the existing body of knowledge. It is suggested that guidelines in the form of design principles can only enhance the design of effective chatbots that will improve the UX of LMSs and consequently their use. In the next chapter, the concept of design principles and their application was considered.

CHAPTER 3: SUGGESTION

This chapter is organised into three main parts: design principles, applicable theories supporting the development of design principles and a final section suggesting a new set of design principles for LMSs.

Building upon insights gained in the preceding phase, Phase 1: Awareness of the problem, the suggested approach is derived from a literature review. This chapter delves into the concepts of design principles, design features and socio-technical systems, examining their relevance in the specific context of chatbots integrated within an LMS. In the field of IS, design principles emerge as critical elements that facilitate the accessibility and transferability of design knowledge (Venable, 2006). This knowledge involves discerning intricate relationships between problem and solution spaces, ensuring the reusability of technology across diverse scenarios, users and temporal contexts (Chandra Kruse et al., 2016; Möller et al., 2020). As explained by Gregor and Hevner (2013), design knowledge manifests in various forms, encompassing designed artefacts, design principles and design theories. Among these, design principles stand out as the primary vehicles for codifying design knowledge in IS research, encapsulating insights from specific design instances and elevating them to a more generalised level with broader applicability (Chandra Kruse & Seidel, 2017; Wache et al., 2022).

Additionally, the chapter presents literature on relevant theories appropriate for developing design principles, encompassing socio-technical systems theory, actor-network theory, structuration theory and activity theory. These theories offer valuable insights into the intricate interplay of social and technical dynamics in LMS settings, emphasising the significance of considering both aspects in the design and optimisation of LMSs. Activity theory supports the understanding of the diverse set of users involved in an LMS by highlighting the interaction between human and technological elements, the relationships between human and non-human actors within networks, the establishment and maintenance of social structures, and the role of tools and artefacts in human activity. Fundamentally, activity theory contributes to a holistic understanding and effective management of LMSs, addressing the needs of users, HEIs, and consequently, LMS service providers.

The subsequent Section 3.1 delves into the overarching concept of design principles, exploring their definitions and presenting illustrative examples. As the researcher narrows

the focus, the subsequent sections 3.2 and 3.3 delve into the specific design principles guiding the development of chatbots, further refining the exploration to examine the nuanced considerations within the educational context. The discussion shed light on how these principles serve as foundational propositions, assisting designers to translate requirements into effective design outcomes (Fu et al., 2015), while recognising the contextual constraints imposed by the intended usage environment and UX.

3.1 DESIGN PRINCIPLES

Reusability of design knowledge is paramount in DSR and is the cornerstone of its “practical ethos” (Iivari, Hansen, & Haj-Bolouri, 2018; Möller et al., 2020; Wache et al., 2022). Design principles are a well-used codification mechanism in IS research to capture knowledge gained in design instances and elevate the resulting design knowledge to a more abstract level (Chandra Kruse et al., 2015; Gregor, Chandra Kruse & Seidel, 2020). Design principles can therefore be described as guidelines that are used to inform and inspire the design of products or systems. These design principles can be based on various sources, such as aesthetic values, functional requirements or cultural values. They help designers make design decisions and ensure that the final product meets the desired goals and objectives.

An examination of published articles by Gregor et al. (2020), which outline IS design principles, revealed three distinct categories in the formulation of design principles: those that encapsulate users’ utilisation of artefacts, those that encapsulate artefact features, and those that describe both aspects, meaning that they focus on both artefact features and user activity (Table 3.1).

Table 3.1: Three categories of design principles with respect to user activity (Gregor et al., 2020)

1.	Design principles about user activity
These principles state what (human) users can do with an artefact (for example, what it should allow the user to do). <i>Example:</i> Build a window so that people can see through it.	
2.	Design principles about an artefact
These principles state the features an artefact should have (for example form, shape, architecture and functions). <i>Example:</i> Assemble a window with a frame and transparent material to fill the frame.	

3.	Design principles about user activity and an artefact
<p>These principles combine the characteristics of the two previous design principles and contain what users should be able to do with an artefact and the characteristics it should possess.</p> <p><i>Example:</i> Assemble a window with a frame and transparent material to fill the frame so that people can see through it.</p>	

Gregor et al.'s (2020) schema for designing design principles presented in Table 3.2 offers a comprehensive structure for articulating design principles, covering the fundamental elements of the principle itself, its context, the mechanisms involved and the underlying rationale. It emphasises the importance of considering the aim, implementer and user, along with the broader contextual factors that may influence the application of the design principle. Assigning a title or label to a principle helps enhance its memorability and effectively conveys its central concept, ensuring that the principle is communicated clearly and resonates with users (Gregor et al., 2020). Including subsidiary components suggested a recognition that complex systems may have nested design principles for specific elements. The rationale adds a critical layer of justification based on theory or empirical evidence.

Table 3.2: Components of the design principle schema (Gregor et al., 2020)

Design principle	
Structure	Components
For Implementer (I) to achieve or allow Aim (A) for User (U)	Implementer, aim and user
In Context (C)	Context (boundary conditions, implementation setting, further user characteristics)
Employ Mechanisms M1, M2, M3... involving Enactors E1, E2, E3,	Mechanisms (acts, activities, processes, form or architecture, manipulation of other artefacts) Subsidiary components or artefacts that can have their own design principles
Because of Rationale (R)	Rationale Theoretical or empirical justification for the design principle

Furthermore, Gregor et al. (2020) explain that the schema allows for the following:

- Considering the diverse roles of human actors and the usefulness of design principles
- Addressing the intricacies of IT-based artefacts by decomposition
- Distinguishing between different types of causation, such as deterministic and probabilistic

- Incorporating a range of mechanisms for achieving goals
- Optionally defining the justificatory knowledge that underlies the design principles

Various terms have been employed in literature to characterise the amalgamation of procedural and declarative knowledge resulting from design research, with “design principles” emerging as the most used term (Kali, 2008; Kim & Hannafin, 2008; Mishra & Koehler, 2006; Quintana, et al., 2018; Van den Akker, 1999). Bell, Hoadley, and Linn (2004, p. 83) define design principles as:

...an intermediate step between scientific findings, which must be generalised and replicable, and local experiences or examples that come up in practice. Because of the need to interpret design principles, they are not as readily falsifiable as scientific laws. The principles are generated inductively from prior examples of success and are subject to refinement over time as others try to adapt them to their own experiences. In this sense, they are falsifiable; if they do not yield purchase in the design process, they will be debated, altered, and eventually dropped.

Van den Akker (1999) proposes that the knowledge encapsulated in design principles can be effectively conveyed through heuristic statements. For instance, he suggested that one can communicate this knowledge by stating, “If you want to design intervention X (for the purpose/function Y in context Z), then you are best advised to give that intervention the characteristics A, B and C (substantive emphasis), and to do that via procedures K, L and M (procedural emphasis), because of arguments P, Q, and R” (Van den Akker, 1999, p. 9).

Design principles are employed to express design knowledge in an accessible manner, but there is significant variability and imprecision in how they are formulated across different perspectives (Gregor et al., 2020). This variability points to issues that need attention, including neglect of human actors, varying degrees of complexity, differing viewpoints on causality, the nature of mechanisms for achieving objectives, and the necessity for justificatory knowledge. Fu, Yang, and Wood’s (2016) literature review about design principles noted the following recurring themes evident in most design principle definitions:

- Design principles are not universally applicable, effective, or true; rather, they are generally applicable, effective and true within a specific context.
- Typically, design principles derive from experiences, examples or empirical evidence.

- The application of design principles may depend on the context or problem at hand, but they should possess a greater level of generalisability than a few isolated instances.
- Design principles serve as foundational elements for comprehension and the development of supporting methods, techniques and tools.

Table 3.3 furnishes a comprehensive overview of definitions and characteristics of design principles from various sources, illustrating the diverse range of views and classifications associated with them and the significance of design principles in various domains, such as education, IS and product design.

Table 3.3: Design principle definitions and characteristics

Source	Definitions or characteristics
Bell et al. (2004, p. 83)	<ul style="list-style-type: none"> • Design principles are "...an intermediate step between scientific findings, which must be generalised and replicable, and local experiences or examples that come up in practice. Because of the need to interpret design principles, they are not as readily falsifiable as scientific laws. The principles are generated inductively from prior examples of success and are subject to refinement over time as others try to adapt them to their own experiences. In this sense, they are falsifiable; if they do not yield purchase in the design process, they will be debated, altered, and eventually dropped".
Wache et al. (2022, p. 3)	<ul style="list-style-type: none"> • "An innate feature of design principles is that they are intended to be reused which implies one or more target users, who have considerable experience and are professionals who can make the 'leap' to applying these prescriptions". • "In IS research, a vital codification mechanism is given by design principles. They are used to describe the design of artefacts, and thus can be classified as a 'meta-artefact'". • "Design principles are a well-used codification mechanism in IS research to capture knowledge gained in design instances and elevate the resulting design knowledge to a more abstract level".
Nilsson & Eckert (2022, p. 9)	<ul style="list-style-type: none"> • "A design principle provides theoretically and empirically grounded guidelines upon which a teacher can develop interventions to meet a learning goal".
Van den Akker (1999)	<ul style="list-style-type: none"> • "Design principles are theoretically underpinned and empirically tested."
McAdams (2003, p. 347)	<ul style="list-style-type: none"> • A design principle is "a recommendation or suggestion for a course of action to help solve a design issue. Offline principles are applied at the design stage. Online principles are applied any time after this stage, including manufacturing and during use. Another characteristic that distinguishes between the principles is the level of detail that they change the design."
Perez, Linsey, Tsenn, & Glier (2011)	<ul style="list-style-type: none"> • "A set of guiding principles can enhance the efficiency of this process and lead to refinements in the initial product's design. These principles offer a framework for organising and synthesising the information acquired during the reverse engineering phase, enabling the generation of innovative concepts based on the specific attributes found in the reference products."

Source	Definitions or characteristics
Fu et al. (2016)	<ul style="list-style-type: none"> “Design principles are created to codify and formalise design knowledge so that innovative, archival practices may be communicated and used to advance design science and solve future design problems, especially the pinnacle, wicked, and grand-challenge problems that face the world and cross-cutting markets.” (p.1) “A design principle is “a fundamental rule or law, derived inductively from extensive experience and/or empirical evidence, which provides design process guidance to increase the chance of reaching a successful solution.” (p. 3)
Gregor et al. (2020, p. 1629)	<ul style="list-style-type: none"> “Design principles are theoretical abstractions that serve a purpose and have utility.”
Chandra Kruse et al. (2015, p. 4040)	<ul style="list-style-type: none"> A design principle is “a statement that prescribes what and how to build an artefact in order to achieve a predefined design goal”.

Table 3.4 presents a comprehensive overview of diverse perspectives on design principles, offering an exploration of various definitions and examples. Curated by Gregor et al. (2020), this table encapsulates a rich spectrum of design-related concepts, spanning technical norms to design propositions across fields like software design, business schema, education and IS. Each entry in Table 3.4 furnishes a clear definition and reference, which contributes to a more profound understanding of the multifaceted dimensions of design principles and their applications across domains.

Table 3.4: Analysis of existing formulations of design principles (Gregor et al., 2020)

Terminology	Field	Definition and reference
Technical norms	General	Niiniluoto’s technical norms are of the form “If you want A, and you believe that you are in a situation B, then you ought to do X” (Niiniluoto, 2014:13), citing Von Wright (1963).
Technological rule	General	To achieve A, do (act ₁ , act ₂ , ..., act _n) (Bunge, 1967). “Instructions to perform a finite set of actions, including manipulations of one or more artefacts, in a given order and with a given aim” (Bunge, 1967:132).
Design pattern	Software design	“A method of mapping human actions to software functions in a way that is intelligible to clients, designers, and engineers simultaneously” (Denning & Dargan, 1996:6).
Object-oriented design	Software design	“Descriptions of communicating objects and classes that are customised to solve a general design problem in a particular context” (Gamma, Helm, Johnson, & Vlissides, 1995:13).
Analysis pattern	Business schema	“Groups of concepts that represent a common construction in business schemes. It may be relevant to only one domain, or it may span many domains” (Fowler, 1997:8).
Design principle	Education	“If you want to design intervention X (for the purpose/function Y in context Z), then you are best advised to give that intervention the characteristics A, B, and C (substantive emphasis), and to do that via procedures K, L, and M (procedural emphasis), because of arguments P, Q, and R” (Van den Akker, 1999:9).

Terminology	Field	Definition and reference
Technological rule	Management	"If you want to achieve Y in situation Z, then something like action X will help" (Van Aken, 2004:227).
Technological knowledge	General	"Goal-directed series of considered actions, including manipulations of one or more artefacts" (Houkes & Vermaas, 2004:57).
Principles of form and function	Information systems	"The abstract 'blueprint' or architecture that describes an IS artefact, either product or method/intervention" (Gregor & Jones, 2007:322).
Computing principle	Computing	Computing principles for conduct have the purpose of enabling "good design by increasing understanding and reducing complexity" (Denning & Martell, 2015: xiv).
Design proposition	Management	"If you want to achieve Y in situation Z, then use the generic design X (or perform the action type X): $Y = X(Z)$ " (Van Aken, Chandrasekaran, & Halman, 2016:4).

Table 3.5, presented by Gregor et al. (2020), offers a comprehensive examination of diverse components within design principle formulations. This table stands as a valuable resource for dissecting the inherent components found in various formulations of design principles.

Table 3.5: Analysis of existing formulations of design principles (Gregor et al., 2020)

Component	Reference	Comment
Aim	All formulations refer to a "goal" (Bunge, 1998), "aim" (Von Wright, 1963), "purpose" (Gregor & Jones, 2007) or similar concept.	Some formulations refer to the aim being tied to an individual user (for example, if you want the aim), while others do not.
Context/ boundary condition	Not included by all: "in situation B" (Von Wright, 1963), "scope" (Gregor & Jones, 2007).	Aim and context are often closely linked. Heidegger (1993) gave an example of a silver chalice: Understanding the nature of the aim/requirement necessitates comprehending that the chalice is to be used in a religious ceremony, where an object of beauty holds significance (Heidegger, 1993).
Means of achieving aim	All formulations include some component of this type, but there are variations: "finite number of acts in a given order" (Bunge, 1998), "intervention or artefact" (Van Aken, 2004), "principles of form and function" (Gregor & Jones 2007), and "something like action X will help" (Van Aken, 2004:227).	There is variation between humans doing something (acting/intervening) and/or using an artefact, and variation in whether there is one or more in a series of actions/uses of artefacts. Human activity is not distinguished from an artefact's activity. Van Aken (2004) indicated some indeterminacy in that the means may be "something like" what is specified
Justificatory knowledge	Not included by all: "grounded on scientific knowledge" (Bunge, 1967), "justificatory knowledge" (Gregor & Jones, 2007).	Gregor & Jones (2007) defined "justificatory knowledge" as "the underlying knowledge or theory from the natural or social or design sciences that gives a basis and explanation for the design (kernel theories)."

3.2 DESIGN PRINCIPLES FOR CHATBOTS

Navigating the dynamic landscape of digital interactions, the design of chatbots has become a focal point in user engagement and experience. Design principles serve as guiding beacons in this realm, offering a structured approach to crafting chatbots that are not only functional, but also user-friendly. This section seeks to unveil the essential guidelines and considerations that underpin the development of these conversational interfaces.

Design principles for chatbots have been explored in various contexts, such as virtual team communication, enterprise applications and education. For example, a study by Benke (2020) emphasised the importance of transparency and human autonomy in the design of affective chatbots to retain trustworthiness. Another study focused on deriving design principles for educational chatbots from empirical studies on human-chatbot interaction (Jung et al., 2020). Additionally, a set of design principles to increase trust in chatbots has been proposed (Guo et al., 2022).

Bisser (2021) provided valuable insights into various aspects of chatbot design, which involved offering suggestions on essential considerations when crafting a generic chatbot. These considerations encompassed critical elements such as personality and branding, greeting and introduction, navigation, conversation flow, adaptive dialogues, UX, rich media attachments, and the use of cards as visual elements. By presenting these aspects, Bisser (2021) aimed to guide designers in creating generic chatbots that are not only functional, but also user-friendly and engaging.

Feine, Morana and Maedche (2020) discussed the design of interactive chatbot development systems. The authors propose three design principles grounded in the interactivity effects model to increase the engagement of domain experts in the chatbot development process. They conducted an online experiment to evaluate the effects of the proposed design and found that it significantly increased subjective and objective engagement, with perceived interactivity mediating these effects. The results provide prescriptive knowledge for designing interactive systems and contribute a novel artefact in the form of an interactive chatbot development system (Table 3.6.).

Table 3.6: Interactive chatbot design principles (Feine, Morana and Maedche, 2020)

Design principle (DP)	
DP1:	An interactive chatbot development system should enable users to directly manipulate the objects of interests to increase the engagement of domain experts.
DP2:	An interactive chatbot development system should contingently respond to any user input to increase the engagement of domain experts.
DP3:	An interactive chatbot development system should collect and visualise interaction metrics to increase the engagement of domain experts.

The study conducted by Feine, Morana and Maedche (2020) focused on investigating design principles for enterprise chatbots. The researchers undertook a comprehensive approach, gathering insights from prior studies to formulate a set of six design principles aimed to guide the development of effective and user-friendly enterprise chatbots, as outlined in Table 3.7.

Table 3.7: List of enterprise chatbot design principles (Feine, Adam, Benke, Maedche, and Benlian, 2020)

Design principle (DP)	Definition
DP1: Sociability	Provide the enterprise chatbot with the ability to adapt its conversation style to communicate in the user's preferred way.
DP2: Flexibility	Provide the enterprise chatbot with conversational flexibility to react to changing contexts, tasks and data requests.
DP3: Transparency	Provide the enterprise chatbot with functional transparency so that users can understand its functions and decisions.
DP4: Usability	Provide the enterprise chatbot with user-friendly, interactive capabilities to create an effective, efficient and satisfying communication experience.
DP5: Proactive communication	Provide the enterprise chatbot with the ability to use proactive messages to automatically notify users about changes.
DP6: Error handling	Provide the enterprise chatbot with the ability to handle errors of any kind and to save them for future improvements.

While the specific design principles discussed may vary based on the context of use, the abovementioned studies highlighted the significance of ethical considerations, usability, adaptability, transparency, user-friendliness, engagement and human-centred design in the development of chatbots for different applications. Like the research studies, many companies have put forth various sets of design principles for crafting conversations with the aim of enhancing the UX of chatbots. These include guidelines like Google's Conversation Design Guidelines, Amazon's Alexa Design

Guide, IBM's Conversation UX Principles, and Microsoft's Cortana Design Guidelines (Amershi et al., 2019; Guo et al., 2022).

3.3 DESIGN PRINCIPLES FOR CHATBOTS IN EDUCATION

In effectively integrating chatbots into an educational context, it becomes imperative to develop design principles that are tailored to the specific objectives of teaching and learning (Jung et al., 2020). Hence, for the development of educational chatbots, the formulation of adaptable design principles or models becomes important to meet pedagogical requirements. Several models, including CommonKADS (Cameron et al., 2018), have found application in educational settings.

Schmitt, Wambsganss, and Leimeister (2022) conducted research on the design and effectiveness of chatbots for information retrieval in education. They employed user interviews and developed the Hermine chatbot to evaluate the influence of user-centred design on enjoyment and trust. Hermine was compared to both a standard question-answering tool and a basic, non-design-driven conversational agent in an online lab experiment involving 41 participants. The study findings revealed that users interacting with Hermine performed significantly better in the information retrieval task compared to those interacting with alternative question-answering tools.

Ramandanis and Xinogalos (2023) conducted a systematic literature review on chatbot design for contemporary education. The review identified the increasing use of chatbots in education, emphasising benefits such as answering FAQ and assessing student progress. However, the review highlighted the challenges faced by instructors without programming knowledge and proposed the need for improved frameworks and guidelines for chatbot development.

Additionally, Ramandanis and Xinogalos (2023) suggested specific design principles for educational chatbots. The proposal included furnishing a tailored learning experience, assessing students, offering feedback on learning performance, integrating external technologies like augmented reality (Chuang, Lo, & Wu, 2023) and incorporating gamification elements (González-González, Muñoz-Cruz, Toledo-Delgado, & Nacimiento-García, 2023) to enhance the overall UX.

Jung et al. (2020) contributed by discussing design principles for educational chatbots based on empirical studies on human-chatbot interaction. They analysed the role of chatbots in educational settings and proposed design principles for chatbots functioning as tutors, evaluators, respondents, communicators and fellow students.

Table 3.8 outlines educational chatbot design principles derived from Jung et al. (2020), emphasising categories such as consistency, shortening, feedback, conversation, problem response and recognition.

Table 3.8: Educational chatbot design principles (Jung et al., 2020)

Category	Design principles
Consistency	Use the UI components of the chat platform uniformly
	Optimise for all users and usage
Shortening	Support a way to solve problems faster
	Provide button and button-type replies to help quick selection in limited circumstances
Feedback	Minimise the waiting process and make the user aware of the waiting state
	Provide notifications in appropriate situations
Conversation	Organise the flow of words and contexts naturally, and maintain the standards of dialogue
	Provide appropriate humour
Problem response	Provide opportunities to respond to failures
	Provide the ability to go back and cancel
Recognition	Let users know clearly how to use chatbot
	Make intuitive awareness of the chatbot's UI components

Literature on chatbot design principles offers valuable insights into creating effective chatbots across various domains, as mentioned in the previous sections. However, a noticeable gap exists concerning chatbots tailored for LMSs. Although studies highlight the benefits of integrating chatbots into LMSs, such as user engagement, multilingualism and AI integration (Bezverhny et al., 2020), there is a scarcity of LMS-specific design principles.

Shilowaras and Jusoh (2022) explored the integration of chatbots in an LMS but did not provide LMS-specific design principles. Similarly, works by researchers such as Bisser (2021), Chang et al. (2023), Chaskopoulos et al. (2022), and Feine, Adam, Benke, Maedche, and Benlian (2020) offer valuable insights, but lack exploration of the unique challenges and requirements associated with chatbots in an LMS

environment. Yang and Aurisicchio (2021) proposed chatbot design principles based on self-determination theory, focusing on user competence, autonomy and relatedness, but these principles are not adapted to the specific needs of LMS chatbots.

Chen et al. (2023) highlighted the potential of chatbots in facilitating student learning, but did not address LMS-specific nuances. In contrast, Chang et al. (2023) provided educational design principles for AI chatbots supporting self-regulated learning, but did not tailor these principles to LMS integration. This gap in LMS-specific design principles underscores the need for focused research efforts to bridge this gap and equip LMS service providers with tools and knowledge to enhance the UX within their platforms.

Table 3.9 summarises contributions and design principles from various studies, emphasising the gap in LMS-specific design principles within existing literature. While scholars have made valuable contributions to chatbot understanding and utilisation in various contexts, a significant void exists concerning design principles tailored to the integration of chatbots into LMSs. Further scientific investigation is crucial to establish evidence-based design principles for the comprehensive enhancement of chatbots within the LMS environment of HEIs.

Table 3.9: Summary of contributions, chatbot design principles and LMS integration aspects available in literature

Author(s) and year	Contribution	Chatbot design principles	LMS integration
Bezverhny et al. (2020)	Discusses the benefits of integrating chatbots into LMSs, improving UX with a focus on user engagement, multilingualism and AI integration. Increased effectiveness of the educational process, enhanced user involvement, multifunctional educational product, combining traditional and modern approaches, ongoing development of chatbots	No design principles	LMS-specific design principles

Author(s) and year	Contribution	Chatbot design principles	LMS integration
Bisser (2021)	Emphasises clear task definition, knowing the target audience, user-centred design, and proper conversation flow in chatbot development.	Personality and branding Greeting and introduction Navigation (menu) Conversation flow Adaptive dialogues Rich media attachments Cards as visual elements	No LMS-specific design principles
Chang et al. (2023)	Provides educational design principles for AI chatbots to support self-regulated learning, proposing design principles such as goal setting, feedback and personalisation.	Goal setting, feedback, personalisation.	Chatbot design principles not tailored to LMS integration
Chaskopoulos et al. (2022)	Explores personalisation and adaptability in LMS chatbot interactions, but omits design principles.	N/A	No LMS-specific design principles
Feine, Adam, Benke, Maedche, and Benlian (2020)	Insights into chatbot design principles in an enterprise chatbots context.	Sociability, flexibility, transparency, usability, proactive communication, error handling	No LMS-specific design principles
Guo et al. (2022)	Acknowledges the widespread use of chatbots, but highlights the lack of research on improving user trust.	Historical data access, repair opportunities, clear feedback, activity progress visibility, intelligent bot, visual security cues, considerate assistant, emotion analysis and empathy, encouragement and rewards, user decision rights	Not LMS-specific research
Krалеva et al. (2019)	Highlights challenges in selecting suitable LMS platforms, emphasising usability and software functionality.	Usability, software functionality	Not focused on chatbot design principles
Shilowaras & Jusoh (2022)	Develops an intelligent LMS chatbot, but does not consider or propose research-based design principles.	N/A	LMS chatbot development, but lacks design principles
Tamayo et al. (2020)	Discusses the development of EconBot for LMS student interaction and support, but does not provide design principles or LMS integration insights.	N/A	Demonstrates LMS chatbot development challenges
Tamrakar & Wani (2021)	Focuses on learning-assisted tools using chatbots, but does not provide design principles.	N/A	No LMS-specific design principles

Author(s) and year	Contribution	Chatbot design principles	LMS integration
Yang & Aurisicchio (2021)	Self-determination theory to understand users' needs in chatbot design, identifying competence, autonomy and relatedness as key factors. Ten guidelines are derived, emphasising the importance of informing users about chatbot capabilities, designing flexible and personalised conversations, and addressing concerns related to social features, intelligence, customisation, and data transparency.	Personalised overview, contextual introduction of new features, assessing performance with new features, understanding conversation flow, concise and informative responses, polite communication, explaining task incompleteness, learning from user history, customisable commands and responses, user data management options	No LMS-specific design principles
Amershi et al. (2019)	Guidelines across various interaction scenarios. Valuable tool for professionals working on AI-powered applications and features and for researchers interested in advancing human-AI interaction design principles	Clarify system functionality, measure system performance, time services based on context, display relevant information, align with social norms, address social biases, facilitate quick activation, enable easy termination, allow for prompt correction, define service boundaries, explain system actions, retain recent interactions, adapt to user behaviour, update and adapt prudently, encourage specific feedback, communicate user action consequences, offer global settings, inform users of updates	No LMS-specific design principles

While literature extensively discusses the benefits of integrating chatbots into education, it consistently falls short of providing design principles tailored specifically for the unique LMS environment as illustrated in Table 3.9. This gap implies that existing general and educational design principles may not adequately address the distinct needs and challenges posed by integrating chatbots into educational platforms like LMSs. The LMS environment in HEIs requires specialised considerations, such as personalised interactions, adaptability to educational contexts, and seamless integration with learning processes and external systems or platforms, which are not comprehensively covered by generic chatbot design principles. Therefore, there is a clear motivation for further scientific investigation to establish evidence-based design principles specifically catering to the comprehensive enhancement of chatbots within the LMS environment of HEIs.

3.4 DESIGN FEATURES

Design principles, as defined and discussed in Section 3.1, are overarching guidelines or rules that shape the design process, contributing to the overall effectiveness and quality of the resulting artefact. They can be characterised as prescriptive design knowledge that guides the design process (Baskerville et al., 2018; Gregor et al., 2020; Miller, Severanceb, & Krajcik, 2021). In the creation of IS, particularly decision support systems, design principles and design features play distinct, but complementary roles.

While design principles abstract from technical specifics, Meth, Mueller, and Maedche (2015:807) argue that design features close the last step of conceptualisation. They define design features as “specific ways to implement a design principle in an actual artefact”. Design features, as outlined by Meth et al. (2015), encompass the specific capabilities integrated into an artefact to align with and adhere to the underlying design principles. These features serve as the practical, functional aspects of a design. Glinz (2017) describes a design feature as a specific, well-defined attribute or characteristic of a system that adds value to stakeholders. It typically encompasses multiple requirements and serves as a means of high-level communication with stakeholders. Design features, as highlighted by Morana, Schacht, Scherp, and Maedche (2017), are specific features of a design artefact that are aimed at assisting individuals in decision making, problem solving and task execution within IS. Design features are concrete and non-negotiable, representing the tangible functionalities within a design. For instance, in the context of chatbots, a design feature might be the ability to provide real-time language translation or the integration of natural language processing for improved user interaction (Miller et al., 2021).

To illustrate, in the context of this study, the term “design feature” refers to a collection of functionalities that LMS chatbots can offer, aligning with design principles to enhance the educational experience. The research paper of Rietz, Benke, and Maedche (2019) examined the impact of anthropomorphic and functional chatbot design features on user acceptance in enterprise collaboration systems. The study focused on chatbots in the workplace, specifically in the popular collaboration platform, Slack.

The authors conducted a survey with professionals who interact with chatbots in their work environment. The results showed that anthropomorphic design features have a

significant effect on perceived usefulness, four times stronger than the effect of functional design features. Anthropomorphic design features in chatbot design refer to incorporating human-like attributes or characteristics into the appearance and behaviour of a chatbot, such as emotional tone in voice, human-like appearances and cultural awareness. The authors suggest that both researchers and practitioners should prioritise anthropomorphic design features in chatbot design and research. The paper provided insights for the trade-off decision between form and function in chatbot design.

Feine, Adam, Benke, Maedche, and Benlian (2020) explored design principles for enterprise chatbots as listed in Table 3.7. The design principles introduced in Table 3.7 are supplemented with associated design features in Table 3.10. Practitioners from an IT consulting company evaluated the importance of these design principles and design features using the analytic hierarchy process method to create importance rankings of the identified design principles and design features.

The results showed that usability and flexibility were ranked higher than socialness and human likeness. Overall, the findings provided valuable insights for the design of enterprise chatbots, although not pertinently related to an LMS chatbot.

Table 3.10: Design features for enterprise chatbots (Feine, Adam, Benke, Maedche, and Benlian, 2020)

Design principle (DP)	Design feature (DF)	Description
DP1: Sociability	DF1	The enterprise chatbot should be able to communicate in either a person-oriented or a fact-oriented manner based on the user's preference.
	DF2	The enterprise chatbot should develop a user model that stores the user's preferred communication style.
	DF3	The enterprise chatbot should exhibit social cues that can be adjusted by the users.
	DF4	The enterprise chatbot should adapt its degree of human likeness in its communication style based on the user's preferences.
	DF5	The enterprise chatbot should be able to change the number of proactive messages based on the user's preferences.
DP2: Flexibility	DF6	The enterprise chatbot should have access to business data that is necessary to answer related requests.
	DF7	The enterprise chatbot should be able to retrieve stored knowledge from previous conversations.
	DF8	The enterprise chatbot should be able to change the length and segmentation of a message based on the situational context.

Design principle (DP)	Design feature (DF)	Description
	DF9	The enterprise chatbot should be able to use clarification and confirmation messages.

DP3: Transparency	DF10	The enterprise chatbot should be able to present its functionalities at the beginning of and during a conversation.
	DF11	The enterprise chatbot should be able to display the current conversation context and its capabilities.
	DF12	The enterprise chatbot should be able to explain its functions to the user in a tutorial.
	DF13	The enterprise chatbot should use social cues (for example, appearance or language style) that are appropriate to the context and do not over- or underplay its abilities.
	DF14	The enterprise chatbot should not pretend to be a real human being.
	DF15	The enterprise chatbot should be able to explain its functions and capabilities, as well as answer questions about them.
DP4: Usability	DF16	The enterprise chatbot should communicate in a human-like interaction style.
	DF17	The enterprise chatbot should engage in one-to-one communication, as well as team communication.
	DF18	The enterprise chatbot should provide the functionalities required by employees at different hierarchy levels.
	DF19	The enterprise chatbot should be able to communicate with the user about several topics at the same time, while understanding to which active conversation the user input belongs.
	DF20	The enterprise chatbot should be able to provide visual input and output elements like buttons or maps.
	DF21	The enterprise chatbot should animate users to use the correct syntax for mentioning others in a team chat or should have the ability to understand this automatically.
DP5: Proactive communication	DF22	The enterprise chatbot should be able to adjust the frequency and type of interruption with a proactive message to avoid disturbing the user.
	DF23	The enterprise chatbot should be able to reduce proactive messages based on decreasing user responses or based on the user's status in a collaboration tool.
DP6: Error handling	DF24	The enterprise chatbot should be able to clarify requests that it did not recognise.
	DF25	The enterprise chatbot should be able to fail gracefully and apply mitigation strategies when an error occurs.
	DF26	The enterprise chatbot should be able to save and categorise errors for future improvement.

Having delved into the significance of design principles in the realm of DSR, where they

serve as guiding elements to capture and elevate design knowledge, the subsequent Section 3.5 transitioned to explore different theories. Specifically, the focus shifted towards understanding the LMS as a socio-technical system. Design principles, as discussed earlier, act as crucial guidelines in the creation of functional and user-friendly conversational interfaces, particularly in the context of chatbot design. As the researcher navigates through diverse theories in sections 3.6.1 to 3.6.4, the study explores how an LMS operates as a socio-technical system, intricately blending technological components with social and organisational elements. Positioned as a digital infrastructure within the educational realm, an LMS integrates software, hardware and human interactions, forming a cohesive framework. Recognising and comprehending the LMS as a socio-technical system is imperative for the subsequent discussions on designing, implementing and optimising these platforms to effectively meet the varied needs of modern educational settings and users.

3.5 SOCIO-TECHNICAL SYSTEMS

A socio-technical system is an intricate combination of social and technical components, and the interactions between them, designed to meet the needs of people, while also being technically feasible and efficient (Alter, 2021). These systems can be found in a variety of contexts, from work organisations and transportation systems to online communities. The social components of a socio-technical system include the people who use the system, the organisations that own and operate it, and the culture and values of those organisations. The technical components, on the other hand, encompass the hardware, software and networks that make up the system. For a socio-technical system to be effective, it is essential to consider both the social and technical aspects, and how they interact with each other (Sony & Naik, 2020).

The concept of a socio-technical system was developed in the 1950s by researchers in the field of organisational behaviour, who sought to understand how to design work systems that were both effective and satisfying for employees (Jones, 2014). They were interested in exploring the intertwined relationship between humans and machines, with the aim of creating a program that would shape both the technical and social conditions of work in a way that would allow efficiency and humanity to co-exist (Brady & Naikar, 2022). IS research is concerned with both the social and technical

aspects of IS, covering a broad range of topics and applying a variety of research methods (Huysmans & De Bruyn, 2013). In some areas, a holistic theoretical framework is needed to provide a basis for research into complex socio-technical phenomena. In many cases, socio-technical systems act as “systems of systems” (Baxter & Sommerville, 2011), connecting multiple social systems and generating and processing information for repetitive or tedious tasks.

Utilising theories as both analytical tools and objects of validation and development has been a common practice in IS research (Larsen & Eargle, 2022). In the 1990s, there was a resurgence of research into the social dimensions of IS (Jones, 2014). Within a socio-technical system, one will find humans, software, hardware, an organisation and any number of other systems working together as a cohesive unit (Oosthuizen & Van T' Wout, 2019). An LMS is a complex system (Yulianandra et al., 2017), and arguably the most intricate system at an HEI, since many systems are in a perpetual state of flux, influenced by the various components of a socio-technical system that shape their design and development. As an LMS is a socio-technical system (Millard & Essex, 2006; Turnbull et al., 2022), the following section explored different theories that address both the social and technical aspects of IS.

3.6 APPLICABLE THEORIES SUPPORTING THE DEVELOPMENT OF THE DESIGN PRINCIPLES

In the following sections, the researcher explored a range of influential theoretical frameworks that provide essential insights into the development of design principles for chatbots integrated within LMS. Each theory offers a unique perspective on the socio-technical dynamics at play in LMS settings. Socio-technical systems (STS) theory underscores the harmonious interplay between human and technological elements, optimising organisational performance (Selbst et al., 2019). Actor-network theory (ANT) delves into the intricate relationships between human and non-human actors within dynamic networks, shaping the socio-technical nature of LMSs (Booth et al., 2016; Walsham, 1997). Structuration theory (ST) offers valuable insights into how social structures and practices are created and maintained through the interplay of human actions and systems (Giddens, 1984). Finally, activity theory provides a comprehensive framework for understanding how chatbots can support the dynamic

processes of teaching and learning within an LMS, emphasising the interconnectedness of human activity and technological tools.

3.6.1 Socio-technical Systems Theory

Socio-technical systems theory is a framework that examines the interplay between the social and technical aspects of organisations, exploring how they can harmoniously work together to achieve system success (Selbst et al., 2019). Socio-technical systems theory emphasises that the success of systems relies on considering and optimising both social and technical elements. It is widely used in fields such as organisational behaviour, IS and human-computer interaction. Socio-technical systems theory focuses on the interaction between human resources, technology, and social and technical systems in the workplace (Selbst et al., 2019). It includes human elements like operators, users and stakeholders, as well as subsystems and automated devices. Socio-technical systems theory aims to optimise the combination of human and technical aspects in organisational structures and processes. It prioritises the adaptation of systems to human needs and social environment requirements, emphasising the design of people-oriented systems over computer-oriented people. This holistic approach considers systems, ensuring harmony and efficiency in the work environment (Hoffman, Klein, & Laughery, 2002; Rachmadtullah, Pramujiono, Setiawan, & Srinarwati, 2022; Sadok & Bednar, 2017).

The philosophy of the STS theory design has inspired several researchers within the field of IS. Enid Mumford (2006), for example, is by many accounts considered to be the most influential researcher to initiate socio-technical research within IS (Alter, 2021). In one of her last publications (Mumford, 2006:45), she describes the essence of the socio-technical approach as follows:

Throughout its history, practitioners have always tried to achieve its two most important values: the need to humanise work through the redesign of jobs and democracy at work. In order to realise these goals, the objective of sociotechnical design has always been ‘the joint optimisation of the social and technical systems. Human needs must not be forgotten when technical systems are introduced. The social and the technical should, whenever possible, be given equal weight [...] The most important thing that socio-technical design can contribute is its value

system [...] This tells us that although technology and organisational structures may change, the rights and needs of the employee must be given as high a priority as those of the non-human parts of the system.

The LMS is regarded as a socio-technical system that involves structure, technology, actors and task. Four overarching categories collectively constitute LMS usage: the individuals engaging with the system (actors), the organisational framework and external factors (structure), the knowledge and skills being disseminated (task), and the technological components such as the LMS, chatbots and associated tools (technology).

By recognising and addressing both the social and technical issues, an LMS can be effectively managed to achieve its full potential. This balanced approach ensures that the system operates harmoniously and efficiently, meeting the needs of its users and the organisation.

3.6.2 Actor-network Theory

Actor-network theory is a theoretical and methodological approach to studying science, technology and society (Walsham, 1997). It views actors as both human and non-human entities interacting within networks, emphasising the importance of studying the relationships between actors and networks (Thumlert, De Castell, & Jenson, 2015). Actor-network theory's relational ontology suggested that the capacity for action exists within connections between entities (Booth et al., 2016). It has been influential in various fields, including sociology, anthropology and media studies, and has been applied to phenomena like scientific research and the internet (Walsham, 1997). Actor-network theory views society, organisations, agents and machines as effects generated through actor-network interactions (Callon & Law, 1997). An LMS can be seen as a socio-technical network, combining technology, applications, materials, students, instructors and intermediaries with participants that are mutually interactive and encouraging (Booth et al., 2016; Thumlert et al., 2015).

3.6.3 Structuration Theory

Structuration theory, developed by sociologist Anthony Giddens, offers insight into how social structures and practices are created, reproduced and transformed (Giddens, 1984). It integrates structuralism and functionalism, emphasising social

structures as the rules and resources guiding individuals' actions (Giddens, 1984). Giddens posits that social structures and practices are mutually constituted, meaning they shape and are shaped by each other (Giddens, 1984). The “division of structure and action” concept in structuration theory highlights the creation of social structures through agent actions, where structure both constrains and enables action. Structuration asserts that structure is activity-dependent, manifested through the rules and resources that agents use in their interactions (Giddens, 1984). Giddens' framework posits the simultaneous creation and being created by society (Giddens, 1984). This theory offers a unique perspective on how social systems are formed and maintained through the actions of agents (Giddens, 1984).

3.6.4 Activity Theory

Activity theory is a social-psychological theory that has its roots in the work of the renowned Russian psychologist Vygotsky during the first half of the 20th century. Vygotsky's groundbreaking insight into the nature of consciousness was that it is fundamentally subjective and is shaped by the individual's unique social and cultural experiences (Vygotsky & Cole, 1978). Moreover, Vygotsky viewed human activity as distinct from that of non-human entities in that those tools, most notably language, mediate it. Leont'ev (1981) and Engeström (1987) built upon Vygotsky's foundational ideas, extending and refining activity theory to address the complexities of human activity and learning within social and cultural contexts. These scholars have significantly enriched the theoretical framework and its application in various fields, including education, psychology and organisational studies.

Leont'ev (1981) constructed a comprehensive conceptual framework for a theory of human activity. According to Leont'ev (1981), an activity is a complex system that has its own structure, internal transitions and transformations, and development. The process of explicitly stating tasks, assigning tasks, and converting rules and goals into different actions is termed “transformation”. This occurs when all the facilitating elements are favourable, allowing activities to be effectively executed, resulting in the achievement of the desired “outcome”.

An activity consists of a series of actions that are designed to achieve specific objectives and operations. These actions are clearly outlined in the IS domain and can be found in

both routines and cognitive or behavioural processes, which are a ubiquitous component of activities involving IS (Hashim & Jones, 2007). Engeström, Mietinen, & Punamäki (1999) and Hashim & Jones (2007) explain that activity theory is a well-established and extensively studied theoretical framework that is used to analyse and comprehend human interaction using tools and artefacts. Activity theory is also a powerful and illuminating descriptive tool, rather than a predictive theory (Nardi, 1996).

Activity theory proposes that any human activity can be described and analysed, and that all activities are performed to meet a purpose, have a structure, happen under certain conditions, and are mediated by tools, instruments or artefacts. Activity theory regards individual human activities as units for analysis (Kaptelinin & Nardi, 2006), and is concerned with the intentional use of tools or mediating artefacts by human beings to accomplish things (Cole, 1999). Activities are not regarded as fixed or permanent, and may change depending on the change in the social matrix (composed of people and artefacts) in which they are undertaken (Nardi, 1996). Cole and Engeström (1993) mention that activity theory is grounded in social-historical theories and draws heavily on Vygotsky's concept of mediation (Gedera, 2014). Vygotsky and Cole (1978) introduced the concept of mediated action as seen in the triangle of mediated action in Figure 3.1. Hasan and Kazlauskas (2014) further explain that activity theory describes who is doing what, why and how. Hardman (2005) adds that activity theory includes a group of people, or a community, who share a common goal that changes the subject under study.

Different stakeholders within activity theory collaborate as a team to reach their desired outcome. According to Lim and Hang (2003), the relationship between activities and activity systems is not always stable, and potential conflicts between, for example, tools and the division of labour can arise. However, these tensions can be beneficial and a valuable source for further development (Uden, 2007). Conflict may emerge when there is a clash between the processes in the activity system. Nevertheless, activity theory provides a comprehensive and contextual approach to discovery, which was utilised to back this qualitative study. Activity theory is often depicted graphically as interconnected triangles (Engeström, 1987). For instance, when using an LMS with tools that enable users to explore, the new roles of the user could be distinct from what was anticipated. These components are interconnected in a constantly changing environment. Therefore, tensions between the components exist and must be addressed. These

tensions can be the consequence of opposition to achieving the set goals. Nevertheless, this activity system is not in isolation, and interacts with, as well as exists within, other activity systems. As such, all participants need to be identified, and the impact of activity systems on one another acknowledged (Lim & Hang, 2003).

In this study, the researcher adopted a comprehensive perspective by applying activity theory as the guiding framework to examine an LMS and the individuals utilising it. Activity theory served a dual purpose in this study, functioning both as a descriptive lens and an analytical tool. By doing so, it enabled the researcher to not only describe the interactions within the LMS, but also to investigate the underlying dynamics and factors shaping these interactions.

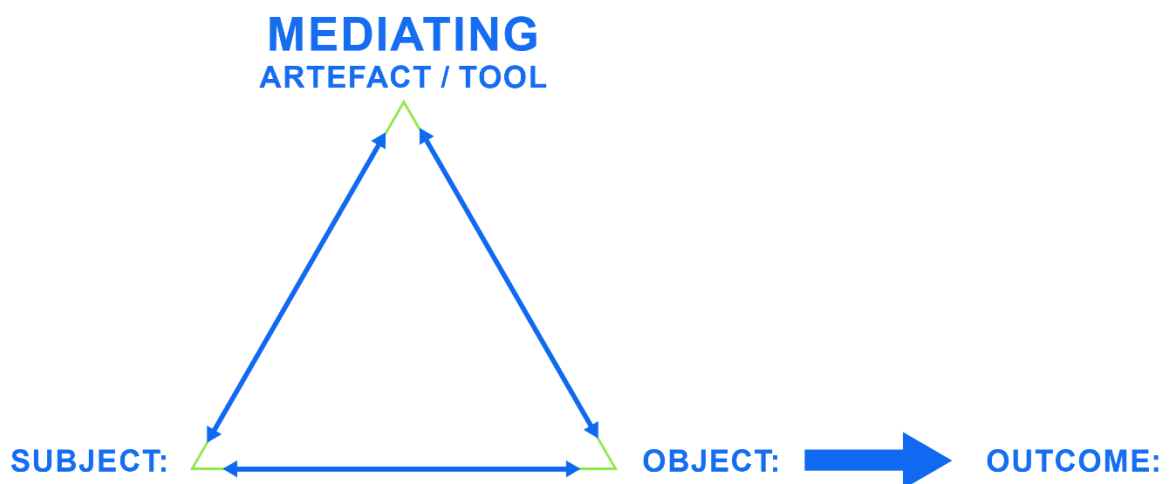


Figure 3.1: Vygotsky and Cole's (1978) triangle of mediated action

Vygotsky and Cole's (1978) triangle of mediated action (Figure 3.1) have three nodes: the human *subject*, who uses *mediating artefacts or tools* to achieve an *object*.

The object is the motivation for the activity. Its goal is the intent to understand the unity of consciousness and activity, as well as to better understand the infiltration of the individual, other people and artefacts in everyday activities. Mediating an artefact or artefacts, sometimes called tools, instruments or technologies, in turn mediates the activity. The process of the subject (the person carrying out the activity) working towards an object using an artefact brings about an outcome. It is possible for the outcome to be unintended and even undesired, and it may be qualitatively different from the object that was set out to be achieved (McAvinia, 2016; Waycott, Jones, & Scanlon, 2005).

Engeström (1987) upgraded the activity theory from the individual activity level to a collective activity level. He did this with a conceptual model of an “activity system” to apply activity theory to educational settings, organisational development and other fields (Engeström, 1987). Engeström (1987) expanded Vygotsky’s triangle of mediated action, and added three elements to the original triangle, thus creating an activity system. This included collective activity or community, rules and the division of labour that denote the situated social context within which collective activities are carried out (Uden, 2007) (Figure 3.2).

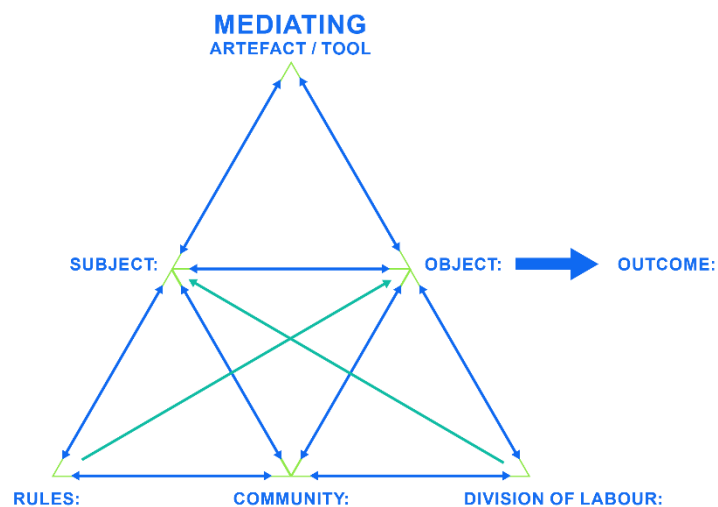


Figure 3.2: Engeström’s (1987) expansion of Vygotsky’s mediational triangle

Rules control the actions and interactions that take place during an activity. Alternatively, a community consists of one or more people who share the same goal (object with the subject); and the division of labour informs how tasks are divided horizontally among members of the community. This includes the subtler, but crucially important vertical divisions and allocations of status and power (Uden, 2007).

3.7 CHOSEN THEORY SUPPORTING THE DEVELOPMENT OF THE DESIGN PRINCIPLES – ACTIVITY THEORY

The set of design principles were developed as part of the DSR process, conceptually informed by activity theory and STS theory. While both theories have influenced the development of design principles, activity theory was the primary influence for the data analysis that informed the design principles in this study. For this study, the researcher considered other socio-technical theories, such as actor-network theory and

structuration theory. However, the decision was made to use activity theory due to its explanatory, analytical, and interpretive power. Activity theory is a promising theoretical framework for the study of tensions in an activity system, in the case of this study, to examine its application in LMSs (Karasavvidis, 2009). Initially developed by Leont'ev (1972), it provides an indispensable theoretical tool to understand tensions, conflicts, contradictions, inconsistencies and friction both between and within the components of an activity system (Engeström, 1987; Engeström et al., 1999).

One of the central objectives of this study was to address SQ5: “Drawing from the principles of activity theory, how do various user groups interact with an LMS?” To address this question, the researcher applied the conceptual framework provided by activity theory to formulate a systematic approach to understand and interpret the interactions within the LMS. In essence, activity theory provided the theoretical foundation to view these interactions as activities, allowing the researcher to explore them as purposeful actions and practices carried out by distinct user groups.

By adopting this activity-based perspective, the researcher aimed to gain a more nuanced understanding of how different user groups engaged with the LMS. This entailed examining not only the surface-level actions, but also the motivations, goals and contextual factors that influence these interactions. Therefore, using activity theory enabled the researcher to go beyond mere observation and description, and assisted in uncovering the underlying structures and processes that shape the user-LMS interactions.

Activity theory was used in the initial stages of the study to comprehensively outline, visually represent and conceptualise the various users of the LMS and its associated activities within a broader “activity system”. This helped to show how different users interact with the LMS and the role that a chatbot might play in enhancing its activities. This conceptualisation served as a solid foundation upon which the design and development of the LMS chatbot design principles can be built.

Activity theory provides a lens through which one can analyse complex systems of human activities. By adopting this approach, the researcher was able to effectively map the interactions, goals and roles of different users (students, instructors and administrators) within the larger context of the LMS environment. This information has

proven invaluable in facilitating crucial decision-making processes in the identification of the design principles by offering a clear understanding of users' needs, goals and the specific environment in which they function.

The conceptualisation of an activity system and the configuration of an established human practice involve the consideration of specific components. In this context, it is posited that activity theory served as a valuable tool when examining any given activity system, such as an HEI, which was undergoing a significant innovation, like the introduction of an LMS chatbot. Activity theory offers a robust framework to analyse the intricate interplay between practical activities and their organisational contexts. Importantly, it underscores the inseparability of an activity from the environment or context in which it unfolds. Consequently, activity theory empowers researchers to conceptualise the effectiveness of innovations, determine obstacles to change, identify the levels at which these weaknesses manifest, and explain the factors that contribute to or hinder the successful implementation of an LMS chatbot.

Anticipating the analysis, it becomes evident that, within the activity system, conflicts, inconsistencies, dilemmas and unforeseen developments are likely to emerge. These may manifest as both innovations that reshape the practice and aspects that deviate from anticipated outcomes. Activity theory provides a lens through which these complexities can be explored and understood, offering insights into the dynamics of change and adaptation within the activity system.

Essentially, activity theory provided the researcher with a tool to study the reconfiguration of practice because of the introduction of the innovation. The researcher was able to examine and explain patterns of activity within an activity system, thinking about interactions, interpretations, contractions and changes, reflecting on what has happened, what is currently happening, and what may happen in the future. What is more, the knowledge gained from this study can be further applied to the improvement of the practice.

3.8 THE LMS ACTIVITY SYSTEM

In the field of DSR, the suggestion phase is significant as it involves the generation of innovative and practical suggestions that address the identified problem, laying the

groundwork for the subsequent DSR processes. To delve deeper into this phase, it becomes imperative to draw upon the principles of activity theory, a framework that sheds light on the intricate dynamics of human interactions within complex systems. In this context, the aim of SQ4 is to explore the engagement and interaction patterns of various user groups within an LMS. By analysing the interplay between users and the LMS through the lens of activity theory, the researcher acquired valuable insights into the dynamics, challenges and opportunities that shape the development and utilisation of LMS platforms.

This section explains the complex connections of an LMS as an activity system, focusing on the relationship between end-users and the LMS, discussing their different roles, objectives and interactions during this important development phase.

The subject of an activity system is the individual or group whose viewpoint is adopted in the analysis (Engeström, 1990). HEIs include the perspectives of individuals such as instructors, students, or the administration. Engeström's (1987) extended version of activity theory was used for this study. It comprises the interrelated components that achieve a common outcome or objective: mediating tools, object, subject, rules, community, and division of labour, as illustrated in Figure 3.2.

Tools refer to the “how” of the activity system (Wuori, 2009). They enable us to “get the job done” and mediate the object of activity. The object is the fundamental “why” of the activity system (Wuori, 2009), the focus of the activity, and what gives the activity its determined direction (Leont’ev, 1978). It is considered the fundamental reason behind various behaviours of individuals, groups, or organisations (Kaptelinin, 2005). The community refers to those “who share the same object of activity” (Engeström, 2005), such as the individuals in a classroom, when considering a traditional setting. The division of labour refers to the division of tasks, roles, power, and status among members of the community (Kuutti, 1996). It refers to the role played by individuals, the power they hold and the tasks for which they are responsible (Bellamy, 1996). In relation to technology, students’ tool use affects the control and independence or lack thereof in their learning, and the degree to which students self-regulate their learning because of using the available tools, such as the internet and other technologies. Rules are “explicit and implicit regulations” (Engeström, 1990) or “customs, guidelines,

and standards” (Worthen & Berry, 2006). They may simultaneously constrain and guide activity (Jonassen, 2002).

The LMS plays a crucial role in HEIs, offering a multitude of functionalities. The potential subjects within an LMS’s activity systems have been identified in literature, and discussed in Section 3.6.4, as the administrator, instructor and student (Agaçi, 2017). In this regard, Table 3.11 outlines the allocation of responsibilities among these users, which are further elaborated upon in the subsequent paragraphs. By examining the roles of the administrator, instructor and student within an LMS, one can gain a comprehensive understanding of their respective contributions and functions.

Table 3.11: Functions of the three actors of an activity system, adapted from Agaçi, 2017

Administrator	Instructor	Student
Login (registration) (Surameery & Shakor, 2021)	Login (registration)	Login (registration)
Administer course registration (Surameery & Shakor, 2021)	Enrol students	Enrol courses (Anand & Eswaran, 2018; Galko, Poruban, & Senko, 2018)
Add courses (Surameery & Shakor, 2021)	View, select, rename courses	View, select courses
Track LMS user registration/access (Steindal et al., 2021)	Upload resources (Remenar, Jovović, & Peraković, 2010)	Download resources, watch videos
Manage the whole system (Teachfloor, 2023)	Post forums, chats, wikis, blogs, social networking (Remenar et al., 2010)	Participate in forums or chats
System configuration (Wahlstedt, 2006)	Assessments: Post quizzes, tests and assignments. Download assignments. Grade tests and assignments	Take quizzes or tests, and take note of assignments or announcements
		Upload assignments
		Evaluation or grade the courses
	Curriculum planning	Socialise with the content (Makumane, 2023)
	Manage reports’ generation, trace log files (Park & Jo, 2017)	
Provide course scheduling/administration (Anand & Eswaran, 2018)		

The efficient functioning of an LMS relies on a well-organised division of responsibilities among its key stakeholders: administrators, instructors and students. As explained in Table 3.11, these actors assume distinct roles within the LMS’s activity

system, collectively contributing to its dynamic operation. This table, adapted from Agaçi's (2017) research, echoed by Anand and Eswaran (2018), intricately outlines the diverse tasks undertaken by administrators, instructors and students, shedding light on their collaborative efforts and individual contributions. By delving into this allocation of responsibilities, the researcher gained a profound understanding of how stakeholders' different roles synergise to create a robust educational environment within the LMS. The subsequent sections explored the specific functions and contributions of each stakeholder, as shown in Table 3.11. This explanation enhances understanding of how all the stakeholders collaborate within the LMS activity system.

3.9 THE ADMINISTRATOR ACTIVITY SYSTEM

The administrator is at the top of the hierarchy from the consumer's point of view. The administrator is the only subject with full power in relation to the entire LMS platform, along with the service provider's programmers and back-end operators. To be clear, it is important to emphasise that this type of administrator is different from the administrator in charge of the maintenance of the LMS, who must manage the server and solve any technical issues. The administrator has the duty, as an e-learning application manager, to manage the application so that it can run well (Muhardi, Gunawan, Irawan, & Devis, 2020). The administrator manages curriculum data, semester years, instructors, students and subjects. On the contrary, this role, held by one or only a few people, oversees all the administrative matters related to the LMS. Among the core functionalities of the administrator are to find and enrol new users to the platform (in different ways), assign roles and associate users to courses, and enrol users in courses. This role is the only subject in the activity system (Figure 3.3) to have a vision of the whole LMS, both from an end-user's perspective and in terms of uploaded content, but, in fact, has no interest in the details of single courses managed by the instructors.

The administrator furthermore does the following:

- Prepares the server, downloads the LMS software and installs it on the server, adds instructor(s), assigns instructor(s) to modules(s) and adds students to the system.
- Makes backups and restores the system if needed and attempts to solve problems related to system operation (Cavus, 2015).

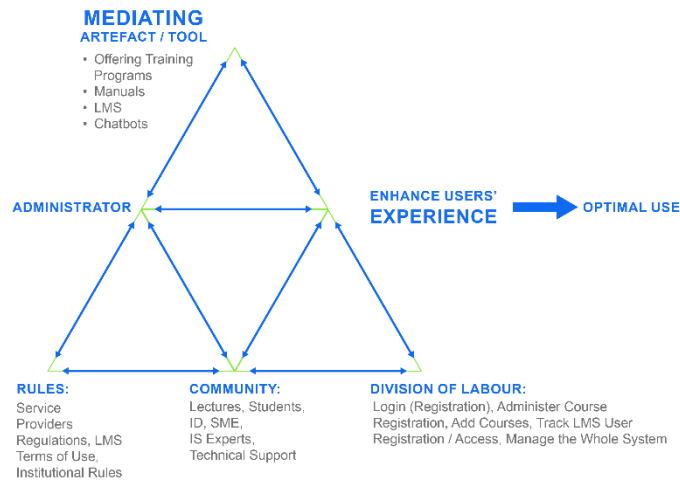


Figure 3.3: Administrator activity system (author's own)

Directly succeeding the administrator activity system is the instructor activity system, which plays a pivotal role in the dynamic landscape of the LMS activity system.

3.10 INSTRUCTOR ACTIVITY SYSTEM

The structure and role hierarchy within the LMS allow the instructor, also as a subject, to concentrate on teaching. This system ranges from the creation, uploading and management of the course content, to the choice of teaching and learning strategies, as well as content delivery. Within the instructor's field of experience and competence, the instructor is responsible for the creation of online lessons, the method of delivery, as well as the addition of different types of resources and activities (Cahaya, Yusriadi, & Gheisari, 2022). In addition, the instructor has access to the data of the online classes; in particular, progress and results reports, and can easily share information, communicate, and schedule events in the course calendar (Singh, Singh, & Matthees, 2022). The instructor creates and uploads the material and assignments. Students will then download the material that has been uploaded by the instructor, and upload their assignments (Muhardi et al., 2020).

In relation to the role of the instructor, it is important to emphasise that instructors can only access material and student data for the courses they manage. They cannot view any other courses on the platform that are not assigned to them. These restrictions are in place as outlined in the activity theory guidelines.

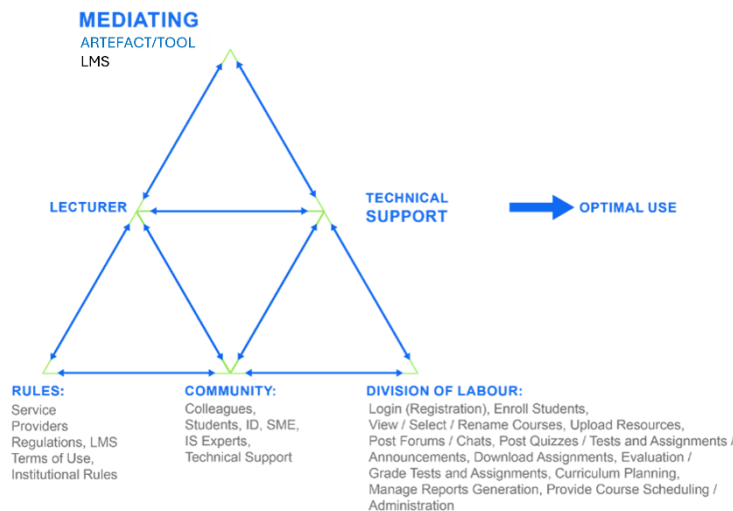


Figure 3.4: Instructor activity system (author's own)

Following the instructor activity system is the student activity system, which takes centre stage in the dynamic landscape of the complex LMS activity system.

3.11 STUDENT ACTIVITY SYSTEM

Eventually, at the base of the hierarchical pyramid of the LMS, are the users enrolled as students. This is the role with the least power: it only allows the student to see enrolled courses, events in the shared calendar, announcements and messages from the instructor, and access their own progress reports and online assessment results (Al-Sharhan et al., 2020; Singh et al., 2022). The student can only complete actions and tasks if the instructor has assigned them. In the end, the roles and functionalities described correspond to the standard version of an LMS but can be customised to meet the needs and requests of the HEI, for example, limiting access to sensitive data (rules) in compliance with the privacy policy (Kabata, 2022).

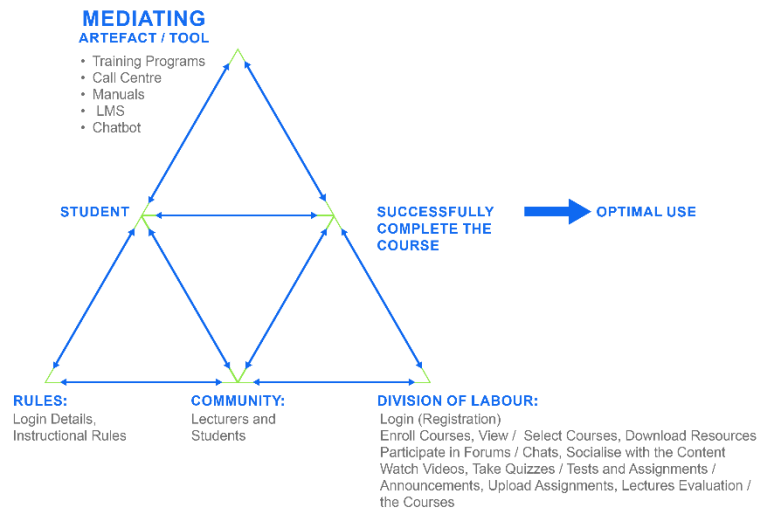


Figure 3.5: Student activity system (author's own)

In conclusion, this literature review has provided a comprehensive overview of the evolving landscape of LMSs and their role in the realm of HEIs. The increasing relevance of LMSs in facilitating online learning has been established, shedding light on the challenges and benefits associated with their integration. The exploration of chatbots' potential within customer services has paved the way for their envisaged application in LMSs. As HEIs embrace technology-driven solutions, the incorporation of chatbots holds promise for enhancing the teaching and learning experience.

This chapter has delved into the multifaceted components of activity theory, offering insights into the intricacies of interactions within the educational context. By explaining the distinctive features and functionalities of LMSs, a solid foundation for understanding their operational scope has been laid. While unveiling both the merits and demerits of LMSs, this review underscores their pivotal role in shaping the landscape of online education. In this pursuit, the identified gap in research regarding chatbot implementation in HEIs emerges as a crucial direction for future investigation, promising to unveil novel dimensions in the realm of technology-enhanced learning. As the educational paradigm continues to evolve, the potential synergy between LMSs and chatbots becomes increasingly evident. This remarkable collaboration serves as evidence to the transformative power of technology in shaping the future of learning.

3.12 SUMMARY OF CHAPTER 3: SUGGESTION

The need to formulate a set of design principles for LMS chatbots to enhance UX has been established through empirical evidence. The suggested approach involves:

- The formulation of design principles.
- Address the existing gap (absence) of LMS chatbot guidelines based on empirical findings (Section 3.3).
- Enhance the guidelines with design features.
- Align with Gregor et al.'s (2020) schema for design principles (Table 3.2).
- Consider the various user activities identified in the LMS activity systems (refer to Section 3.9, 3.10 and 3.11).
- Incorporate Morville's (2004) UX honeycomb model, detailed in Section 2.7.3, to enhance UX.

This methodology ensures the integration of user types based on activity theory to improve UX, while considering the aspects highlighted in the UX honeycomb model. These principles and features were further discussed in Chapter 5.

CHAPTER 4: METHODOLOGY

4.1 INTRODUCTION

This chapter starts by providing a rationale for the philosophical paradigm, research approach and methodology adopted as the framework for this study. When selecting a methodology for IS research, the researcher’s focus goes beyond merely choosing between qualitative and quantitative methods; it involves the ability to discern the philosophical and theoretical underpinnings that justify the selected methodology (Creswell, 2013). At the outset of a study, researchers hold certain assumptions about the insights they aim to gain through their investigation (Creswell, 2008). According to Creswell (2013), all research is built upon foundational assumptions about what constitutes a valid study, and which philosophical and theoretical principles are aligned with the specific research, ultimately guiding the methodology selection process (Myers, 1997).

This study follows a DSR approach with pragmatism as the underlying philosophy. All data collected is qualitative in nature. The sections that follow provide more detail on this. Figure 4.1 illustrates the mapping of the DSR processes within the thesis structure.

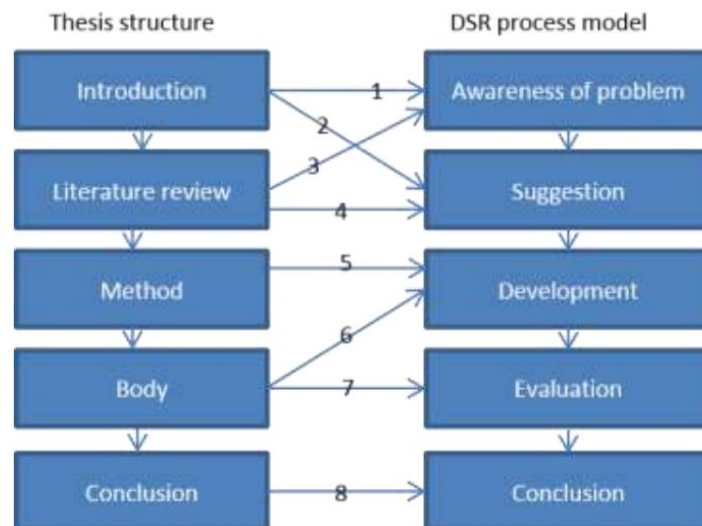


Figure 4.1: Thesis mapping for a single design science research process cycle (Van der Merwe, Gerber, & Smuts, 2017)

4.2 RESEARCH PHILOSOPHY: PRAGMATISM

When studying IS phenomena, researchers can adopt various philosophical assumptions and research perspectives. It is important for researchers to recognise the potential implications of the chosen viewpoint, while maintaining an openness to other perspectives. In practice, this implies that, when investigating IS, researchers should not confine themselves to a single approach or philosophy. Instead, they should consider multiple viewpoints to gain a more comprehensive understanding of the subject (Orlikowski & Baroudi, 1991).

Every research endeavour operates within the confines of the researcher's paradigm or their personal understanding of the world. This perspective can be seen as the foundation of an individual's principles, which, in turn, steer their actions and ideas (Maree, 2013). The selection of a paradigm is further influenced by the nature of the research questions and the specific research methods employed within the research discipline (Oates, 2012). A paradigm can thus be viewed as an individual's world view, reflected in their assumptions about reality and the acquisition of knowledge, and is of importance for optimising the research design (Cibangu, 2010). According to Lincoln and Guba (1985), a paradigm consists of four elements: ontology, epistemology, methodology, and axiology. It is considered imperative to have a firm understanding of these elements. This is because they comprise the underlying assumptions, beliefs, norms and values that each paradigm holds. Each element is discussed separately in the paragraphs to follow.

The four elements of a paradigm were explored and constructed through human interactions (a design thinking workshop and questionnaires). Multiple realities exist due to varying experiences. This means that the researcher considered including the users' subject knowledge, personal views and opinions.

Table 4.1 delineates two contrasting approaches. Pragmatism emphasises the application of knowledge for effective action and change, whereas interpretivism delves into the realm of understanding socially constructed beliefs and meanings. The researcher's role varies between serving as an agent of change and assuming the role of a seeker of insight. Much like two sides of a coin, pragmatism and interpretivism

offer distinct, but valuable perspectives on how to explore and engage with the world through the lens of research.

Table 4.1: Pragmatism vs interpretivism: ideal-typical differentiation (Goldkuhl, 2012)

	Pragmatism	Interpretivism
Ontology	Symbolic realism	Constructivism
Empirical focus	Action and changes	Beliefs (socially constructed cognition)
Type of knowledge	Constructive knowledge	Understanding
Role of knowledge	Useful for action and change	Interesting to audiences
Type of investigation	Inquiry	Field study
Data generation	Data through assessment	Data through interpretation
Role of researcher	Engaged in change	Engaged in understanding

Based on the nature of this research study, the philosophy of pragmatism emerges as the most suitable foundation for this study, as it emphasises practicality and real-world application. Within this pragmatist framework, activity theory is employed as a valuable tool to comprehensively examine the diverse user activities within the LMS activity system. By integrating pragmatism with activity theory, the study aims to provide a practical and theoretically sound understanding of the intricate social dynamics within the varied LMS community, which encompasses a wide range of user types. This combination of pragmatism and activity theory enriches the research approach by facilitating both practical solutions and a robust theoretical foundation. By integrating activity theory into a DSR study, the researcher aimed to understand the underlying activities and interactions that take place within the context of the LMS activity system, seeking insights into the ways in which assistive technologies contribute to and influence the user's experience.

Scholars (Myers, 1997; Orlikowski, 2002) recognise the challenges associated with attempting to simplify the intricate blend of social and technical phenomena within the IS field into mere quantitative metrics (Goldkuhl, 2012). By enhancing the depth of understanding and methodological robustness within this DSR study, the research adopted a qualitative approach. Orlikowski and Baroudi (1991) have classified research into two distinct categories: conceptual and empirical. Conceptual studies involve the construction of models or frameworks, including literature reviews, without the inclusion of empirically gathered data. On the other hand, empirical research encompasses

methods such as surveys, interviews, multi-method approaches, case studies and experiments. This DSR study have elements of both categories. These different categories were addressed in the posed phases, guided by the research questions.

It can be confirmed that a researcher's world view or paradigm serves as the groundwork for research as it delineates the ontology (conception of reality), epistemology (nature and origins of knowledge or facts), and axiology (values, beliefs and ethics) that guide the research process (Creswell, 2008; Melnikovas, 2018; Moon & Blackman, 2017). Below follows the discussions of each assumption that has an influence on this study.

4.2.1 Ontological assumptions

Ontology refers to the researcher's philosophical assumptions about the nature of reality (Denzin & Lincoln, 2003). Ontological assumptions help orientate the study concerning the research problem, with the intention of answering the research questions, understanding the problem and contributing to its solution by producing the best-desired outcomes (Kivunja & Kuyini, 2017). The essence of a pragmatist ontology is actions and change; humans acting in a world that is in a constant state of becoming (Goldkuhl, 2012). In his classical article "How to make our ideas clear", Peirce (1878) formulated this pragmatic principle: "Thus, it comes down to what is tangible and practical as the root of every real distinction, no matter how subtle it might be; and there is no distinction of meaning so fine as to consist in anything but a possible difference of practice".

4.2.2 Epistemological assumptions

Epistemology deals with the relationship between the "knower" (the participant) and the "would-be knower" (the researcher). Epistemology can be defined as the study of the origin, nature, limits and methods of human knowledge and how knowledge can be acquired, applied and validated (Hitchcock & Hughes, 2002). Epistemological assumptions affect the researcher's adequacy to uncover knowledge in the context of investigation (Kivunja & Kuyini, 2017). This study's epistemological stance is that knowledge is constructed to better manage existence and taking part in the world by solving problems. For this reason, it is assumed that interpretations of users'

requirements (as defined in the design thinking workshop) constitute knowledge that can be used and built on in this study. Designing with a focus on UX entails not just addressing issues, but rather generating additional possibilities and advantages for users (Vyas & Van der Veer, 2005). Finding a solution to a real-life problem is the means and modifying it (developing a set of design principles) is the underlying aim.

4.2.3 Methodological assumptions

Ary, Jacobs, and Sorensen (2013) define a paradigm as a way of looking at the world, while Shuttleworth (2008) describes it as a set of assumptions or fundamental beliefs. A clear paradigm guides the researcher in making and justifying all the necessary decisions about the research design of the project (Maxwell, 2005).

Qualitative research is often associated with interpretivism, but alternatives exist. Besides critical research and sometimes positivism, qualitative research in IS can be performed following a paradigm of pragmatism (Goldkuhl, 2012). The pragmatic paradigm arose among philosophers who argued that it was impossible to access the “truth” about the real world merely under a single scientific method, as advocated by the positivist paradigm, nor was it possible to determine social reality as constructed under the interpretivist paradigm (Kivunja & Kuyini, 2017). A mono-paradigmatic orientation of research was therefore considered inadequate. Hence, philosophers such as Tashakkori and Teddlie (2010) and Patton (2001) emphasised the necessity of a more inclusive world view. This view would provide a research method that is regarded as appropriate for studying the phenomenon at hand. Theorists looked at approaches that could allow a combination of techniques to shed light on the actual behaviour of participants, the beliefs behind those behaviours, and the possible consequences that are most likely to follow from different behaviours.

The great ethos of DSR in IS has been to design innovative artefacts that are relevant for practice and not only of interest in research (Iivari et al., 2018). One of the primary goals of DSR is to supplement efforts aimed at comprehending, elucidating and occasionally forecasting the evolution, utilisation and impact of IS and associated socio-technical elements within organisations and various social settings (Baskerville et al., 2018; Hevner et al., 2004; Kuechler & Vaishnavi, 2012). DSR aims to generate prescriptive knowledge, which may or may not draw upon explanatory and predictive

knowledge, and must be effectively communicated (Baskerville & Pries-Heje, 2010; Gregor & Hevner, 2013; Kuechler & Vaishnavi, 2012). Given this context, the aim of Gregor et al. (2020) was to create a clear, understandable and practical framework that is designed to streamline the development of prescriptive knowledge. This knowledge is intended to aid in shaping the anatomy of design principles for this study.

DSR thus adopts a pragmatic research paradigm to construct artefacts that are innovative and orientated to real-world practice (Van der Merwe et al., 2017). It is associated with action, intervention and constructive knowledge, and is fundamentally practical in nature (Goldkuhl, 2012). It emphasises relevance and requires the contribution to the environmental application to be clear (Hevner et al., 2004). Furthermore, it can be argued that scientific research should be evaluated for its practical implications. The functional relevance should be considered equally valued in terms of the rigour with which the study was performed to achieve the result (Hevner & Chatterjee, 2010).

Many DSR researchers consider pragmatic philosophy most applicable (Hevner & Chatterjee, 2010; Hevner et al., 2004; Van der Merwe et al., 2017). The purpose of conducting a DSR study (Hevner, 2007) is to create an artefact through a balanced process that combines the highest standards of contributing rigour to the body of research and relevance. Pragmatism is concerned with action and change, and the interplay between knowledge and action (Goldkuhl, 2012), which makes it appropriate as a basis for research approaches intervening into the world and not merely observing the world. This would be the case if the intervention is organisational change (as in action research) or the building of artefacts (as in design research). Due to the practical value of this study, pragmatism could be appropriate. Therefore, DSR was selected for the investigation to develop a relevant set of design principles. The following paradigmatic assumptions and perspectives explained how this study is rooted in the pragmatist paradigm alongside the philosophical assumptions that underpin this approach for optimal use.

Pragmatism acknowledges that cultural and personal perspectives can affect how the researcher observes, interprets and reports the findings. It further accepts that the researcher's values play an essential role in the interpretation of the results (Tashakkori & Teddlie, 2010). When locating this study in a particular research

paradigm through pragmatism, it is evident that this study were guided by the assumptions, beliefs, norms and values of the chosen paradigm.

4.2.4 Axiological assumptions

Axiology is “the science of value” (Hartman, 2011) and is considered a branch of philosophy that deals with the study of values, including ethics (moral values) and aesthetics (aesthetic values). Aesthetics studies the beauty or the appreciation of beauty, while ethics is concerned with social conduct. Axiology encompasses the researcher’s objectives for the study, which may include the aspiration to conduct research that can bring about benefits and hold value. It also reflects on the ethical considerations that are applied throughout the study. Axiological assumptions, on the other hand, pertain to the fundamental beliefs or principles regarding what is deemed valuable, worthy or desirable. These assumptions influence how individuals perceive and interpret the world, make judgments and engage in various aspects of life, including the social, cultural and academic domains. Axiological assumptions play a crucial role in shaping the perspective of researchers, scholars and readers. These assumptions have a significant impact on the methods used, the questions asked, the interpretations made, and the conclusions drawn in this study.

The concept of being “value-laden” is a notion that characterises science as a human activity, shaped by the impact of values, ideologies or beliefs (Gonzalez, 2013). When a statement, argument or research is deemed value-laden, it means that it contains subjective judgments or biases stemming from personal values, ethics or cultural perspectives. It is important to note that being value-laden does not render the information incorrect or invalid; instead, it underscores that the information is influenced by subjective viewpoints (Ward, 2021). Being value-laden is a crucial consideration in academic research. It is important for researchers to acknowledge their values and perspectives and strive for transparency in their work to minimise the impact of personal bias on their findings (Kapiszewski & Karcher, 2020). This assists researchers to avoid making unwarranted assumptions that could undermine the credibility and impartiality of their findings. Researchers aim for objectivity in their work to minimise personal bias. However, complete objectivity is often challenging to

achieve, as researchers and scholars are human with inherent values and perspectives that may subtly influence their work (Khatwani & Panhwar, 2020).

Recognising and addressing axiological assumptions is essential to maintain academic integrity and rigour. The researcher has employed the following strategies to mitigate the impact of being value-laden:

- **Self-awareness:** The researcher was aware of her own values, biases and assumptions. Introspection and self-examination helped the researcher to identify potential sources in this study of being value-laden (London, Sessa, & Shelley, 2023).
- **Transparency:** The researcher has explicitly stated her axiological assumptions, as well as any potential biases that might influence the study's findings (Kelly et al., 2018).
- **Diverse perspectives:** The researcher has embraced a multitude of perspectives from literature, a diverse range of participants and various data collection techniques. By incorporating these multiple viewpoints into the study, the potential influence of a single set of values has been mitigated (Carter et al., 2014).

4.3 SAMPLING

Sampling is a critical aspect of research that has a significant influence on a study's scientific rigour, perceived value and practical implications (Serdar, Cihan, Yücel, & Serdar, 2021). It serves as a pivotal component in knowledge construction, research methodologies and the overall impact of research (Cash, Daalhuizen, & Hay, 2022). The vast array of sampling techniques, ranging from random, systematic, stratified, cluster and purposeful sampling to snowball, self-selection and convenience sampling (Oates, 2012), enables researchers to tailor their approach to the unique demands of their study. Figure 4.2 illustrates the different sampling techniques available.

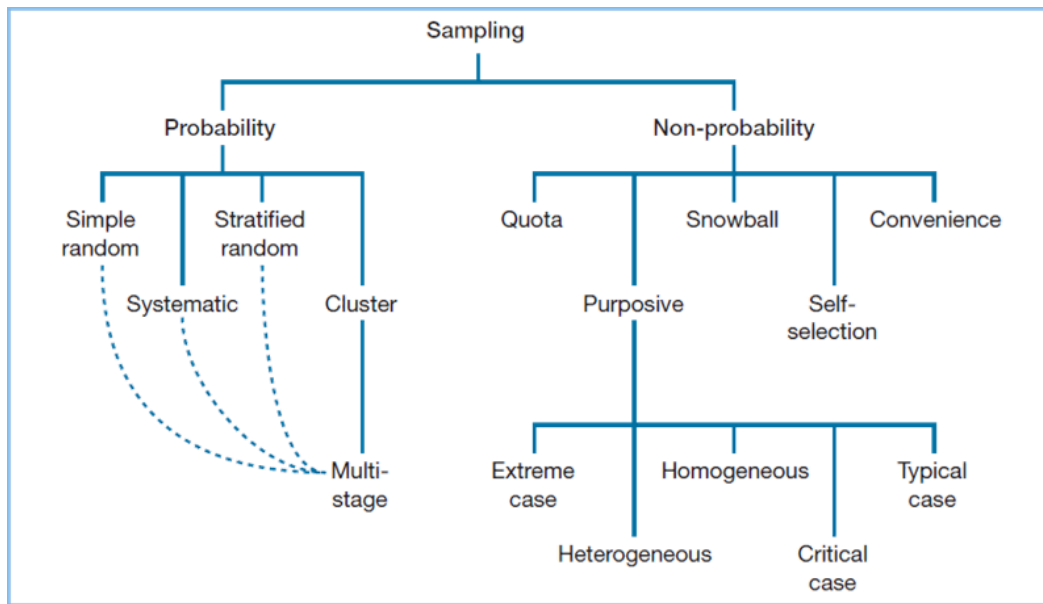


Figure 4.2: Sampling techniques (Saunders, Lewis, & Thornhill, 2007)

This research adopted purposive sampling, a non-probability method aligned with the characteristics of the population and research objectives (Sarker & Al-Muaalemi, 2022). In this approach, participants had to meet specific inclusion criteria, ensuring the selection of individuals who possess extensive knowledge or experience regarding the phenomenon of interest (Creswell & Plano-Clark, 2011). Availability, willingness to participate, and the effective communication of experiences and opinions, as emphasised by Palinkas et al. (2015), played a significant role in the selection process. Crilly and Firth (2019) followed a similar approach, employing various criteria to create a purposive sample with specific characteristics of interest, limiting the study's scope, but facilitating the development of comprehensive findings. To ensure successful DSR, it necessitated the collaboration of a multidisciplinary design team, whose expertise was deemed crucial to the study (McKenney & Reeves, 2014). The target population for this investigation comprised proficient LMS users, skilled in utilising LMS platforms for administrative, teaching and learning tasks. The sample population was purposefully selected, comprising instructional designers, instructors, students, technical support staff and curriculum developers (Table 4.2). In the evaluation phase of the DSR, four LMS experts were purposefully selected (Table 4.2).

4.4 CONSTANT COMPARATIVE ANALYSIS

This method involved systematically comparing findings from various studies, utilising existing literature as a foundational reference (Vaishnavi & Kuechler, 2015). Through this process, the researcher discerned how existing knowledge could contribute to formulating a solution, identifying and defining the problem, and developing a tentative set of design principles. The comparison of data from diverse sources, including academic literature, websites, reports, informal conversations and observations, contributed to constructing a comprehensive understanding of the problem's context and nuances.

Fram (2013) discussed the application of constant comparative analysis (CCA) outside grounded theory, as seen in this study. CCA is a qualitative research methodology that aims to develop theory or concepts grounded in the data itself. It involves an iterative process of reducing data through constant recoding (Glaser & Strauss, 1967). Urquhart and Fernandez (2013) describe it as “constantly comparing instances of data in a particular category against other instances of data to see if these categories fit and are workable”. This systematic process helps identify patterns, categories and relationships by comparing data within and across different sources.

The coding process begins with open coding, developing categories from the initial round of data reduction. Further reducing and recoding allow possible core categories to emerge (Adu, 2019; Charmaz, 2006; Elliott, 2018). Constant comparison ensures that all data is systematically compared, preventing potential disregard on thematic grounds (O'Connor, Netting, & Thomas, 2008). This iterative process facilitates the identification and classification of codes and higher-order codes as researchers familiarises themselves with the data (Elliott, 2018; Fram, 2013). This comprehensive approach ensures that data from various sources is thoroughly analysed, contributing to a robust understanding of the research problem.

The CCA method was utilised to analyse all the gathered data throughout this study.

4.5 RESEARCH STRATEGY: DESIGN SCIENCE RESEARCH

The research design of a study encompasses a comprehensive plan, ranging from broad philosophical assumptions to specific methodological strategies. It involves philosophical assumptions, participant selection criteria, data collection strategies and

subsequent data analysis techniques (Creswell, 2013). It plays a pivotal role in determining the necessary evidence to address the research question (Mouton, 2001).

Since the 1990s (Hevner et al., 2004; Nunamaker Jr, Chen, & Purdin, 1990; Peffers, Tuunanen, Rothenberger, & Chatterjee, 2008), the field of IS research has witnessed the emergence of DSR as a novel approach (Jacob, Pez, & Volle, 2022). Design science research is geared towards generating knowledge that is both scientifically rigorous and practically applicable (Gregor et al., 2020).

At the theoretical level, foundational work by Hevner et al. (2004) paved the way for subsequent scholars, such as Indulska and Recker (2010) and Niehaves and Becker (2006), to develop a comprehensive framework for DSR application within IS research (Vaishnavi & Kuechler, 2015). Design science research involves the creation and evaluation of innovative artefacts that contribute to both theoretical advancement and practical application (Hevner & Chatterjee, 2010). Following Hevner's model (Hevner, 2007), DSR involves cycles of relevance, design and rigour, which necessitate integrating environmental needs, technologies and knowledge bases.

Chosen for its capacity to balance research rigour and practical relevance, DSR was adopted for this study. Design science research places importance on context-specific innovation, making it a suitable strategy for artefact development (Gregor, 2006; Hevner & Chatterjee, 2010).

It should, however, be noted that developing a set of design principles could also be achieved through a variety of research methodologies, including user-centred design and action research, where the choice of methodology should be thoughtfully aligned with the research goals, the specific nature of the research problem and the available resources. Design science research was selected as the preferred methodology for this study, driven by the belief that it is the most suitable approach.

User-centred design is a profoundly human-centric method that directly engages users and stakeholders. By employing techniques such as interviews, surveys and observations, designers can effectively pinpoint user needs and preferences, subsequently translating these insights into actionable design principles (Hasani, Sensuse, Kautsarina, & Suryono, 2020). On the other hand, action research is characterised by a cyclic process that intertwines research and practical action.

Design principles emerge through iterative cycles in which designers engage in real-world design activities and collaborate with stakeholders to assess outcomes (Daiberl et al., 2019).

While this study opted for DSR, the flexibility of methodologies like user-centred design and action research should be recognised, as it can serve as a valuable alternative to develop design principles based on different research contexts and goals, depending on a study's needs.

Considering this, Hevner et al. (2004) outlined the types of contributions that can be made through DSR:

- Problem identification and a clear awareness of the problem.
- Demonstrating that no clear solution exists.
- Producing both tangible (physical objects) and intangible artefacts (conceptual or digital), which may be in the form of a framework, construct, model, method, conjecture maps or set of design principles or instantiations (Sandoval, 2014; Vaishnavi & Kuechler, 2008; Van den Akker, 1999).
- Developmental stages of such design principles will occur during a literature review, design thinking workshop session, formulation of design principles, and revisiting and refining the design principles with LMS experts.
- Rigorous evaluation and assessment of the utility of the artefact will take place. Design rigour ensures that the process of creating artefacts is systematic, well-grounded and well documented. By adhering to design rigour, the research outcomes become more reliable and reproducible, enhancing the overall credibility of the work.
- Expressing the practical and theoretical added value of the artefact (Vom Brocke, Winter, Hevner, & Maedche, 2020), the artefact must contribute to both theory and practice. Theoretically, the research should offer insights into the design process, methods and outcomes. Practically, the designed artefact should be deployable and valuable in real-world scenarios.
- Involving stakeholders throughout the research process ensures that the artefact is relevant, user-friendly and aligned with the actual needs of the target audience.

As was shown in Section 3.12 the suggestion provided by the thesis is to develop chatbot design principles that are specifically tailored for integration into LMSs. The design process for formulating design principles is elaborated upon in distinct phases. Figure 4.3 depicts the DSR process model, adapted from Kuechler and Vaishnavi (2008).

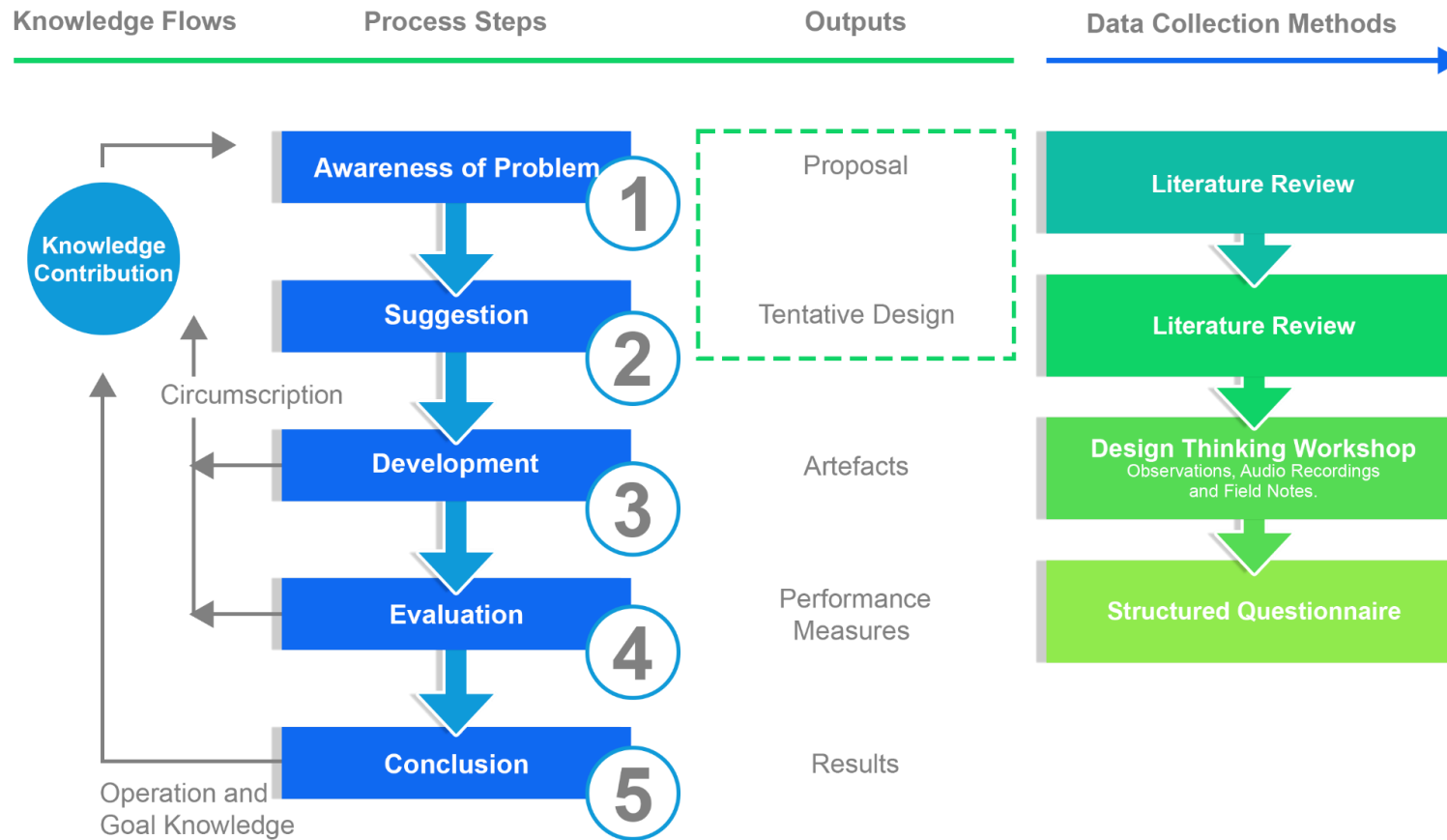


Figure 4.3: The DSR process model as adapted from Vaishnavi and Kuechler (2008)

The DSR process typically comprises multiple phases, each serving a specific purpose in the development and evaluation of an information system or artefact, as discussed in more detail in the subsequent sections.

4.5.1 Phase 1: Awareness of the problem

a) Data collection method

The primary method of data collection in Phase 1 involved drawing from personal experience, engaging in informal discussions with other users and a literature review. Anecdotal evidence, comprised of first-hand or second-hand reports of personal experiences, served as a significant source of information. The researcher utilised these personal narratives to gain awareness of a real-life problem faced by service providers. Additionally, information was gathered through a critical review of the existing knowledge base (Vaishnavi & Kuechler, 2015). This analysis systematically compared findings from various studies to harness data for the construction of the research artefact.

By conducting a literature review, the researcher detected recurring themes and trends in the existing body of work, enabling the identification of gaps or discrepancies within this knowledge domain. Consequently, this process guided the researcher towards becoming aware of the research problem (Phase 1), as well as finding a possible solution to address the problem in literature, which served as the suggestion phase (Phase 2).

b) Data analysis method (CCA)

The data analysis approach employed in Phase 1 utilised CCA method, specifically hermeneutical textual analysis, as previously discussed in Section 4.4.

c) Findings

The findings of Phase 1 are structured around the phases of the DSR process. In Phase 1, the researcher focused on creating awareness of the problem, laying the foundation for the study by identifying, defining and justifying the problem (Vaishnavi & Kuechler, 2015). The outcomes of this phase include a well-articulated problem statement that considers the specific context of the issue. The problem statement established in Phase 1 serves as a crucial stepping stone for subsequent DSR phases, with the ultimate objective of developing an innovative solution to systematically and effectively address the identified problem

(Vaishnavi & Kuechler, 2015). The findings of this phase are articulated as the awareness of the problem summarised in Section 2.10.

4.5.2 Phase 2: Suggestion

a) Data collection method

In Phase 2, the researcher engaged in an extensive literature review with the primary goal of exploring the perspectives of chatbots, customer services, UX, LMS users and the LMS platforms themselves. The data collection method in this phase involved a thorough examination of academic articles, research papers, conference proceedings, reports and other scholarly sources to delve into the realm of LMS UX, opinions and perspectives. The researcher aimed to deepen her understanding of the various aspects that users consider crucial when interacting with LMS platforms, identifying recurring themes, challenges or opportunities that emerge from literature and their perspectives, and how they can be improved and addressed.

b) Data analysis method (CCA)

The data analysis method in Phase 2 involved a thorough investigation, resulting in a series of recommendations and suggestions. The CCA approach was applied, allowing the researcher to identify recurring themes, challenges and opportunities, and synthesise them into recommendations to address the research problem. Recommendations and suggestions emerged from a comprehensive literature review that studied a diverse array of literature, as discussed in Chapter 2. The primary objective was to attain a comprehensive understanding of the multifaceted aspects that influence how users perceive LMS platforms.

c) Findings

The literature review in Phase 2 played an important role in guiding the researcher's path, particularly in proposing design principles to address the research problem. The comprehensive examination of existing literature facilitated an exploration of the design principles underpinning chatbot development. Importantly, the inquiry revealed a significant gap: the absence of design principles tailored specifically for LMS chatbots to enhance UX. This recognition underscores the need for the development of unique design principles in this context, providing valuable insights for the subsequent phases of the DSR. The suggestion for a solution to the problem is presented in Section 3.12.

4.5.3 Phase 3: Development

a) Sampling

This participatory and human-centred approach involved 12 diverse participants, including LMS administrators, instructors and students, each from different institutions utilising distinct LMS platforms as recommended by Parizi, Prestes, Marczak, and Conte (2022). A local expert design thinking facilitator facilitated the workshop, guiding participants through a structured process of problem solving and innovation.

A sample size of 12 participants was consequently considered suitable for this qualitative research. While 30 prospective participants were initially invited via email, only 12 were able to attend the full-day workshop due to work commitments. While it is acknowledged that small sample sizes may limit generalisability, it is crucial to understand that rigorous qualitative research with a narrower scope can yield insights and a nuanced understanding. This perspective is supported by Hennink and Kaiser (2022) and Young and Casey (2019). Rather than viewing the small sample size as a limitation, it should be seen as a contributor to the depth and richness of data, offering valuable insights.

Table 4.2: Distribution of sample for the design thinking workshop

Team	Student	Instructor	Administrator
Team 1	1	2	1
Team 2	1	2	1
Team 3	1	1	2
Total	3	5	4

b) Data collection method

In this study's third phase, a design thinking workshop, conducted on 25 May 2023, served as a dynamic platform for data collection, aligning with the principles of The Hasso Plattner Institute of Design at Stanford University (Meinel et al., 2022). The design thinking workshop played a crucial role in obtaining a better understanding of the context and practical needs identified in literature regarding UX in the LMS environment (Parizi et al., 2022). The workshop aimed to explore the perspectives of chatbots, customer services, LMS users and LMS platforms.

In the design thinking workshop, participants were organised into teams to collaboratively complete a worksheet (Appendices C to F), engaging in activities such as informal interviews

with stakeholder representatives. Each team conducted two interviews to build empathy (Stage 1), focusing on understanding the user's problems and needs. The worksheet included typical questions about expectations from an LMS chatbot for students, instructors and administrators. Subsequent in-depth inquiries probed the reasons behind these expectations, aiming to unveil opportunities, unexpected insights and potential tension. Teams were then instructed to conduct a second interview, delving into implicit reasons behind user expectations by asking "why" questions. This phase aimed to reveal opportunities, insights and tensions, considering perspectives as students, instructors and administrators. The teams articulated the problem based on insights acquired during the empathy phase (Stage 1), defining needs and uncovering fresh insights into users' emotions (Stage 2). They developed a point-of-view statement for the user they represented, serving as a guiding force for the design.

During the ideate stage (Stage 3) of the Stanford d.school design thinking process, teams engaged in brainstorming using the prompt "How might we... to help the stakeholder?" This high-energy activity focused on addressing identified needs based on the established point-of-view statement. Teams shared their ideas with LMS users, gathering valuable feedback. The feedback was captured, providing insights for reflection and generating new solutions. The final step involved choosing the idea with the most traction, considering it as a potential product or service and envisioning its form and function (Stage 4). This structured process allowed the design team to iteratively refine their understanding of user needs and generate innovative solutions in a collaborative and inclusive manner using Figma software (Stage 5).

Figma screenshots, observations and field notes were also used as a method of data collection. The researcher, stationed in an adjoining room, separated by a one-way glass window, conducted non-participatory observations, documenting the proceedings of the design thinking workshop. This approach was chosen to maintain an impartial perspective and gather rich qualitative data on how the five stages of the Stanford d.school design thinking were practically applied (Meinel et al., 2022). The five stages are discussed in greater detail in Sections 5.1.1 to 5.1.5.

c) Data analysis method (CCA)

The data analysis method that was employed following the design thinking workshop extensively embraced the CCA approach, as discussed in Section 4.4. This systematic and iterative method involved a thorough examination of the rich qualitative data collected during the workshop, which included audio recording transcripts, field notes, participant worksheets and Figma screenshots. The CCA method, rooted in grounded theory, facilitated the identification and comparison of recurring themes, patterns and insights across the diverse datasets that contributed to the creation of a tentative set of design principles (Ukagwu & Gray, 2023).

d) Findings

Participants engaged in activities, ranging from empathising with LMS users, conducting interviews and developing point-of-view statements to ideating and prototyping a chatbot solution for LMS platforms. The workshop facilitated a collaborative and inclusive environment, allowing the design team to challenge assumptions, reframe problems and generate innovative solutions (Parizi et al., 2022). The findings from this workshop, combined with the literature review, contributed to the formulation of design principles aimed at addressing the identified UX challenges in LMS platforms by means of a chatbot solution. The development phase are discussed in greater detail in Chapter 5.

4.5.4 Phase 4: Evaluation

a) Sampling

In Phase 4, the researcher engaged a purposefully selected group of LMS experts, consisting of four participants with extensive experience (Table 4.3). To evaluate the tentative set of design principles, invitations were extended via email to 12 LMS experts. However, only four participants responded by completing the questionnaire. These participants voluntarily provided valuable insights by filling in a structured questionnaire and offering critical feedback on the tentative set of design principles.

Table 4.3: Distribution of sample for the LMS expert evaluation

LMS expert	Expertise
Expert 1	Project manager: E-learning at a university
Expert 2	Senior learning designer at a private e-learning company
Expert 3	Senior learning designer at a university
Expert 4	Head: E-learning (Education Innovation) at a university

b) Data collection

This evaluation focused on assessing the functionality, usability and potential of the design principles to enhance the UX within an LMS activity system.

LMS experts evaluated the artefact (design principles) in the context of an existing real-life interactive LMS chatbot environment, specifically the Blackboard Chatbot (Anthology Inc., 2023). It is important to note that the Blackboard chatbot is accessible to SaaS clients in North America who have activated the ultra base navigation and ultra course view features. Permission was obtained from Blackboard to allow experts access to their system, enhancing the evaluation's real-world applicability. It is crucial to note that the evaluation primarily focused on the tentative design principles rather than the chatbot itself. The purpose of engagement with the real-life chatbot was to provide real-life examples of the implementation of some of the design principles and to make them aware of design principles lacking in the real-life chatbot.

The data collection method employed a structured questionnaire (Appendix H). This questionnaire facilitated active engagement with an LMS chatbot, simulating its use within an educational context.

c) Data analysis (CCA)

The data obtained from the expert evaluation structured questionnaires underwent analysis using the CCA method, as discussed in Section 4.4. This systematic approach involved organising and coding the data, focusing on patterns that emerged during the organisation and coding process. The application of the CCA method aimed to systematically review and verify data sources, enhancing the robustness of the analysis (Charmaz, 2006). The iterative nature of the CCA method allowed for continuous improvement and validation of the data, ensuring a comprehensive and thorough examination of the evaluation outcomes.

During the expert evaluation, additional insights were gained through suggestions to enhance the tentative set of design principles and incorporate desirable features into the artefact. The CCA method facilitated a systematic examination of these insights, contributing to the refinement of the tentative set of design principles to suggest a final set of LMS design principles (Glaser & Strauss, 1967).

d) Findings

This evaluation was conducted through a comprehensive process, involving input from four LMS experts. The aim was to examine the functionality, usability and relevance of the tentative set of design principles to address the identified problem within the LMS context.

User feedback played a pivotal role in gaining insight into the practical usability of the design principles. The expert LMS users completed a structured questionnaire, which provided valuable perspectives, shedding light on user needs, identifying areas for improvement, and facilitating the refinement of the design principles. This iterative refinement process, guided by the evaluation results, involved making necessary adjustments to address identified issues and enhance the overall functionality of the design.

A significant aspect of this evaluation phase was the discussion of the findings. This involved a detailed account of the strengths, weaknesses and any unexpected outcomes derived from the evaluation of the tentative set of design principles. This discussion served a dual purpose, contributing not only to the scholarly understanding of the research process, but also offering practical implications for the application of these design principles.

4.5.5 Scientific rigour

Scientific rigour pertains to the verification steps taken by researchers to ensure the legitimacy of the data (Maxwell, 2005). According to Lincoln and Guba (1985), specific criteria have been developed to assess the trustworthiness of naturalistic inquiries, particularly in qualitative research. These criteria encompass credibility, transferability, dependability and confirmability.

In the following sections, the researcher's attempts to achieve quality measures in this study are described.

a) Credibility

Credibility in qualitative research is essential for producing reliable and trustworthy data and analysis (Patton, 2001). Credibility refers to the degree of confidence that can be placed in the accuracy and validity of the research findings and their alignment with the participants' experiences and the research context.

To ensure the trial achieves this, the researcher considered rich contextualised detail in each stage of the research methodology. The endeavour is to create a clear link between reality and its interpretation. Hendricks (2006) argues that triangulation helps increase the reliability of the research. According to Cohen, Manion, and Morrison. (2007), triangulation refers to the use of multiple sources of data, methods or theories by combining methods. To avoid any limitations, methodological triangulation was used to verify the credibility of the interpretations in this study. This was accomplished by gathering data through various methods, including observation, audio recordings, participant worksheets and Figma screenshots, which allowed for a comprehensive and multi-dimensional examination of the research phenomenon. To ensure accuracy, the transcripts of the design thinking workshop were checked against the audio recordings and reread multiple times. Lastly, to ensure credibility, multiple truths and realities were captured in this study, and different data collection instruments were used, as discussed earlier.

To enhance the credibility of this study, the researcher implemented several strategies. Firstly, the researcher observed the design thinking workshop session and transcribed the audio recordings. This enabled the researcher to thoroughly analyse the participant worksheets and maintain a deep engagement with the data, thereby enhancing the credibility of the study findings (Rolfe, 2006).

Credibility was achieved by presenting relevant participant data, incorporating participant quotes from the transcripts, and maintaining a clear audit trail (Rolfe, 2006). These measures not only enhanced the overall quality of the study, but also provided a transparent and reliable framework for future researchers to build on.

b) Transferability

In accordance with Guba and Lincoln's (1994) perspective, transferability serves as a means for readers to make informed judgments by comparing the research context to their own,

identifying similarities and differences. The responsibility of the researcher lies in furnishing detailed data and descriptions, allowing other researchers to assess the applicability of the findings across various contexts, rather than simply offering a transferability index. The achievement of transferability hinges on whether the outcomes of a qualitative study can be applied to similar settings. Yilmaz (2013) recommends that, to achieve transferability, the researcher must furnish a thorough and comprehensive description of the setting, context, individuals, actions and events under investigation to ensure that the findings are transferable.

To enhance the transferability of this study, the researcher diligently provided a rich and detailed account of the research methodology employed. The methodology was thoroughly contextualised based on literature. A comprehensive description of the paradigmatic assumptions and perspectives that guided this study can be found in Section 4.2.

c) Dependability

Dependability, as articulated by Merriam (1998), refers to the degree to which research findings can be consistently reproduced in similar contexts. In essence, it underscores the need to observe consistent outcomes when the same conditions are replicated. The researcher's unique position as the sole participant amplifies the significance of dependability. To ensure the dependability of the study, meticulous attention is required in presenting comprehensive data and detailed research descriptions.

Ensuring methodological transparency is imperative to ensure dependability. This involves a clear and thorough articulation of the research methods and procedures, facilitating not only the replication of the study by others, but also a comprehensive understanding of how data was collected and analysed (Aguinis, Ramani, & Alabduljader, 2018). The researcher has thoroughly documented how the data was collected and analysed, providing an additional layer of clarity and transparency to the methodological framework.

Triangulation, a practice advocated by Hendricks (2006), is instrumental in enhancing dependability. By employing multiple methods, data sources or data collection techniques, researchers can cross-verify findings. This approach fortifies the reliability of results by mitigating the impact of limitations associated with any single method. Embracing these practices collectively contributes to the dependability of the research endeavour.

d) Confirmability

Confirmability, as defined by Guba and Lincoln (1994), is the extent to which research findings can be verified, tracked to their source, and validated by others. Seale (1999) further argues that auditing is a key tool to demonstrate confirmability. Like the notion of Guba and Lincoln (1994), the researcher in this study provides a clear audit trail to ensure that data can be traced to its source and that the process of interpreting data to reach findings and conclusions can be confirmed.

e) Bias: Recognising the influence of personal knowledge and preconceptions

Throughout the qualitative research process, it is vital to acknowledge the potential for personal knowledge and preconceptions to introduce bias and compromise the trustworthiness of the study (Slettebø, 2021). To counteract this inherent bias, the researcher employed a range of deliberate strategies. These strategies encompassed the meticulous documentation of observational notes and the application of a CCA method, ensuring a rigorous and objective approach to data analysis.

Additionally, the researcher took deliberate steps to uphold a neutral position throughout the study, a commitment that was further reinforced by the appointment of an external facilitator to conduct the design thinking workshop. Simultaneously, the researcher actively engaged in self-awareness and reflectivity to lessen the influence of personal bias. This was complemented by a dedicated focus on the theoretical foundations that underpinned the interpretations, ensuring that the research process remained grounded in academic rigour.

In summary, the trustworthiness of this study has been strengthened through careful observation, thorough analysis and the implementation of various strategies to mitigate bias. By presenting the data in a clear and transparent manner, this research contributes to the field and provides a solid foundation for future studies. These efforts have bolstered the credibility, transferability, dependability and confirmability of the study's findings.

4.6 ETHICS

In any research endeavour, a solid foundation in good scientific conduct and research integrity is crucial. This places scientific and ethical appropriateness as the primary foundational consideration, encompassing the integrity of the research and the individuals

involved. This ensures the fair treatment and protection of participants (Kitchenham et al., 2002; Onwuegbuzie & Collins, 2007).

As the research was a pragmatic study, the researcher had to carefully navigate ethical considerations such as informed consent, privacy protection and the potential impact on participants' well-being, while ensuring that the research provided practical solutions and meaningful outcomes for the real-world context it aimed to address. Researchers must always remember that, in the process of conducting research, they are intruding into the private spaces of their participants.

In accordance with the requirements established by the Ethical Committee of the University of Pretoria, the researcher took steps to obtain ethical clearance. Additionally, the Research Ethics Committee of the Faculty of Engineering, Built Environment and Information Technology at the University of Pretoria formally approved the study proposal (Ref. No. EBIT/246/2022). Throughout the study, the researcher diligently adhered to the University of Pretoria's ethical research guidelines. These guidelines covered aspects such as voluntary participation, informed consent, participant safety, privacy, confidentiality and anonymity.

Before participating in the research, individuals were informed about the study's purpose and objectives, how the results would be used, and the potential social consequences it might have on their lives (Creswell, 2008). Informed consent involved informing participants about the study's nature, possible benefits, procedures and implications. This information was provided in the invitation letter to the participants and reiterated before conducting the research. Obtaining participants' informed consent was important.

Throughout the research process, the researcher ensured that participants took part in the study freely and without undue risk (Cohen et al., 2007). Participants had the right to decide whether or not to participate after being fully informed of factors that might influence their decisions (McMillan & Schumacher, 2001).

Participants were given the choice to either accept or decline the invitation to participate in the study, and they were explicitly informed of their right to refuse at any stage of the research. The ethics approval letter from the University of Pretoria, which authorised the research, was included as an attachment to the invitation email. Additionally, participants were assured that no incentives would be provided at any point to induce their voluntary participation.

Upon gaining access to the participants, the researcher provided each participant with a letter detailing the study's purpose, nature, data collection instruments and scope. Before the investigation commenced, all participants were provided with written informed consent forms. By returning these signed forms, they confirmed their acceptance of the associated risks.

All types of research carry inherent risks for participants, who may experience discomfort and emotional distress when discussing their attitudes and motivations. To ensure that participants felt comfortable, the researcher maintained sensitivity and respect from the outset. It was essential to clarify that the research was solely for academic purposes, enhancing participants' perceived sense of safety in participation.

Confidentiality was maintained by concealing participants' real identities. Only the researcher knew their actual names. Anonymity was further protected by assigning each participant a pseudonym, which was used on transcripts, data and questionnaires throughout the data collection process.

The researcher archived all collected data at the University of Pretoria in an organised, retrievable form, making it available to anyone who wishes to access it. This operation created an audit trail that can be used to trace and summarise the raw data, as well as to present the analysis and research notes.

4.7 SUMMARY OF CHAPTER 4: METHODOLOGY

This chapter discussed the methodology and research philosophy employed in the study, which followed a DSR approach with pragmatism as its underlying philosophy. This encompassed a comprehensive plan for participant selection, data collection and data analysis. Pragmatism was chosen as the research philosophy due to its ability to combine various techniques to study the phenomenon at hand and its emphasis on practical relevance. Furthermore, this chapter explored the ontological, epistemological and axiological assumptions that underpin the research. To construct the design principles for the LMS chatbot, qualitative methods, including a design thinking workshop, were utilised. This chapter also highlighted the role of the researcher in promoting action and understanding. As discussed in Section 4.5.3, Chapter 5 will delve into Phase 3: Development of DSR in more detail.

CHAPTER 5: DEVELOPMENT

This chapter marks a strategic shift from the extensive exploration of suggestions and potential solutions, as detailed in Chapter 3, to a more targeted and focused approach. The imperative to formulate a set of design principles for LMS chatbots, grounded in empirical evidence, has been substantiated (Section 3.7). The proposed methodology involves the development of design principles that are informed by empirical evidence, guided by the schema outlined by Gregor et al. (2020), as depicted in Table 3.2. The subsequent step involves enhancing these design principles through the integration of specific design features.

Chapter 5 is dedicated to addressing the SQ5 and SQ6, with a specific focus on elucidating the design principles guiding LMS chatbot development and providing actionable guidelines in the form of design features. SQ5 poses the fundamental question: “What design principles guide the development of an LMS chatbot?” The exploration extends further to SQ6, which aims to pinpoint actionable guidelines in the form of design features. The overarching objective is to align these guidelines with the diverse needs of LMS users, ultimately contributing to the development of a chatbot that enhances the overall LMS UX.

To achieve this alignment, a design thinking workshop was conducted, incorporating a representative sample that considered the various types of LMS users, as explicated in sections 3.9 to 3.11 within an LMS activity system.

The first section of Phase 5 illustrates the systematic collection of empirical evidence, considering each user type, as defined by the LMS activity systems (Section 3.8) during the design thinking workshop (Section 5.1). Subsequently, Section 5.2 delineates that the development of design principles and design features followed a comprehensive analysis of all the data collected during the design thinking workshop. The researcher then presents a tentative set of design principles (Section 5.3). The chapter concludes by situating these principles within the broader conceptual framework of UX, modelled after the UX honeycomb introduced by Morville (2004) (details of which are provided in Section 5.4).

5.1 DESIGN THINKING WORKSHOP

In sections 3.9 to 3.11, the researcher elucidates the diverse roles of various LMS users and their integration into the LMS activity system. The facilitator of the design thinking workshop grouped the participants according to their respective roles as users, instructing them to collaborate in completing a worksheet.

The Stanford d.school five-stage design thinking process encompasses the following phases: empathy, definition, ideation, prototyping and testing (Meinel et al., 2022) (Figure 5.1).



Figure 5.1: The Stanford d.school five-stage design thinking process
(https://www.slideteam.net/business_powerpoint_diagrams/five-stages-of-solution-design-thinking-process.html)

The design thinking phases are presented in sections 5.1.1 to 5.1.5. The outcome of the workshop is summarised in Section 5.1.6. Details of the data collected during this design thinking workshop can be found in Appendices C to F.

5.1.1 Stage 1: Empathise

The design team was organised into three groups, structured to represent an administrator, an instructor, and a student. While the design process often begins with end-users presenting complex problems that require innovative solutions, it is crucial for designers to recognise that the problem may not be fully understood at the outset.

Empathy is defined as “the action of understanding, being aware of, being sensitive to, and vicariously experiencing the feelings, thoughts and experience of another without having the

feelings, thoughts and experience fully communicated in an objectively explicit manner” (Merriam-Webster, 2023). Empathy involves the capacity to envision oneself in another individual’s circumstances, gaining a genuine understanding of the world from their perspective within a specific context, and understanding their needs and problems (Dam & Siang, 2023). For designers, cultivating empathy for users is crucial for making informed decisions. It is important to grasp the user’s emotional responses during their interaction with a product or interface. By fostering empathy, designers can develop products that resonate with users, enhancing their overall experience. Without this empathetic approach, the design process lacks the essential user-centricity that often determines the success or failure of a product. Therefore, each stage of design thinking must focus on the user and be guided by empathy. To cultivate empathy, participants initiated the process by posing questions, on two occasions (interviews), to each stakeholder representative within their team. In addition, and to understand the problem or need more clearly, notes were taken. Following this, team members actively listened to the participants’ stories, concentrating on absorbing the nuances of their experiences. Moreover, they paid close attention to the stakeholders’ body language and reported their observations through notetaking. The goal was to document and capture the essence of the stakeholders’ experiences, creating a comprehensive record while adopting an empathetic approach.

The researcher acknowledged that a mistake occurred in the design of the first interview. Best practices from Design Thinking advise that during the Empathise phase, one should not ask for opinions or expectations directly. Instead, needs and problems should be derived from analysing interviews and observations. However, during the first interview, participants completed a worksheet with questions such as: What do you expect from a chatbot in an LMS? What should it be able to do for you? What should it not do? How should it do this? These questions were considered from the perspectives of a student, an instructor, and an administrator. See Figures 5.2 to 5.4 below for screenshots with example worksheets. The rest of the worksheets are available in Appendix C.

What do you expect from a chatbot in an LMS?

Some leading questions:

- **What** should it be able to do for you?
- **What** should it not do?
- **How** should it do this?
 - As a **student**
 - As an **instructor**
 - As an **administrator**

user friendly
track the number of students
how courses

How = increase bandwidth
= give instant feedback to multiple students at the same time

1 Interview with ... Student

- ① use different languages - detect spelling errors
- ② 24/7 assistance
- ③ file directory
auto spell checker
Voice recognition
- ④ no limits (unsupervised learning) (multi display)
- ⑤ ~~track~~ cookies to keep track
- ⑥ tutorials to use LMS

≠ limit the time period.

≠ restart canvas / cant last activity

≠ put them in a queue

Figure 5.2: Participant Worksheet 1: Interview with student

What do you expect from a chatbot in an LMS?

Some leading questions:

- **What** should it be able to do for you?
- **What** should it not do?
- **How** should it do this?
 - As a **student**
 - As an **instructor**
 - As an **administrator**

1 Interview with ... Instructor

what to do:-

1. Provide answers to any questions
Knowledgeable in the field of the possible questions
2. FAQs + Commonly asked questions.
Knowledge database.
3. Making provision for visually impaired or any disability conditions.
4. Language translation ability.
5. Moderator Service - in the case where the bot is unable to answer the question.
6. Question Tracking to assist updates.

What not:

1. Inactive on exams for subjects using proctoring.
2. Not able to answer any subject related questions
3. Direct students, instead of providing info on subject.

Figure 5.3: Participant Worksheet 1: Interview with instructor

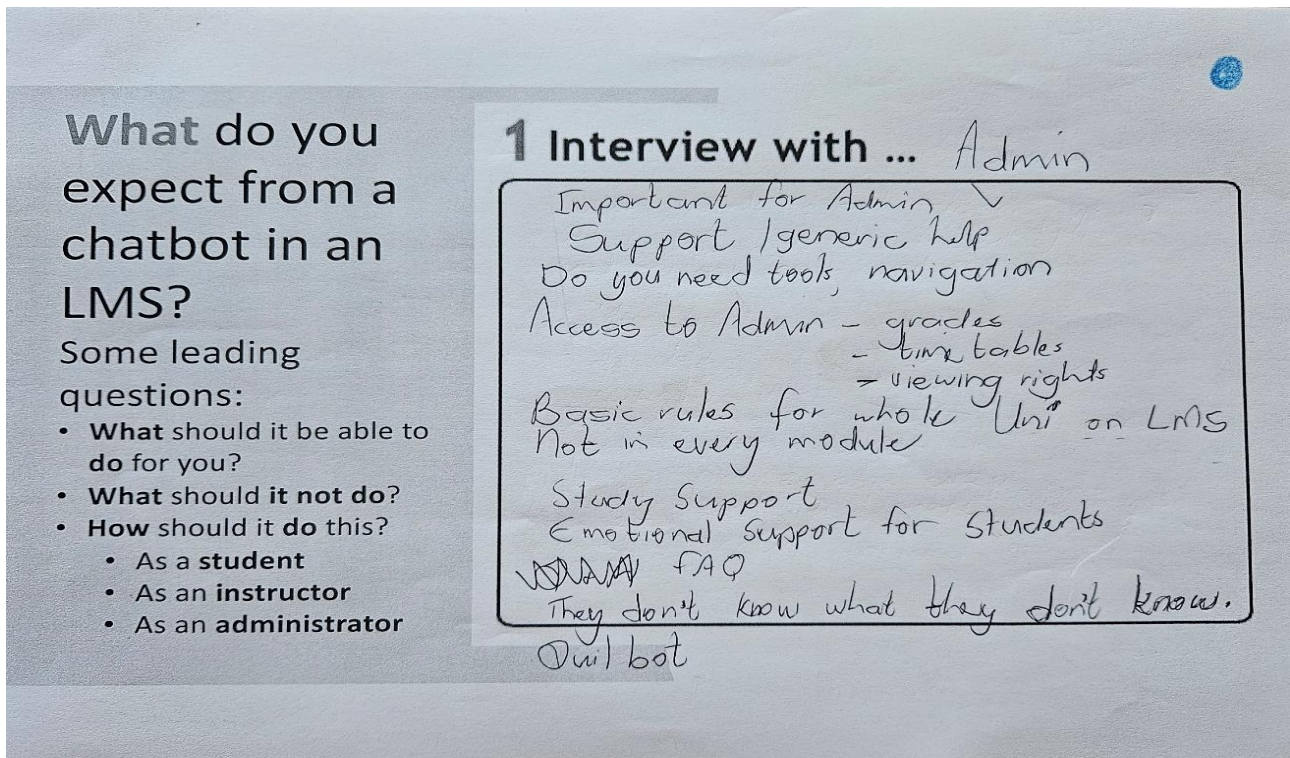


Figure 5.4: Participant Worksheet 1: Interview with administrator

Following the initial interview, which asked “what” type questions, the team members gathered a significant amount of information regarding expectations for a chatbot in an LMS. Subsequently, they needed to conduct a second interview, aimed at uncovering the implicit reasons for these expectations. This involved asking probing “why” questions to understand the underlying motivations. These questions were designed to determine the reasons why they had those expectations for a chatbot in an LMS. They were advised to identify opportunities, unexpected insights and tensions, while taking into consideration the perspectives of students, instructors and administrators. The goal was to delve deeper into the reasons behind these expectations and gain a more nuanced understanding of the stakeholders’ perspectives.

After sharing initial ideas, the team engaged in more in-depth inquiries to uncover the reasons behind user expectations, aiming to reveal unexpected insights and potential tensions. These probing questions were directed at participants in their roles as students, instructors, and administrators. Figures 5.5 to 5.7 provide examples of the findings from these interviews. Additional worksheets are available in Appendix D.

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... Student. (Dig deeper)

Why

- Prefer human intervention to clarify any uncertainties - in the case where the chatbot cannot provide answers.
- Easier to schedule appointment.
- Reduce waiting time.
- Share questions & answers to all students to keep all students informed to reduce replication of questions. eg. shy students who are too shy to ask.
- If a student is not in class, it will prompt them to investigate or study further.
- Less interference amongst students, interfering with each other's study time.
- To improve time management & Reduce incomplete work.
- Assist with revision - class generated work/content.
- Accuracy of info-providing legit information & content.
- Reduce everyone's workload.

Figure 5.5: Participant Worksheet 2: Interview 2 with student

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... Instructor (Dig deeper)

Why

- Solve queries*
 - + Reduce physical consultation
 - + Help student get feedback immediately & instruct use time admin work
 - + Have a lot of workload, help student getting feedback even at night, anywhere anytime, save them time, stop procrastinating. the lecturer.
 - + Help student to consult with ~~consultation~~
- Why Provide files?*
 - + Why Give them files ~~files~~ & download them
 - + Get enough content
- Why Immediate feedback*
 - + Allow students to study anytime
 - + To see students progress
 - + Aware with their performance.
 - + Catch-up class & offer consultations

Figure 5.6: Participant Worksheet 2: Interview 2 with instructor

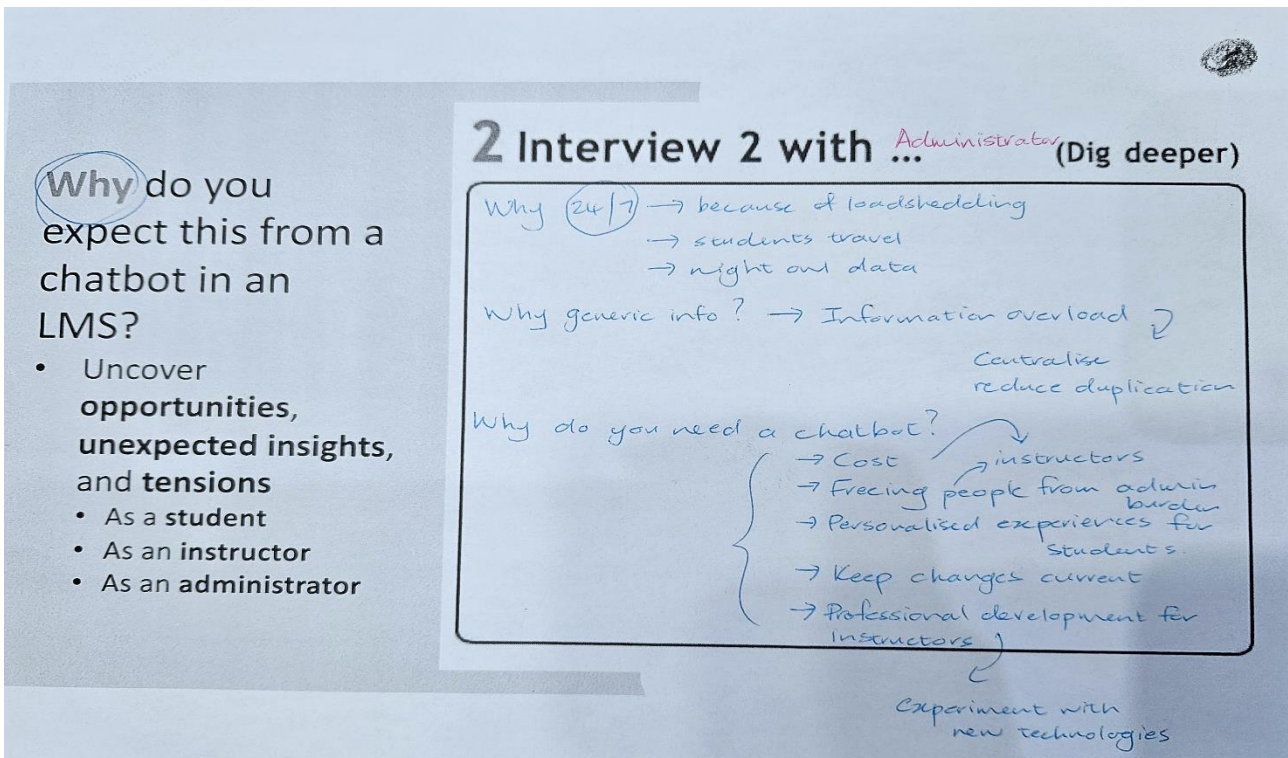



Figure 5.7: Participant Worksheet 2: Interview 2 with administrator

5.1.2 Stage 2: Define

The "define" stage aimed to identify the needs, frustrations, and problems users experienced while working in an LMS (Dam & Siang, 2023). The point-of-view (POV) statement was explained as including a description of the user, their specific need, and the corresponding insight related to that need. Using an empathy map, participants defined the scope of their project, which was then succinctly described in a POV statement. This statement served as the foundation for designing better solutions. The team was tasked with developing POV statements for the user types they represented, using these statements as a guiding force for the design. See Figures 5.8 to 5.10 for example POV statement worksheets completed by the participants. Additional worksheets are included in Appendix E.


Student (Studying 2nd Year Education)
User's name/description

needs the LMS chatbot to improve effective learning Experience
user's need


Surprisingly/because/but . . .
[circle one]

Easy access to lectures to ensure timely confirmation of correct information of correct info to ensure deadlines are met
Sharing of key information with all stakeholders
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

Figure 5.8: Participant Worksheet: POV statement of student


Instructor
User's name/description

needs the LMS chatbot to assist and support
user's need

Surprisingly/because/but . . .
[circle one]

I want my work to be easier, students will benefit as I have more time to teach.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

Figure 5.9: Participant Worksheet: POV statement of instructor

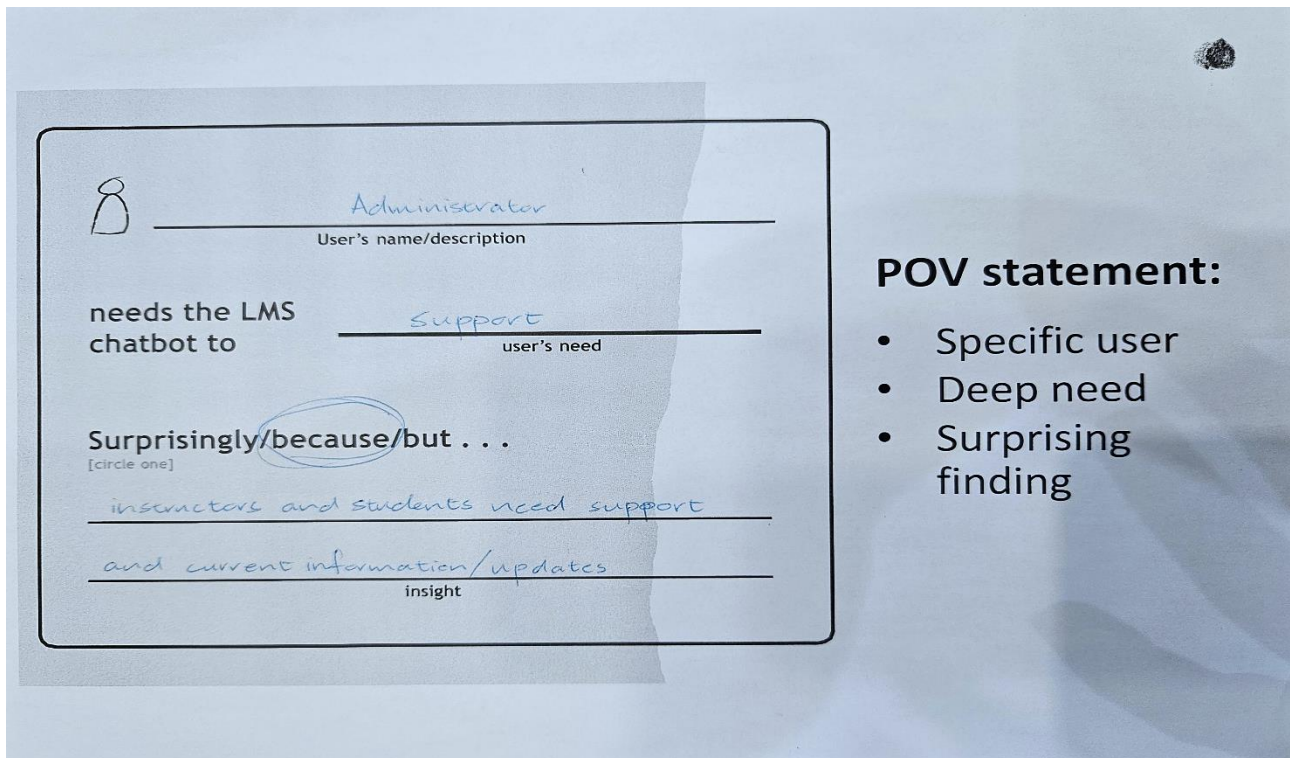


Figure 5.10: Participant Worksheet: POV statement of administrator

5.1.3 Stage 3: Ideate

Once the problem was well defined, the subsequent stage involved solution ideation, a process that challenges assumptions and generates ideas (Dam & Siang, 2023). This stage was characterised by high-energy activities, emphasising the enthusiasm and engagement of individual team members. Ideation often involves interactive efforts and considerable noisy crosstalk. The focus was on brainstorming around the established POV statement to address the identified needs.

A key technique for generating ideas involved using "how might we" statements (Gottlieb, Wagner, Wagner, & Chan, 2017). These statements prompt action-oriented brainstorming, such as designing, implementing, developing, or changing specific aspects. For example, a "how might we" statement could be "How might we find and supply academic resources?" Ideas were generated based on insights from design team members through collaborative group work, participant worksheets, and interactions with LMS users.

The ideation process aimed to create a broad and diverse range of potential solutions. Participants engaged in clustering activities to group similar ideas, which helped in

identifying common themes and areas of focus. This clustering facilitated a clearer understanding of the problem and highlighted key areas for innovation.

After generating a wide array of ideas, the team shared their concepts. The ideas considered originated from the participants (Appendix G), ensuring that the prototype closely aligned with their needs and insights. By integrating these participant-driven ideas as extensively as possible, the prototype was tailored to address real-world challenges and enhance UX effectively. These ideas were captured in Figma, which provided a platform to visualise and reflect upon them, inspiring further creative and novel solutions. The final step involved selecting the idea with the most traction, considering it as a potential product or service, and envisioning its form and function. Figure 5.11 illustrate the prominent ideas shared by the design team, specifically for administrators, showing how the ideation process influenced the design of the prototype. The rest of the Figma screenshots are included in Appendix G.

5.1.4 Stage 4: Implementation

Once ideas are generated, they can be organised into common themes to guide the “prototyping” portion of the design thinking process. “Prototyping” involves creating low-fidelity models of a proposed solution based on the ideas generated during the “ideation” stage. During this specific design thinking workshop, a very basic LMS chatbot prototype was created. Figure 5.11 illustrates an idea given to the team indicating what a possible solution might look like. The rest of the Figma screenshots are included in Appendix G.

The team experienced this stage as fun, seeing how their contributions were visualised.

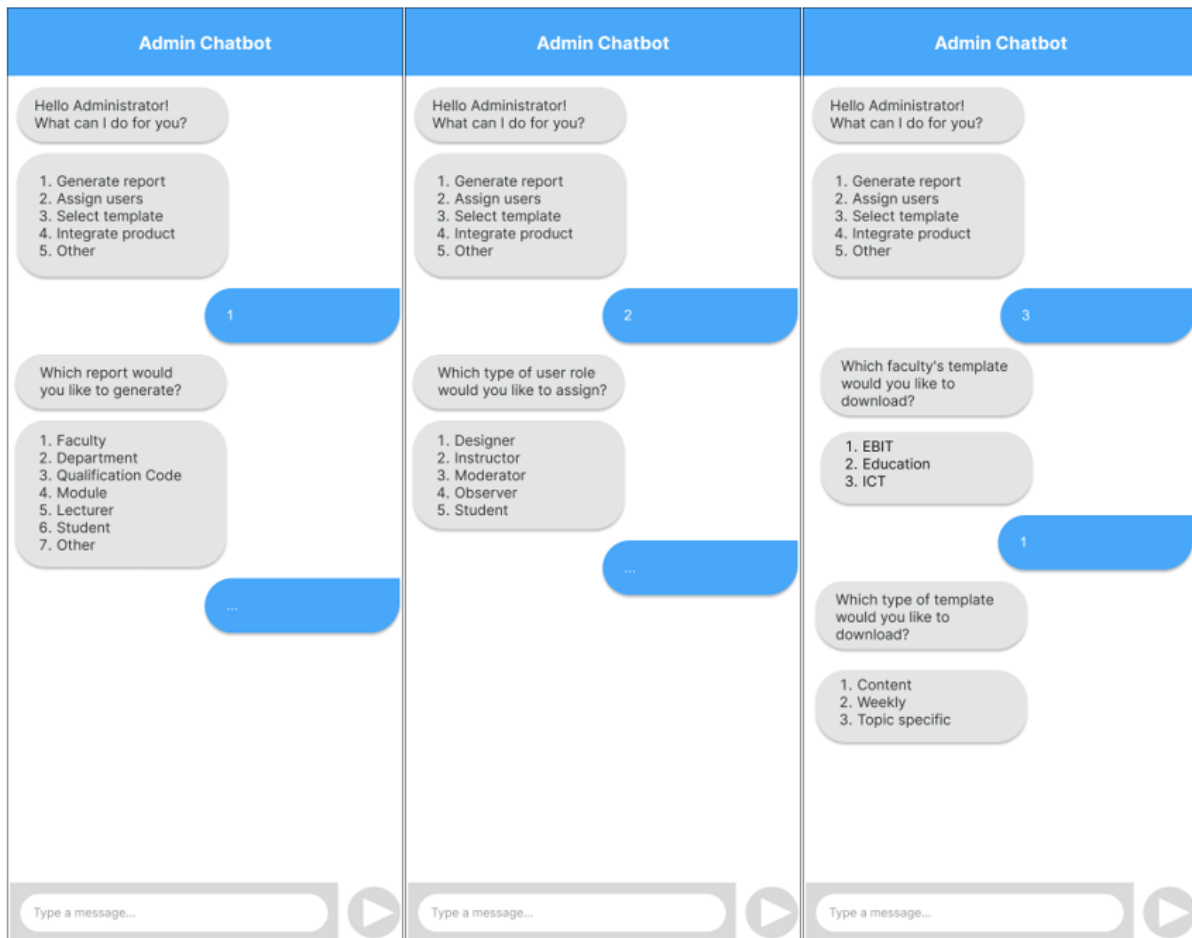


Figure 5.11: Figma screenshot for administrative users

The LMS chatbot prototype was built during the workshop by a postgraduate IS student, and the LMS users (design team) acted as co-designers during the process. This phase allowed participants to select and develop ideas from the ideate phase that users felt may work. The objective was to build a fast, low-cost version of the product so that, if it fails, it will “fail fast and fail cheap” (Petersen & Killian, 2023). By adopting a prototyping approach, teams avoided spending significant amounts of time and money on efforts that do not meet their users’ requirements. Note that the LMS chatbot prototype is not considered the desired artefact of the DSR process, the artefact is the tentative set of design principles, described in Section 5.3. The screenshots were used, inter alia, to develop the design principles. The basic structure and preferred layout of the chatbot were proposed and discussed during the design thinking workshop. By referring to the screenshots and regularly revisiting the audio recordings and transcripts, the researcher could draw insights from the prototype and what the users indicated they would like to experience.

5.1.5 Stage 5: Test

The design process typically advances to the "test" phase, a crucial stage where researchers gather insights into user preferences and refine the prototype, establishing a preliminary set of design principles (Dam & Siang, 2023). Although the screens created in Figma for this study were not active or integrated into an LMS, they effectively represented the LMS chatbot design principles. Informal feedback was gathered from LMS users during the design thinking workshop when the Figma screens were developed. This testing phase centered on sharing, illustrating, and visualising user needs and preferences for the desired look and feel of an LMS chatbot.

It's important to note that the testing primarily involved informal feedback, focusing on understanding and incorporating user perspectives rather than formal testing procedures. Additionally, it's crucial to emphasise that the chatbot itself was not the design artifact developed during the workshop.

5.1.6 Summary of design thinking workshop outputs

The data was analysed with elements of the UX honeycomb model and activity theory in mind: capturing the perspective of end-users, specifying actions or tasks undertaken, identifying the goal or objective, and detailing the challenges or requirements encountered throughout an LMS user journey. The analysis incorporated transcripts of audio-recordings, observations and field notes that are available at request, participant worksheets (Appendices C to F) and Figma screenshots (Appendix G), which were analysed and interpreted to develop the design artefact, which embodied a tentative set of design principles.

Throughout the design thinking workshop, team members displayed a relaxed and collaborative approach to their work. Notably, no instances of tension or conflict were observed, fostering a positive and productive atmosphere conducive to the design team's activities.

The formulation of design principles for LMS chatbots, with the goal of enhancing the overall UX in HEIs, should be customised to address the specific requirements of LMS users, aligning seamlessly with the principles of activity theory. This tailored approach aimed to holistically improve the overall UX, addressing the distinctive challenges and demands encountered by LMS users. However, upon analysing the data, it was observed that the

diverse needs of LMS users were not unique to each LMS user group. Instead, there were overarching, generic needs related to features and functionalities that can be effectively addressed through the implementation of a chatbot.

5.2 THE DEVELOPMENT OF DESIGN FEATURES AND DESIGN PRINCIPLES

The output from the design thinking workshop was analysed to propose a tentative set of design principles with associated design features in accordance with the schema reported in Section 3.1. Gregor et al.'s (2020) schema for the formulation of design principles includes the well-established elements of design principles, such as contextual goals and the means to accomplish them. For this study, the researcher was influenced by the third category, as illustrated in Table 3.1, following the components, as illustrated in Table 3.2, for the design and development of design principles. The reason for choosing this specific schema lies in its user-centric approach, emphasising the activities users should be able to perform with the artefact, and defining the essential characteristics it should possess. This choice aligns with the study's objectives, aiming to create a design that is not only functional and usable, but also contextually relevant and informed by a holistic understanding of user interactions.

In alignment with this comprehensive approach, the development of this study's artefact progressed through the integration of design features and design principles. Design features were identified and incorporated, outlining the specific functionalities and characteristics that were essential for addressing the identified problems and enhancing the UX.

The components of the design principle schema (Gregor et al., 2020) (Table 3.2) was systematically applied to illustrate how the researcher used the schema to formulate the design principles.

The development of the first design principle, "responsive interaction", is given below as an example of the formulation of the design principles. The structure of the design principle was defined by identifying the implementer's aim to optimise the UX within a specific context – the LMS. Components such as the aim, implementer (LMS chatbot developers) and users were clearly outlined. The context considered factors like technical constraints, implementation settings and user characteristics, which influenced the responsiveness of the chatbot. Mechanisms, including acts, activities, processes, form/architecture and the manipulation of other artefacts, were specified, and involved enactors like LMS administrators and users. Recognising the existence of subsidiary components highlighted

the possibility that specific features within the chatbot system could warrant their own design principles. Lastly, the rationale provided a solid justification for the design principle, grounded in user-centric design theories and empirical evidence, emphasising the importance of timely and helpful interactions for optimal user satisfaction within digital interfaces.

Table 5.1: Example of the schema layout of Design Principle 1 (Gregor et al., 2020)

Design principle: Responsive interaction	
Structure	Components
For Implementer (I) to achieve or allow Aim (A) for User (U)	<p>Implementer (I): Develop and maintain an LMS chatbot.</p> <p>Aim (A): Optimise the UX by ensuring a smooth and efficient conversation through responsive interaction.</p> <p>User (U): Individuals interacting with the LMS chatbot.</p>
in Context (C)	<p>Context (C): The design principle is applicable within the context of the LMS. It considers boundary conditions (for example, technical constraints), implementation settings (for example, integration with the LMS interface) and user characteristics (for example, students, instructors), which influence the responsiveness of the chatbot.</p>
Employ Mechanisms (M) M1, M2, M3... involving Enactors (E) E1, E2, E3,...	<p>Mechanisms (M):</p> <p>Acts: Promptly interpreting and responding to user input.</p> <p>Activities: Regularly updating the chatbot's knowledge base for relevance.</p> <p>Processes: Employing algorithms for efficient information retrieval.</p> <p>Form/architecture: Designing an intuitive conversational interface.</p> <p>Manipulation of other artefacts: Integrating with the LMS for seamless interaction.</p> <p>Enactors (E):</p> <p>E1: LMS administrators responsible for chatbot maintenance.</p> <p>E2: Users initiating and participating in chatbot interactions.</p> <p>Subsidiary components/artefacts that can have their own design principles: Recognise that, within the LMS chatbot system, specific features (for example, NLP module, knowledge base) may have their own design principles.</p>
Because of Rationale (R)	<p>Rationale (R): Responsive interaction enhances the UX by minimising response time, thereby facilitating efficient communication and information retrieval. This principle is supported by user-centric design theories and empirical studies that emphasise the importance of timely and helpful interactions for optimal user satisfaction within digital interfaces.</p>

Below are the codes and themes derived from the design thinking workshop. These encompass the audio recordings and participant worksheets, organised according to the diverse roles of the participants (Tables 5.2 to 5.5).

Table 5.2: Codes and themes resulting from the design thinking workshop's audio recording

Codes	Themes	Evidence (place in recordings)
Soft tone	Responsive interaction	34:30 minutes
User-centric design		
Collaboration		
Interaction tools assistance		01:03:19 minutes
Instant response		
User engagement and interaction		37:39 minutes
Personalised guidance		
Personalisation of LMS		32:30 minutes

Codes	Themes	Evidence (place in recordings)
Customisation of LMS Language preference		
Stay on topic NLU	Focused conversation	
Help/assistance Transparency on limitations	Transparency on capabilities and limitations	37:39 minutes
Autonomy	Opt-out functionality	
Soft tone Emojis Formality of responses Language preference	Appropriate tone and language	34:30 minutes 1:20:00 minutes
Different language styles NLU, Intelligent agent activation Intelligent agent as how-to assistant Stay on topic	NLU	1:19:30 minutes
Visual design Emojis Avatar Colour Pretty Calendar (academic and social) User interface and design	Engaging visual elements	32:30 minutes 33:15 minutes 29:55 minutes 29:57 minutes 01:36:01; 01:29:29 minutes
Intelligent agent activation	Ensure 24/7 availability	
Different language styles Multilingual options Language preference	Embrace multilingual support	01:13:11 minutes 01:15:49 minutes 01:16:12 minutes
Personalisation of LMS Customisation of LMS Third-party integration (for example, Turnitin) Navigation assistance on campus	Seamlessly integrate into an LMS platform	01:43:54 minutes 01:32:54 minutes 1:32:57 minutes
Reports Tracking Learning analytics gap Assessment creation Continuous improvement Comprehensive support Learning style and development User engagement and interaction	Progress tracking and recommendations	13:18; 37:41; 01:04:39 minutes 37:43; 01:05:15 minutes 37:18 minutes 37:50 minutes
Accessing resources Privacy and data security	Privacy and data security	1:31:57 minutes
Error support Continuous improvement through feedback	Error handling and graceful recovery	1:34:54 minutes
Intelligent agent activation Human-agent handover Error support	Human-agent handover	1:36:50 minutes
Continuous improvement User needs Preferences Transparency on limitations	Continuous improvement through feedback	36:30 minutes

Codes	Themes	Evidence (place in recordings)
Soft tone Emojis Avatar Comprehensive support User engagement and interaction Warm personality	Engaging personality	34:30 minutes 33:15 minutes 29:46 minutes 32:21 minutes
Accessing resources Calendar (academic and social) User interface and design Academic resources Help/assistance Mental health	Information and resources	01:34:16 minutes 01:36:01; 01:45:27 minutes 01:33:57 minutes 35:10; 36:30 minutes 01:31:33 minutes

Table 5.3: Codes and themes resulting from the design thinking workshop student worksheets

Codes	Themes	Evidence
Notifications Share information	Notifications and information	Interview 1 with student: brown Interview 1 with student: brown
Interactive chatting Ask/understand questions	Interactive guidance	Interview 1 with student: brown Interview 1 with student: brown
Enable collaboration and interaction in class Access to class-generated content	Collaboration and content access	Interview 1 with student: red Interview 1 with student: red
Use different languages	Multilingual assistance	Interview 1 with student: orange
File directory	File management	Interview 1 with student: orange
Voice recognition Correct spelling errors Instant feedback when students access it simultaneously Have a large bandwidth to handle many student queries No limits Unsupervised learning	Advanced features	Interview 1 with student: green Interview 1 with student: orange Interview 1 with student: green Interview 1 with student: green Interview 1 with student: orange Interview 1 with student: purple Interview 1 with student: purple
Predetermined questions Track digital footprint Provide tutorial on how to use LMS Immediate feedback Tolerance to handle a lot of queries at the same time Ability to provide text and numbers Automated Saving conversation User-friendly	Learning preferences and support	Interview 1 with student: blue Interview 1 with student: purple Interview 1 with student: purple Interview 1 with student: orange Interview 1 with student: orange Interview 1 with student: purple Interview 1 with student: purple Interview 1 with student: purple Interview 1 with student: purple
Navigation within subjects/courses Glossary Basic concepts Guidance to revision Navigation to admin functions, such as registration, etc. Prerequisites of a subject. Credits (subjects), changing course and transfer	Navigation assistance	Interview 1 with student: black Interview 1 with student: blue Interview 1 with student: black Interview 1 with student: black Interview 1 with student: black Interview 1 with student: black Interview 1 with student: black Interview 1 with student: black

Codes	Themes	Evidence
Immediate support Social events Mental health Provide guidance rather than detailed replies Glossary Register online Course information Prerequisites of the course Indicate exemptions Hotline for mental health Guide to independent learning Appointments with lecturer Updates and reminders of submissions Offer 24/7 assistance Interaction in classes Collaboration Access to class-generated content Academic resources How to find and supply academic resources Correction and highlight errors in references Electronic guide to referencing	Comprehensive support services	Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: black Interview 1 with student: black Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: blue Interview 1 with student: pink Interview 1 with student: purple Interview 1 with student: brown Interview 1 with student: orange Interview 1 with student: pink Interview 1 with student: pink Interview 1 with student: pink Interview 1 with student: pink
Various limitations such as not providing subject work, not giving lessons, not doing connections for the student, not restarting conversation when the network fails/ documents uploading, having a limited time period, not giving direct answers, not explaining work over, providing summaries or overviews.	Listed limitations	Interview 1 with student: blue
Do not restart conversation when the network fails/documents uploading Forget the conversation when the system fails Have a limited time period Short period of login and automatic log out Put them in a queue	Network and system handling	Interview 1 with student: green Interview 1 with student: purple Interview 1 with student: red Interview 1 with student: purple

Table 5.4: Codes and themes resulting from design thinking workshop instructor worksheets

Code	Theme	Evidence
Accessible for disabled students	Accessibility	Interview 1 with instructor: brown
Available 24/7		Interview 1 with instructor: blue
Easy to update		Interview 2 with instructor: brown
Limit language barrier		Interview 2 with instructor: brown
User-friendly		Interview 2 with instructor: orange
Communication		Interview 1 with instructor: brown
Multimodal input		Interview 1 with instructor: purple
Responsive		Interview 1 with instructor: brown
Knowledgeable		Interview 1 with instructor: brown
Share accurate info	Accuracy and reliability	Interview 1 with instructor: blue
Reliable		Interview 2 with instructor: yellow

Code	Theme	Evidence
Quality and Integrity	Effectiveness	Interview 1 with instructor: light blue
Accuracy		Interview 2 with instructor: yellow
Inclusive studies		Interview 2 with instructor: brown
Tutorials		Interview 1 with instructor: light blue
Effective		Interview 1 with instructor: brown
Navigation		Interview 1 with instructor: light blue
Enhance learning		Interview 1 with instructor: purple
Timely		Interview 2 with instructor: purple
Update		Interview 2 with instructor: brown
Manage deliverable		Management and support
Tracking	Interview 1 with instructor: brown	
Manipulate data	Interview 2 with instructor: orange	
Support	Interview 1 with instructor: blue	
Time management	Interview 2 with instructor: purple	
User-friendly	User-friendly interface	Interview 2 with instructor: orange

Table 5.5: Codes and themes resulting from design thinking workshop administrator worksheets

Codes	Theme	Evidence
Accessible via audio, text, file	Accessibility	Interview 1 with administrator: green
Adaptable		Interview 2 with administrator: black
Availability		Interview 2 with administrator: black
Communicate		Interview 1 with administrator: red
Controlled		Interview 2 with administrator: pink
Deliverable		Interview 2 with administrator: blue
Accurate	Accuracy and reliability	Interview 2 with administrator: pink
Assured		Interview 2 with administrator: green
Reliable		Interview 2 with administrator: pink
Trustworthy		Interview 1 with administrator: pink
Integrity		Interview 1 with administrator: black
Effective	Effectiveness	Interview 2 with administrator: blue
Enhance learning		Interview 2 with administrator: blue
Goal-orientated		Interview 1 with administrator: purple
Rapidly communicate		Interview 2 with administrator: blue
Delegation of tasks	Management and support	Interview 1 with administrator: pink
Guide		Interview 1 with administrator: black
Manage time		Interview 1 with administrator: green
Product integration		Interview 1 with administrator: red
Support		Interview 1 with administrator: black
Filter, manage and manipulate data		Interview 1 with administrator: pink

Codes	Theme	Evidence
Helpful	User-friendly interface	Interview 1 with administrator: purple
Innovative tool		Interview 1 with administrator: black
Navigation		Interview 1 with administrator: green
Power users/admin		Interview 1 with administrator: purple
Time management		Interview 1 with administrator: pink
Enhance usage		Interview 2 with administrator: pink
Easy to update		Stakeholder Admin Findings: blue
User-friendly		Interview 1 with administrator: green
Limit frustration & annoyance		Interview 1 with administrator: red

To identify common themes across the various tables, the researcher analysed the themes presented in each table and searched for overlapping or related concepts. A consolidated summary, capturing common themes found in Tables 5.2 to 5.5, is presented in Table 5.6.

Table 5.6: Consolidated Table that captures common themes in Tables 5.2 to 5.5

Common themes	Table 5.2	Table 5.3	Table 5.4	Table 5.5
24/7 availability	✓		✓	
Accessibility	✓	✓	✓	✓
Accuracy and reliability				✓
Appropriate tone	✓			
Comprehensive support services		✓		
Continuous improvement through feedback	✓			
Effectiveness				✓
Engagement (interactive guidance, collaboration)	✓	✓		
Engaging personality	✓			
Error handling and graceful recovery	✓			
File management		✓		
Human-agent handover	✓			
Information access	✓	✓	✓	
Information and resources	✓			
Interactive elements (visual elements, guidance)	✓			
Learning preferences and support		✓		
Management and support				✓
Multilingual support	✓	✓	✓	
NLU	✓			
Notifications and information		✓		
Opt-out functionality	✓			
Privacy and data security	✓			
Problem solving and feedback			✓	

Common themes	Table 5.2	Table 5.3	Table 5.4	Table 5.5
Student query management			✓	
Transparency on capabilities and limitations	✓			
User-friendly interface				✓

Table 5.6 summarises the common themes identified across the different data sets collected during the design thinking workshop. Note that the “✓” indicates the presence of the theme in the respective table. If a theme is not present in a particular table, it is left blank for clarity.

Design principles often guide the development of products, services or systems to ensure that they meet specific criteria and objectives. Table 5.7 gives an indication of how the common themes presented in Table 5.6 relate to the tentative set of design principles (Section 5.1). While there may not be an exact one-to-one correspondence, the researcher identified connections based on common themes, qualitative interpretation and understanding.

Table 5.7: Explanation of how the themes were used to articulate the tentative set of design principles

Design Principle	Themes	Explanation
Design Principle 1: Responsive interaction	Accessibility, information access	Ensuring that the LMS chatbot promptly responds to user input is crucial to optimise the UX. This principle aligns with the themes of accessibility and information access, emphasising the significance of offering timely and useful information to users.
Design Principle 2: Focused conversation	Engagement, user-friendly interface	Effective conversation management is pivotal to maintain a conversation on the intended topic and prevent unnecessary diversions. This principle aligns with the themes of engagement and user-friendly interface, highlighting the importance of sustaining a coherent and purposeful dialogue with users.
Design Principle 3: Transparency on capabilities and limitations	Transparency on capabilities and limitations	Clearly stating the chatbot’s capabilities and limitations is indispensable for managing user expectations. This principle directly aligns with the theme of transparency on capabilities and limitations, ensuring that users understand what the chatbot can and cannot do to avoid frustration.
Design Principle 4: Opt-out functionality	Privacy and data security	Providing users with the option to opt-out aligns with the theme of privacy and data security.
Design Principle 5: Appropriate tone and language	Engagement, engaging personality	Maintaining an appropriate tone and language in the chatbot’s interactions is crucial for fostering engagement; ensuring that the chatbot communicates in a manner that resonates positively with users and enhances the overall UX.
Design Principle 6: NLU	NLU	The implementation of advanced NLU techniques is crucial for naturally comprehending and interpreting user queries; enhancing the chatbot’s

Design Principle	Themes	Explanation
		capacity to provide pertinent and accurate responses.
Design Principle 7: Engaging visual elements	Engagement, interactive elements (visual elements, guidance)	Incorporating engaging visual elements is essential to enhance user engagement and interaction; emphasising the importance of visually appealing components to make the UX more interactive and enjoyable.
Design Principle 8: 24/7 availability	Availability	Emphasising the importance of continuous availability aligns with the theme of availability.
Design Principle 9: Embrace multilingual support	Multilingual support, accessibility	Offering multilingual support enhances inclusivity and accessibility. This principle aligns with the theme of multilingual support, enabling users to interact with the chatbot in their preferred language; ensuring that the design is accessible to all users, aligning with the theme of accessibility.
Design Principle 10: Seamless integration into an LMS platform	Management and support	The seamless integration of the chatbot into the LMS platform elevates the overall UX. This principle aligns with the theme of management and support, fostering a unified and efficient environment for users.
Design Principle 11: Progress tracking and recommendations	User-friendly interface, effectiveness	Implementing progress tracking and offering personalised recommendations are crucial for creating a user-friendly interface and enhancing effectiveness. This principle aligns with the themes of user-friendly interface and effectiveness, emphasising the importance of helping users track their progress within the system and providing tailored recommendations to optimise their experience.
Design Principle 12: Privacy and data security	Transparency on capabilities and limitations, privacy and data security	Ensuring robust privacy and data security measures aligns with the themes of transparency on capabilities and limitations and privacy and data security. This principle emphasises the critical importance of safeguarding user data and maintaining transparency about the chatbot's capabilities in handling sensitive information, contributing to user trust and confidence.
Design Principle 13: Error handling and graceful recovery	Problem solving and feedback	The chatbot's ability to handle misunderstandings and errors gracefully is essential for minimising user frustration. This principle aligns with the theme of problem solving and feedback, providing informative error messages and suggesting alternative solutions. Focusing on effective problem-solving and feedback mechanisms aligns with the theme of problem solving and feedback.
Design Principle 14: Human-agent handover	Problem solving and feedback	Recognising situations where the chatbot's capabilities are limited, and smoothly transitioning to human support is vital. This principle aligns with the theme of problem solving and feedback, ensuring users receive the necessary assistance.

Design Principle	Themes	Explanation
Design Principle 15: Continuous improvement through feedback	Continuous improvement through feedback	Emphasising the importance of continuous improvement aligns with the theme of continuous improvement through feedback.
Design Principle 16: Engaging personality	Engagement	Developing a friendly and approachable personality in the chatbot contributes to a positive and engaging UX. This principle aligns with the theme of engagement, fostering a stronger connection between users and the chatbot.
Design Principle 17: Information and resources	Information and resources	Furnishing accurate and reliable information on mental health conditions, coping strategies and available resources is important. This principle aligns with the theme of information and resources, guiding users to helpful articles, helplines and support services as needed.

Based on the data sets in Tables 5.2 to 5.5, which included the design thinking workshop's audio recordings and participant worksheets, a tentative set of design principles were formulated (Section 5.3).

5.3 TENTATIVE SET OF DESIGN PRINCIPLES INFORMED BY DESIGN FEATURES

The following section provide an illustration of 17 design principles informed by design features (Tables 5.8 to 5.24) derived from the analysed data obtained during the design thinking workshop (Tables 5.2 to 5.6).

Table 5.8: Tentative Design Principle 1: Responsive interaction

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot must acknowledge the query within seconds by confirming that it is processing the request. • The chatbot must understand the questions posed and provide accurate responses within seconds. • The chatbot should inform the user politely and suggest alternative sources or actions when it encounters a query it cannot answer. • The chatbot should maintain context and reference prior to interactions, so that the user does not have to repeat the question. • The chatbot should proactively offer additional resources or assistance when it detects that the user is struggling. • The chatbot should be available 24/7, ensuring that the user can access help and information whenever needed. 	<p>Design Principle 1: Responsive interaction: Create an LMS chatbot to be responsive to user input and minimise response time to optimise the UX. The chatbot should provide timely and helpful information to users, ensuring a smooth and efficient conversation.</p>

Table 5.9: Tentative Design Principle 2: Focused conversation

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should be capable of recognising and addressing off-topic user inputs, gently guiding the conversation back to the intended subject matter. • The chatbot should maintain a coherent conversation flow by referencing previous user queries and responses, creating a sense of continuity in the discussion. • The chatbot must sustain conversation context, recalling previous interactions and incorporating this knowledge into responses to ensure coherent and context-aware conversations. • The chatbot should respond to each question separately and logically, avoiding confusion when multiple questions are asked within a single message, • The chatbot should refrain from introducing unrelated content during the conversation, focusing solely on providing relevant support and information. • The chatbot should respond with a polite refusal when a user attempts to introduce inappropriate or offensive content. 	<p>Design Principle 2: Focused conversation: Create an LMS chatbot that implements effective conversation management techniques to keep the conversation on topic and prevent the introduction of unnecessary information or distractions. The chatbot should maintain a coherent and purposeful conversation with users, ensuring that their needs are met, and queries are addressed accurately.</p>

Table 5.10: Tentative Design Principle 3: Transparency on capabilities and limitations

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should provide an initial greeting message that includes a brief, but clear description of its role and purpose within the LMS. • The chatbot should proactively clarify its capabilities and limitations by stating what types of queries it can answer and the areas in which it can provide support. • The chatbot must suggest alternative resources or contacts for assistance when it cannot help. • The chatbot should explicitly communicate when it cannot help or when human intervention may be necessary. • The chatbot should periodically remind users of its role and limitations to ensure that expectations remain aligned with its capabilities throughout the conversation. 	<p>Design Principle 3: Transparency on capabilities and limitations: Create an LMS chatbot that effectively manages user expectations by clearly stating the chatbot’s capabilities and limitations. The chatbot should ensure that users have a clear understanding of what the chatbot can and cannot do, avoiding frustration and disappointment.</p>

Table 5.11: Tentative Design Principle 4: Opt-out functionality

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot’s UI should prominently always display a clear and easily identifiable “opt-out” or “end conversation” button or command during the interaction. • The chatbot should immediately acknowledge the opt-out request and provide a polite confirmation message, ensuring that the user’s intent is understood. • The chatbot should also offer users the ability to change the topic or request assistance on a different subject, ensuring they can redirect the conversation as desired. 	<p>Design Principle 4: Opt-out functionality: Create an LMS chatbot with an easily accessible opt-out function within the chatbot’s interface, granting users the freedom to end the conversation or change the topic whenever they desire. The chatbot should empower users to have control over their interactions, enhancing the UX by respecting their preferences.</p>

Table 5.12: Tentative Design Principle 5: Appropriate tone and language

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should have predefined communication profiles or styles that can be dynamically adjusted based on the user’s role or preferences, such as student, administrator or instructor. • The chatbot should be capable of recognising and adapting to user preferences for tone and style, allowing users to customise their chatbot experience. • The chatbot’s tone should always remain friendly and respectful, regardless of the chosen communication style, ensuring a positive and welcoming interaction. 	<p>Design Principle 5: Appropriate tone and language: Create an LMS chatbot that uses a tone aligned with the context and user preferences. The chatbot should be friendly, professional and adaptable to different communication styles, ensuring a positive and engaging experience for users during interactions.</p>

Table 5.13: Tentative Design Principle 6: NLU

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should be equipped with advanced NLU algorithms that enable it to accurately identify and understand common abbreviations and acronyms. • The chatbot should possess a robust synonym database, allowing it to recognise and interpret synonymous terms used by users, ensuring accurate comprehension. • The chatbot should exhibit the ability to interpret paraphrased queries and requests, providing relevant responses even when users express themselves differently. 	<p>Design Principle 6: NLU: Create an LMS chatbot that employs advanced NLU techniques to comprehend and interpret user queries naturally. The chatbot should ensure more fluid and intuitive interactions, as the chatbot understands synonyms, paraphrases and context to provide relevant and accurate responses. Implementing advanced NLU techniques is crucial to enhance the chatbot’s ability to understand and cater to user needs effectively.</p>

Table 5.14: Tentative Design Principle 7: Engaging visual elements

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot’s interface should include an avatar that adds a human touch and creates a welcoming and relatable presence for users. • The chatbot should utilise visually distinct buttons or interactive elements to enhance user comprehension and encourage interaction when presenting multiple-choice options or navigation within the chatbot. • The chatbot should be designed to look and work well on different screen sizes and devices, so that it provides a consistent and engaging UX. • The chatbot’s visual design should incorporate the LMS branding colours, fonts and styles. Visual cues should be used to draw attention to important information or calls to action, making it easier for users to follow instructions or navigate through the conversation. • The chatbot’s interface should seamlessly blend with the overall look and feel of the LMS platform. 	<p>Design Principle 7: Engaging visual elements: Create an LMS chatbot that integrates visually appealing elements, such as avatars or buttons, to enhance engagement. The chatbot should implement visual cues to assist users in understanding available options and make the conversation more interactive and visually stimulating.</p>

Table 5.15: Tentative Design Principle 8: Ensure 24/7 availability

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should be hosted on a trusted and reliable infrastructure, capable of handling increased user load without performance degradation during peak usage times. • The chatbot should implement load balancing and failover mechanisms to ensure redundancy across multiple servers or cloud instances, reducing the risk of downtime due to server failures. • The chatbot should regularly conduct automated health checks to monitor the chatbot's system and components, promptly detecting and addressing any issues that may arise to minimise service interruptions. • The chatbot should implement a 24/7 monitoring system that alerts administrators to any glitches or performance issues, enabling rapid response and issue resolution. • The chatbot should provide advance notice to users and gracefully redirect them to alternative support channels or resources during the downtime. 	<p>Design Principle 8: Ensure 24/7 availability: Develop an accessible LMS chatbot that ensures uninterrupted user support. The chatbot should incorporate redundancy measures to ensure optimal availability and minimal downtime, enabling users to access the chatbot whenever they require assistance, regardless of the time of day.</p>

Table 5.16: Tentative Design Principle 9: Embrace multilingual support

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot's interface should include a language selection option prominently displayed, allowing users to easily choose their preferred language from a list of supported languages. • The chatbot should support a diverse range of languages commonly used by the LMS's user base, ensuring that users can interact in their native or preferred language. • The chatbot should immediately switch its responses to that of the selected language, ensuring that all subsequent interactions occur in the chosen language. • The chatbot should ensure that its knowledge base and responses are accurate and culturally sensitive in each supported language, avoiding misunderstandings or cultural insensitivity. 	<p>Design Principle 9: Embrace multilingual support: Create an LMS chatbot to cater to users who prefer interacting in different languages. The chatbot should incorporate a multilingual option in the LMS chatbot, allowing users to choose their preferred language to enhance inclusivity.</p>

Table 5.17: Tentative Design Principle 10: Seamlessly integrate into an LMS platform

Design features	Design principle
<ul style="list-style-type: none"> • The LMS chatbot should seamlessly integrate with the existing LMS infrastructure and other platforms, tools and data sources, ensuring compatibility and smooth communication. • Users should be able to access a wide range of information and services through the chatbot, including academic and social announcements, progress reports, marks, financial statements, proof of registration and other relevant resources. • Regularly update and maintain the integration to accommodate changes in the LMS environment, ensuring ongoing compatibility and functionality. 	<p>Design Principle 10: Seamlessly integrate into an LMS platform: Develop a cutting-edge LMS chatbot that seamlessly integrates with the LMS platform and other platforms, tools and data sources. The chatbot should serve as a valuable addition to the existing LMS resources and tools, significantly enhancing the overall UX. Ensuring a seamless integration allows users to benefit from a cohesive and efficient environment.</p>

Table 5.18: Tentative Design Principle 11: Progress tracking and recommendations

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should be integrated with the LMS analytics and data tracking systems, allowing it to access real-time data on students' online activity, such as course participation, assignment submissions and assessment results. • Implement machine learning algorithms that analyse students' activity and performance data to identify trends, strengths and areas for improvement. The chatbot should use this information to create personalised profiles for each student. • The chatbot should proactively engage with students, offering personalised recommendations and suggestions based on their profiles and preferences. These recommendations may include additional study materials, relevant courses, peer collaboration opportunities and time management tips, summarising their achievements and highlighting areas where improvement is needed. These updates should be accessible through the chatbot and, if desired, sent via email or notifications. • The chatbot should be capable of answering questions related to students' performance, academic standing and progress towards their goals, providing transparency and clarity. • The chatbot should implement data privacy and security measures to safeguard students' personal and academic information, ensuring compliance with relevant regulations. 	<p>Design Principle 11: Progress tracking and recommendations: Design an LMS chatbot that enhances the chatbot's ability to monitor students' progress and offer personalised recommendations based on their performance and preferences. The chatbot should help students to stay focused and continuously enhance their presence, knowledge and skills within the LMS platform.</p>

Table 5.19: Tentative Design Principle 12: Privacy and data security

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should be designed to collect and store only the minimal amount of user data necessary to fulfil its intended functions, avoiding unnecessary data retention. • The chatbot should implement robust encryption mechanisms to protect user data during transmission and storage, ensuring that it remains confidential and secure. • The chatbot should clearly communicate to users the purposes for which their data is collected and how it will be used within the LMS chatbot, providing transparency and clarity about data usage. • The chatbot should obtain explicit consent from users before collecting any personally identifiable information or sensitive data, ensuring that users have the option to opt-in or opt-out of data collection. • The chatbot should provide users with the ability to access, correct or delete their personal data through the chatbot interface, in compliance with data subject rights, as specified by relevant regulations. • The chatbot should regularly audit and monitor its data handling practices ensuring ongoing compliance with data protection regulations, and promptly address any potential breaches or issues. • The chatbot should implement a comprehensive data protection policy that outlines the chatbot's data handling practices, including data retention, security measures and user rights, making this policy easily accessible to users. • The chatbot should continuously educate and train chatbot operators and administrators on data protection best practices to maintain a culture of privacy and security within the institution. 	<p>Design Principle 12: Privacy and data security: Create an LMS chatbot that adheres to data protection regulations and maintains the privacy and security of user information. The chatbot should be transparent by communicating data usage and storage policies to establish trust and confidence among users, ensuring that their data is handled responsibly and securely.</p>

<ul style="list-style-type: none"> The chatbot should establish procedures for notifying users in the event of a data breach or security incident, in compliance with legal requirements. 	
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Table 5.20: Tentative Design Principle 13: Error handling and graceful recovery

Design features	Design principle
<ul style="list-style-type: none"> The chatbot should be equipped with an error detection mechanism that identifies ambiguous queries or misunderstandings during user interactions. When the chatbot detects a potential misunderstanding or error in the user’s query, it should respond with a polite and informative error message that clearly identifies the issue and explains why the query cannot be processed as-is. The chatbot should employ a friendly and understanding tone in its error messages, avoiding language that may come across as dismissive or unhelpful. The chatbot should implement a feedback loop that collects user input regarding the effectiveness of error messages and suggestions. Use this feedback to continually improve the chatbot’s error-handling capabilities. The chatbot should be capable of recognising and addressing common language or terminology misunderstandings, adapting its responses to align with the user’s intended meaning. The chatbot should continuously refine the error-handling algorithms through machine learning and NLU techniques, allowing it to improve its ability to handle a wide range of user queries and nuances over time. The chatbot should ensure that it can gracefully handle errors or misunderstandings that occur during multi-turn conversations, maintaining conversation context and guiding the conversation back on track. 	<p>Design Principle 13: Error handling and graceful recovery: Design an LMS chatbot to handle misunderstandings and errors with finesse. The chatbot should provide informative error messages and suggest alternative solutions when faced with ambiguous queries. This approach ensures a seamless UX and minimises frustration during interactions with the chatbot.</p>

Table 5.21: Tentative Design Principle 14: Human-agent handover

Design features	Design principle
<ul style="list-style-type: none"> The chatbot should implement a threshold mechanism that identifies when it is unable to adequately address a user’s query or when the user’s request falls outside the chatbot’s capabilities. When the chatbot reaches its limit or encounters an issue beyond its scope, it should politely and clearly inform the user that human support is necessary for further assistance. The chatbot should provide a seamless transition process that allows the user to request human support by simply responding positively or confirming their consent to be connected to the service desk via email. The chatbot should automatically generate an email to the service desk, including relevant details of the user’s query and the chatbot’s responses up to that point to ensure a smooth handover and minimise the need for users to repeat information. The chatbot should notify the user that their request has been forwarded to human support and that they will receive assistance via email shortly. The chatbot should advise the user that the human support is not available 24/7. 	<p>Design Principle 14: Human-agent handover: Design an LMS chatbot to identify situations where the chatbot’s capabilities may be limited, and seamlessly transition to human support through an email to the service desk. The chatbot should prevent user frustration and ensure that users receive the necessary assistance to overcome any challenges they encounter during their interactions with it.</p>

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should ensure that it provides a reference or ticket number to the user, which they can use to track the progress of their support request with the service desk. • The chatbot should continuously monitor and evaluate its limitations and the effectiveness of transitions to human support, using user feedback and metrics to improve the transition process and minimise the need for such transitions over time. • Chatbot operators and service desk staff must be trained to handle transitioned requests effectively and provide a seamless and responsive human support experience. 	

Table 5.22: Tentative Design Principle 15: Continuous improvement through feedback

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should implement a user feedback mechanism within the chatbot interface, allowing users to provide input, suggestions or comments at any point during their interactions. • The chatbot should encourage users to share feedback through friendly and unobtrusive prompts, ensuring that users are aware of the option to provide input without feeling pressured to do so. • The chatbot should gather feedback on various aspects, including its responses, user interface, functionality and overall UX. • The chatbot should regularly analyse and categorise user feedback to identify common themes, trends and areas requiring improvement. • The chatbot should prioritise feedback based on its impact and significance to users, addressing critical issues promptly and planning for iterative enhancements. • The chatbot should establish a feedback loop with users by acknowledging their input and informing them of any improvements or changes made in response to their feedback. • The chatbot should utilise machine learning and NLP techniques to extract insights from user comments and feedback, helping to uncover hidden patterns and opportunities for improvement. • The chatbot should continuously train its algorithms to adapt to evolving user preferences and expectations based on the collected feedback. • The chatbot should regularly communicate the importance of user feedback to LMS service providers, chatbot operators and administrators, emphasising its role in driving continuous improvement. 	<p>Design Principle 15: Continuous improvement through feedback: Create an LMS chatbot that regularly gathers user feedback to identify areas for improvement and optimise performance. Utilise this feedback to iterate and enhance the chatbot's capabilities, ensuring that it aligns with users' evolving needs and expectations. The chatbot should regularly seek user feedback, which will assist in continuously improving its efficiency and user satisfaction.</p>

Table 5.23: Tentative Design Principle 16: Engaging personality

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should have a friendly and approachable personality, including a tone of voice, language style and demeanour that aligns with creating a positive UX. • The chatbot should incorporate conversational elements such as greetings, expressions of empathy and polite language to make users feel valued and respected during interactions. • The chatbot should enhance personalised interactions by addressing users by name (obtained from the integrated systems). • The chatbot should utilise humour or light-hearted language when appropriate and contextually relevant to add an enjoyable and engaging dimension to the interaction. 	<p>Design Principle 16: Engaging personality: Create an LMS chatbot that cultivates a friendly and approachable personality to create a positive and captivating UX. The chatbot should foster a stronger connection between users, which will make the learning process more enjoyable and effective. A friendly and</p>

Design features	Design principle
<ul style="list-style-type: none"> • The chatbot should actively listen to users, demonstrating understanding and empathy when users' express concerns or frustrations. • The chatbot should continuously monitor and analyse user feedback to assess its personality and impact on user engagement and satisfaction. • The chatbot's designers should regularly train its NLP algorithms to fine-tune its conversational skills and ensure that its personality remains engaging and user-friendly. • The chatbot's designers should collaborate with language and communication experts to refine its personality and maintain alignment with the desired UX. 	<p>engaging personality helps to establish rapport and trust, making users more comfortable interacting with the chatbot.</p>

Table 5.24: Tentative Design Principle 17: Information and resources

Design features	Design principle
<ul style="list-style-type: none"> • Develop a comprehensive knowledge base within the chatbot that includes accurate and up-to-date information on various topics and available resources within the institution and on-campus. • The chatbot should implement NLU capabilities to effectively interpret user enquiries. • The chatbot should offer users access to a range of resources, including articles, guides and documents, that provide valuable information on mental health topics and strategies for coping with stress, anxiety, depression and other conditions. • The chatbot should be able to provide contact information for on-campus support services, including counselling centres or mental health professionals, as well as help lines or crisis intervention services. • The chatbot should direct users to reputable external websites or organisations that offer additional health resources and support, ensuring that users have access to a diverse range of information and assistance. • The chatbot should maintain a compassionate and supportive tone when discussing sensitive topics, avoiding judgment and stigma, and encouraging users to seek help when needed. • The chatbot should implement privacy and confidentiality measures to protect user data and ensure that sensitive information, such as issues related to mental health, is handled with care and security. 	<p>Design Principle 17: Information and resources: Create an LMS chatbot that provides accurate, relevant and reliable information. This feature supports users in finding the necessary resources and support for their needs.</p>

5.4 TENTATIVE SET OF DESIGN PRINCIPLES MAPPED WITH THE UX HONEYCOMB MODEL

All the tentative design principles (Section 5.3) can be mapped to the facets of the UX Honeycomb Model (Morville, 2004) (Section 2.7.3 and Table 5.25). Each design principle is aligned with one or more facets of the LMS's usefulness, usability, accessibility, credibility, desirability and findability. Therefore, there are no design principles in the given set that do not map to the facets of the UX Honeycomb Model. Each principle contributes to enhancing the overall UX of the LMS by addressing specific aspects of usability and user satisfaction.

Table 5.25: Tentative set of design principles mapped with the UX Honeycomb Model (Morville, 2004)

LMS chatbot design principles		UX Honeycomb Model (Morville, 2004)
1.	Responsive interaction	Useful: Ensuring that the LMS chatbot promptly responds to the user, minimises response time and optimises the UX. This aligns with the usefulness aspect of UX, as users find the chatbot's responsiveness valuable in obtaining timely information and support within the LMS.
2.	Focused conversation	Usable: Effective conversation management is crucial to maintain a conversation on the intended topic, sustaining a coherent and purposeful dialogue with users. This aligns with the usability aspect of UX, ensuring that users can easily and efficiently interact with the chatbot, enhancing overall usability within the LMS.
3.	Transparency on capabilities and limitations	Credible: The chatbot's capabilities and limitations must be clearly stated to manage user expectations and contribute to the credibility of the interaction. This ensures that users trust the information provided. This aligns with the credibility aspect of UX within the LMS.
4.	Opt-out functionality	Usable: The opt-out functionality grants users control over their interactions, aligning with the usability aspect of UX by respecting user preferences. This enhances the overall usability of the chatbot within the LMS, accommodating diverse user needs.
5.	Appropriate tone and language	Desirable: The use of appropriate tone and language contributes to a positive and engaging UX, aligning with the desirability aspect of UX. This ensures that interactions with the chatbot are not only functional, but also enjoyable within the LMS.
6.	NLU	Useful: The implementation of advanced NLU techniques enhances the chatbot's capacity to provide pertinent and accurate responses. This aligns with the usefulness aspect of UX within the LMS, as users benefit from more effective and relevant interactions.
7.	Engaging visual elements	Desirable: Integrating visually appealing elements enhances engagement, aligning with the desirability aspect of UX. This contributes to a more enjoyable and aesthetically pleasing UX within the LMS.
8.	Ensure 24/7 availability	Accessible: Ensuring 24/7 availability contributes to the accessibility aspect of UX, providing users with uninterrupted support whenever needed within the LMS.
9.	Embrace multilingual support	Accessible: Offering multilingual support enhances inclusivity and accessibility, aligning with the accessibility aspect of UX within the LMS. This ensures that the diverse user base can effectively engage with the chatbot.
10.	Seamless integration into an LMS platform	Usable: The seamless integration of the chatbot into the LMS platform elevates the overall UX, contributing to the usability aspect of UX. This fosters a cohesive and efficient environment for users within the LMS.
11.	Progress tracking and recommendations	Useful: Progress tracking and personalised recommendations enhance the usefulness of the chatbot, helping students stay focused and continuously improve within the LMS platform.
12.	Privacy and data security	Credible: Adhering to data protection regulations and ensuring privacy and data security contribute to the credibility aspect of UX. This establishes trust and confidence among users within the LMS.

13.	Error handling and graceful recovery	Credible: The chatbot's ability to handle errors gracefully contributes to its credibility, minimising user frustration during interactions within the LMS.
14.	Human-agent handover	Desirable: Recognising situations for human-agent handover ensures a desirable UX, providing necessary assistance when required within the LMS. Credible: The incorporation of a chatbot's capability to seamlessly transfer users to human-agent handover significantly bolsters its credibility, effectively increasing the user's trust.
15.	Continuous improvement through feedback	Usable: Regularly gathering user feedback and iterating based on it contributes to the usability aspect by improving efficiency and user satisfaction within the LMS.
16.	Engaging personality	Desirable: Developing a friendly and approachable personality in the chatbot contributes to a positive and engaging UX within the LMS.
17.	Information and resources	Useful: Creating an LMS chatbot that provides accurate, relevant and reliable information supports users in finding necessary resources, aligning with the usefulness aspect of UX within the LMS.

5.5 SUMMARY OF CHAPTER 5: DEVELOPMENT

In conclusion, the mapping of the tentative set of design principles (Section 5.3) with the UX Honeycomb Model (Morville, 2004) reveals a comprehensive alignment between the principles and key facets of the UX of the LMS. The principles address crucial aspects such as usability, desirability, accessibility, credibility and usefulness. By ensuring responsive interaction, focused conversation and transparency on capabilities and limitations, the chatbot promotes a usable and credible interaction with the LMS. Features like opt-out functionality, appropriate tone and language, engaging visual elements and 24/7 availability contribute to the desirability and accessibility aspects, enhancing user engagement and ensuring continuous support. The principles of multilingual support, seamless integration, progress tracking, privacy, error handling, human-agent handover, continuous improvement, engaging personality and information provision collectively contribute to creating a holistic UX. Overall, these design principles provide a robust foundation for the design of an LMS chatbot, promising to possibly enhance the overall UX within the LMS platform by creating a user-centric, efficient and trustworthy interaction.

CHAPTER 6: EVALUATION

The critical phase of evaluation takes centre stage in Phase 4 of the DSR methodology. Evaluating artefacts is an essential aspect of the design process. This process begins with a designer identifying a compelling problem to solve, suggesting a possible solution and developing design solutions. Subsequently, the actual construction and development phase takes place. Once the artefact has been built, the subsequent step involves evaluating its efficiency, utility or performance (Hevner & Chatterjee, 2010).

During this evaluation phase, the researcher addressed SQ7 to determine the extent to which the set of design principles guides the design of an LMS chatbot to satisfy the UX needs of LMS users. To assess the viability and effectiveness of the tentative set of design principles for an LMS chatbot, a carefully planned process was initiated. This process involved the participation of four LMS experts who were entrusted with immersing themselves in a real-life LMS chatbot experience, as discussed in Section 4.5.4. In doing so, the participants gained insight into the functionalities and interactions of a real-life LMS chatbot.

Following their immersive experience with the real-life LMS chatbot, the experts were presented with a structured questionnaire (Appendix H), designed to elicit their insights and evaluations. This questionnaire included Likert-type questions (Section 6.1), yes/no questions (Section 6.2) and open-ended questions (Section 6.3) and were discussed in the same order. The combination of these questions sought to cast a comprehensive net, capturing a multifaceted understanding of the experts' perspectives on the tentative design principles. It was by means of this thorough and well-rounded evaluation process that several pivotal considerations, valuable suggestions and insights came to the fore, all with the overarching aim of refining the presented design principles for a chatbot for LMSs to enhance the UX.

Section 6.4 provides an overview of the discussion of the findings presented. Section 6.5 presents the recommendations of the experts. The recommendations of the experts were incorporated into the final set of design principles, presented in Sections 6.6 to 6.10, respectively, discuss the technical, language, UX and feedback considerations for implementing the LMS design principles.

6.1 STRUCTURED QUESTIONNAIRE: SECTION 1

The first section of the questionnaire presented Likert-type questions, directly associated with the 17 tentative design principles. The column headings signify the Likert scales (1 = strongly agree; 2 = agree; 3 = neutral; 4 = disagree; 5 = strongly disagree). The columns' contents represent the number of expert responses for each value on the scale.

Table 6.1: Visual representation of the answers to the Likert-type questions

Question		1*	2*	3*	4*	5*
1.	How important is it for the LMS chatbot to provide timely and helpful responses to user input to optimise the UX?	4				
2.	How important is it for the LMS chatbot to maintain a coherent and purposeful conversation with users, keeping it on topic and avoiding unnecessary distractions?	2	2			
3.	How important is it for the chatbot to clearly communicate its capabilities and limitations to manage user expectations effectively?	3	1			
4.	How important is it for the chatbot to provide an easily accessible opt-out function, allowing users to end conversations or change topics as desired?	4				
5.	How important is it for the chatbot to use a tone aligned with the context and user preferences to ensure a positive and engaging UX?	3	1			
6.	How important is it for the chatbot to employ advanced NLU techniques to provide more fluid and intuitive interactions?	3	1			
7.	How important is it for the chatbot to integrate visually appealing elements to enhance engagement and interactivity?	1	2	1		
8.	How important is it for the chatbot to be accessible, ensuring uninterrupted user support?	3	1			
9.	How important is it for the chatbot to offer multilingual options to enhance inclusivity?		1	2	1	
10.	How important is it for the chatbot to seamlessly integrate with the LMS platform and other platforms, tools and data sources to enhance the overall UX?	3	1			
11.	How crucial is it for the chatbot to track student progress and offer personalised recommendations?	1	2	1		
12.	How important is it for the chatbot to prioritise user data privacy and security?	4				
13.	How important is it for the chatbot to handle errors gracefully and provide alternative solutions?	4				
14.	How important is it for the chatbot to identify situations that require human support and facilitate handovers?	4				
15.	How important is it for the chatbot to gather user feedback for continuous improvement?	2	2			
16.	How important is it for the chatbot to have a friendly and engaging personality?	2	2			
17.	How important is it for the chatbot to provide accurate information and link to resources, especially regarding mental health support?	3	1			

*1: Strongly agree, 2: Agree, 3: Neutral, 4: Disagree, 5: Strongly disagree

The analysis of the structured, Likert-type questionnaire revealed a nuanced and insightful perspective on the design principles for the LMS chatbot. Participants, comprising a diverse group of four participants with varied expertise, expressed distinct preferences and priorities in relation to the 17 tentative design principles.

The importance of providing timely and helpful responses emerged as a unanimous consensus among participants. This underscores the critical role responsiveness plays in optimising the overall UX within an educational context. Additionally, the significance of maintaining coherent and purposeful conversations was highlighted, with two indicated strong, while two only agree on the importance of this feature. Communication emerged as a key theme, with participants stressing the necessity of the chatbot clearly articulating its capabilities and limitations. Managing user expectations through effective communication was deemed essential, emphasising the role of transparency in fostering a positive UX. Participants uniformly advocated for the provision of an easily accessible opt-out function, allowing users to conclude conversations or shift topics at their discretion. This underscores the importance of user autonomy in shaping their interactions with the chatbot. Aligning the chatbot's tone with context and user preferences emerged as a crucial aspect for a positive and engaging UX. The three out of four experts expressed a preference for a positive and contextually appropriate tone, emphasising the role of emotional intelligence in the interaction. The application of advanced NLU techniques gained significant support, with participants recognising its potential to facilitate fluid and intuitive interactions, thereby enhancing user engagement. While opinions on integrating visually appealing elements exhibited some diversity, there was an overall inclination towards favouring such enhancements for a more engaging UX. Accessibility was unanimously acknowledged as crucial, with participants emphasising the need for the chatbot to be accessible to ensure uninterrupted user support. Multilingual options, although of interest to some, did not receive unanimous approval, indicating varying levels of priority among participants. Seamless integration with various platforms, tools and data sources was deemed important to improve the overall UX, aligning with the participants' vision of a holistic and interconnected learning environment. The significance of tracking student progress and offering personalised recommendations was acknowledged, reflecting the desire to enhance the UX through tailored experiences. User data privacy and security were non-negotiable, as all participants strongly advocated prioritising these aspects in the chatbot's design. Graceful error handling and the provision of alternative solutions were unanimously considered essential to ensure a reliable and smooth UX. Human intervention in certain situations, as well as the

ability to identify scenarios that required handovers to human support, received unanimous approval, emphasising the participants' recognition of the chatbot's supportive role alongside human assistance.

While gathering user feedback was widely recognised as being valuable for continuous improvement, the aspect of providing mental health support within the LMS chatbot evoked a divergence of opinions. While three participants concurred with the importance of supplying precise information and connecting users to mental health resources, one participant, Expert 2, expressed a contrasting viewpoint. Expert 2 made a note at this particular question, and expressed her belief that mental health support did not align with the LMS chatbot's function, indicating a rating of 5 (strongly disagree), in stark contrast to the higher ratings given by others. However, Expert 2 noted that, if Design Principle 17 is only related to providing accurate information and a link to resources, she would give it a rating of 1 (strongly agree). This disparity highlighted the need to examine the role of mental health support within the context of an LMS.

The LMS chatbot's ability to provide information about mental health resources, including counselling services, self-help materials and crisis helplines, is an asset. Anonymity (Design Principle 12) is another benefit as students can engage with the chatbot discreetly, making it a compelling option for those hesitant to seek help in person. Furthermore, by analysing user interactions, the chatbot can identify signs of distress or mental health challenges, enabling early intervention and personalised support. Its 24/7 availability (Design principles 1 and 8) ensure that students can access assistance whenever they need it. The ideal would be if the system has advanced adaptability features to tailor its support resources and recommendations based on individual needs. The LMS chatbot can function as an educational tool by providing content on topics such as mental health and well-being, study methods, stress management, and coping strategies. This approach encourages a proactive and holistic approach to well-being among users. Moreover, to improve its effectiveness, the chatbot can gather user feedback on mental well-being resources and services, enabling continuous enhancement. Additionally, the chatbot can connect users with human counsellors or support services. Ultimately, it possesses the capability to refer students to trained psychologists when required, thus providing a comprehensive solution. The current function is, however, not advanced (Figure 6.1).

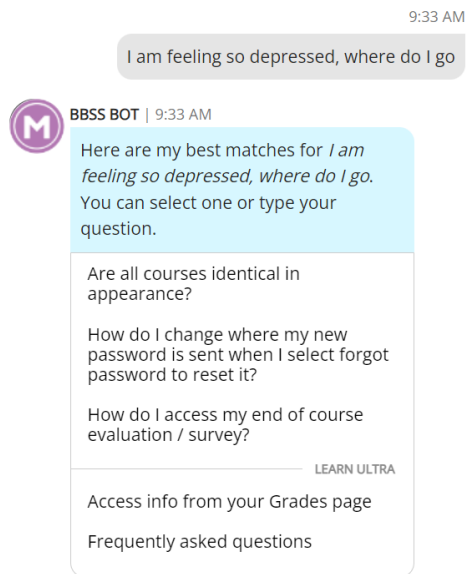


Figure 6.1: Mental health enquiry

To ensure the success of this suggested integration, it is vital to approach it with care, adhering to privacy regulations and ethical standards, upholding user data security, and regularly refining the system based on user input. Furthermore, the chatbot should be seen as a complement, not a replacement, for existing mental health services on campus, thereby ensuring a holistic approach to student well-being.

The analysis of the Likert-type questionnaire provided a comprehensive understanding of the participants' perspectives on design principles for an LMS chatbot. The insights gathered contribute valuable considerations for the development and enhancement of an effective and user-centric set of design principles for an LMS chatbot within an HEI setting.

6.2 STRUCTURED QUESTIONNAIRE: SECTION 2

The analysis of the yes/no questions followed the Likert-type questions and revealed valuable insights into participants' perspectives into the LMS chatbot's performance and the significance of tentative design principles during their interactions with the chatbot. Table 6.2 represents the yes/no questions, while Figure 6.2 is a visual representation of the responses.

Table 6.2: LMS expert evaluation of the yes/no questions

No	Question	Yes	No
1.	Did you experience frustration or irritation when the chatbot was slow to respond?	2	2
2.	Would you like to know the chatbot’s capabilities and limitations during user interactions? Such as: “I can assist you with some administrative tasks, but changing your course enrolment is not within my capabilities. This requires manual intervention by the system administrator or academic advisor. I recommend contacting the relevant department”.	3	1
3.	Did the opt-out function offer you a sense of control?	4	0
4.	Do you think that the chatbot’s tone, aligned with context and user preferences, is important for a good UX? For example, Greeting to a student: Chatbot: “Hello there! How can I assist you today?” Greeting to an instructor: Chatbot: “Good day, instructor. How may I be of assistance with your teaching or administrative tasks?”	4	0
5.	Do you think that multilingual support would improve the UX?	2	2
6.	Do you feel that there are too many design principles?	1	3
7.	While using the LMS chatbot, could you recognise any of the suggested design principles that were mentioned as you interacted with it?	4	0

Figure 6.2 illustrates the answers to the yes/no questions.

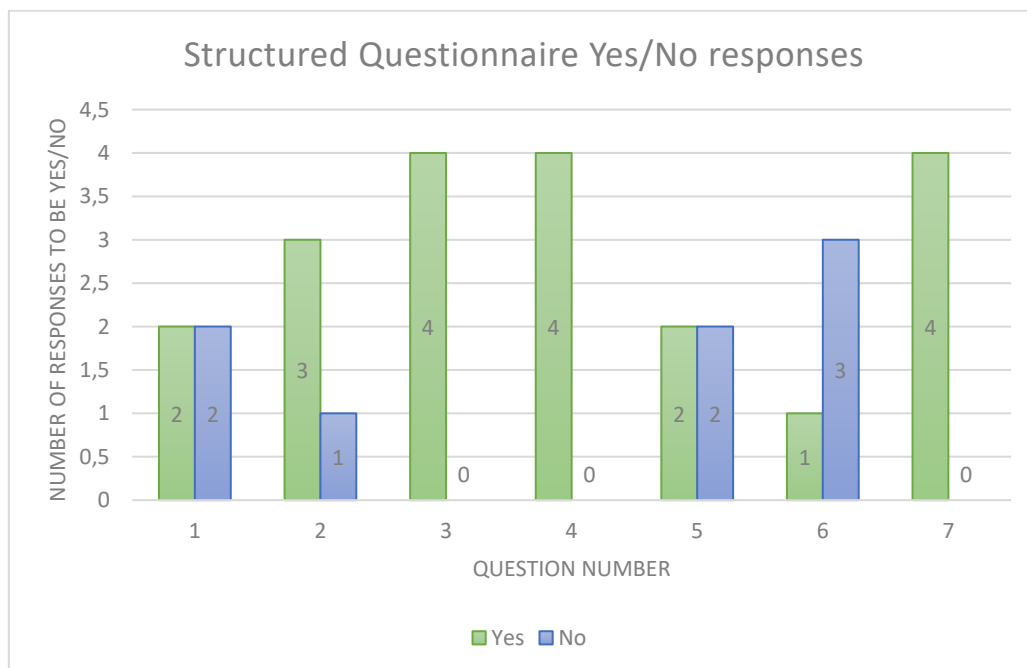


Figure 6.2: Structured questionnaire with the yes/no responses per question

In terms of the chatbot’s response time, two experts reported experiencing frustration or irritation, while the other two experts did not encounter such issues, underscoring the varied nature of UX in this aspect. Regarding understanding the chatbot’s capabilities, three

experts expressed a clear interest, emphasising the importance of transparency. Conversely, one expert did not prioritise this information. All four experts unanimously found the opt-out function valuable, providing a sense of control. Aligning the chatbot's tone with context and user preferences was recognised by all four experts as being crucial for a positive UX. Opinions on multilingual support were divided (two positive, two indifferent), indicating diverse expectations. The majority, consisting of three experts, did not find the number of design principles overwhelming, emphasising the need for balance. All four experts identified some tentative design principles during their interactions with the existing Blackboard LMS chatbot, indicating the relevance of the design principles.

In summary, this refined analysis provides a comprehensive overview of participants' views on the chatbot's performance and the relevance of the tentative design principles.

6.3 STRUCTURED QUESTIONNAIRE: SECTION 3

The open-ended questions that concluded the questionnaire were deemed the most conclusive and valuable. In this section, experts were provided the opportunity to express their opinions and offer valuable suggestions for refining the tentative set of design principles for the LMS chatbot. The overarching goal was to create a more engaging LMS chatbot and enhance the overall UX of an LMS. Each expert's feedback shed light on specific areas of improvement, making it imperative to carefully consider these recommendations.

In this comprehensive examination of the answers to the open-ended questions, several critical insights and recommendations emerged from the feedback provided by the panel of experts. These experts emphasised the importance of context awareness, network connectivity, fairness and inclusivity, continuous improvement through feedback, unobstructed UI, mental health support, navigation, concise responses, an opt-out function, NLU, multilingual support, error handling, human-agent handover, 24/7 availability and transparent communication about capabilities and limitations. The experts also suggested the incorporation of voice input capabilities, multilingual options and customisability for an enhanced UX of the chatbot. Challenges in implementation, such as NLU, multilingual support and maintaining focused conversations, were acknowledged. The critical nature of responsive interaction, focused conversation, transparency, NLU, multilingual support, seamless integration, error handling, human-agent handover, engaging personality and access to information and resources was underscored as a key principle.

Additionally, the experts highlighted the importance of a clear guide to these principles, ensuring they are accessible to a diverse range of designers. Overall, these insights contribute to a holistic understanding of the design principles that are needed to create an effective and user-centric LMS chatbot.

These critical insights and recommendations are discussed in detail in Section 6.4.

6.4 DISCUSSION OF FINDINGS

The examination of expert insights unveils critical considerations for the design and implementation of an LMS chatbot, shedding light on essential elements as discussed in Sections 6.4.1 to 6.4.16. These insights, coupled with recommendations, provide a comprehensive guide for developing an effective and user-friendly LMS chatbot that addresses the diverse needs and challenges within educational environments. The emphasis on critical design principles, challenges in implementation and the importance of clear guidelines adds depth to the understanding of creating a successful LMS chatbot that aligns with user expectations and enhances the overall learning experience.

6.4.1 User recognition and personalisation in chatbot interactions

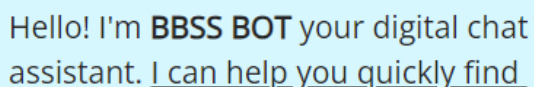
Recognising and addressing users by their names during interactions significantly enhances the UX. This importance is underscored by studies conducted by Jain et al. (2018) and Ogan et al. (2012), both of which highlight the crucial role of this feature in establishing a personal connection between the chatbot and the user. Furthermore, beyond the interpersonal aspect, chatbots can function as connectors to campus and community resources, thereby fostering a holistic support system for users, as noted by Chen et al. (2023).

In addition to the emphasis on personalisation, Expert 1 highlighted the significance of incorporating contextual awareness into the chatbot's design. Specifically, the expert recommended that the chatbot should possess the capability to discern the user's role within the course immediately upon login, utilising user credentials. Subsequently, the chatbot should tailor its responses based on this contextual understanding. Additionally, Expert 1 suggested that the chatbot should be aware of the specific page the user is on within the LMS and provide context-specific support. For instance, if the user is working on an assignment, the chatbot should offer assignment-related assistance. This approach not only contributes to a more tailored and personalised UX, but also reflects awareness of the diverse needs and requirements of different users within the LMS.

6.4.2 Enhancing customer satisfaction through responsive and conversational chatbot interaction

In pursuit of enhancing customer satisfaction through responsive and conversational chatbot interaction, Expert 3 emphasised the importance of the chatbot's response strategy. Rather than providing irrelevant answers, Expert 3 suggested a more transparent approach, proposing the use of a response such as "outside of my range" when the chatbot encountered questions beyond its capabilities. Figure 6.3 is an example of the chatbot's willingness to be responsive and to answer "quickly". Research by Chen, Le, and Florence (2021) supports this viewpoint, highlighting the pivotal role that responsiveness and a conversational tone play in positively influencing customer satisfaction.

Furthermore, Expert 3 commended the chatbot for its quick response time. However, Expert 3 also noted a limitation in conversational interaction, pointing out the absence of options to delve deeper into the conversation. To address this, Expert 3 proposed that the chatbot could respond by acknowledging the user's intent, stating, for example, "I see that you are looking for a location, which is outside of my area of information. Please contact..." or offering an alternative solution, like "I can see you are looking for a location. Try the campus map on the app." Building on these insights, the research of Jiang, Cheng, Yang, and Gao (2022) further underscores the significance of these factors in shaping a positive UX within chatbot services.



Hello! I'm **BBSS BOT** your digital chat assistant. I can help you quickly find

Figure 6.3: Responsive chatbot

6.4.3 Stable network connectivity

Unreliable network connectivity, as experienced by Expert 3 (Figure 6.4), can significantly impact the seamless operation of an LMS, as well as the LMS chatbot. In the context of Expert 3's reported connectivity issues when attempting to transition between user roles, it underscores the critical importance of having a stable network connection when utilising an integrated LMS chatbot. A stable network connection is paramount for several reasons.

Firstly, uninterrupted connectivity ensures the smooth functioning of the LMS chatbot, allowing users to seamlessly navigate the system. Secondly, a stable network connection is essential for timely and responsive interactions with the chatbot. Any disruptions in connectivity can lead to delays in receiving information or assistance, hindering the overall UX. In an

educational environment, where prompt access to resources and support is often critical, a reliable network connection becomes indispensable. Furthermore, a stable network connection contributes to the overall reliability and effectiveness of the LMS chatbot's functionalities. It ensures that data exchange between the user and the chatbot occurs seamlessly, reducing the likelihood of errors or service interruptions. This reliability is particularly crucial to maintain a positive user perception and trust in the LMS and its integrated chatbot. A stable network connection is foundational for the efficient operation of an LMS and its chatbot, impacting the UX, responsiveness and overall reliability of the system. Recognising and addressing these connectivity concerns is integral to optimising the performance of educational technologies and ensuring a positive and uninterrupted learning experience for users. It is, however, noteworthy that network connectivity issues are sometimes beyond the control of the LMS service provider, and rather a localised issue, such as load shedding in the South African HEI context (Kgarose, Makhubela, & Setaise, 2023).

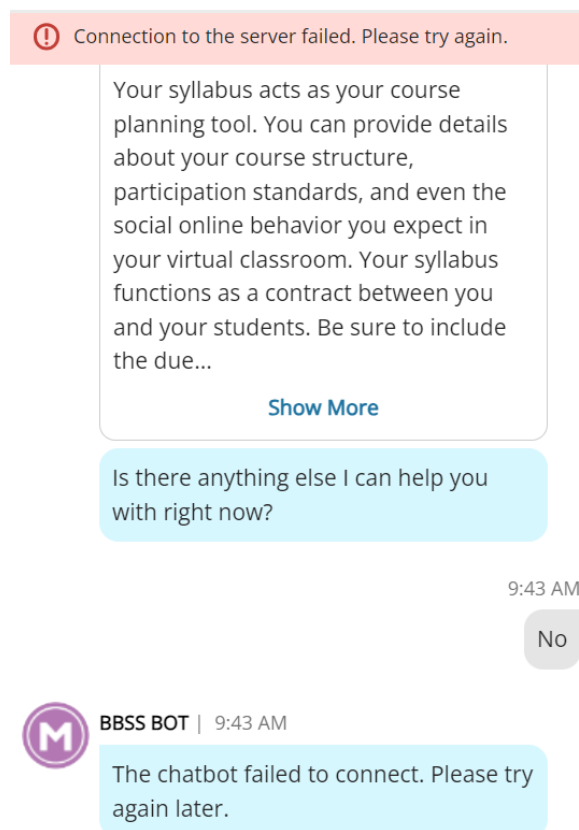


Figure 6.4: Unreliable network connectivity or other issue

Expert 1 had also experienced network connectivity issues (Figure 6.5). This experience gave rise to another concern, as discussed in Section 6.4.4.

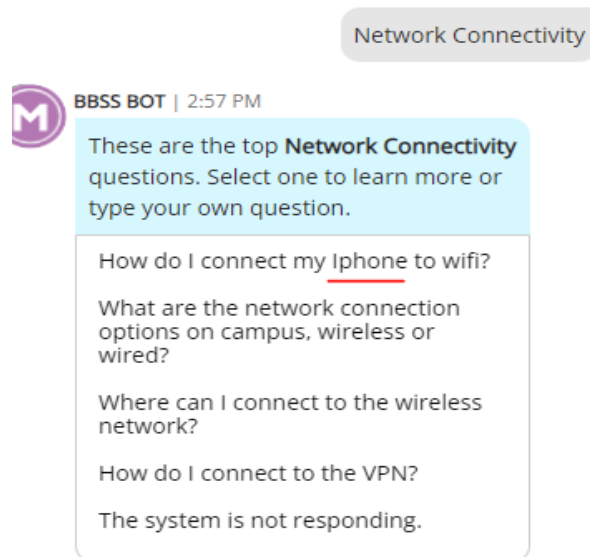


Figure 6.5: Network connectivity

6.4.4 Multi-device inclusivity for LMS users

During the interaction with the chatbot, Expert 1 encountered network connectivity issues (Figure 6.5). Upon seeking assistance, the expert observed that the LMS chatbot support specifically only provided help to iPhone users facing connectivity problems. This observation appeared unusual, considering that LMS users utilise a diverse range of devices.

The comment highlighted a potential concern related to fairness and inclusivity in the LMS chatbot's support system. The observation that assistance is tailored specifically to iPhone users with connectivity issues raises questions about the universality and fairness of the support provided. If the support system disproportionately focuses on a specific device, it may unintentionally introduce a form of bias, potentially neglecting users who employ different devices. It underscores the importance of ensuring that the chatbot's support mechanisms are inclusive and considerate of the diverse range of devices that users may utilise. Examining and addressing such observations are essential to avoid unintended biases and promote a more equitable UX.

6.4.5 Continuous improvement through feedback

Feedback plays an important role in refining and enhancing various systems, services and products, including an LMS chatbot. It serves as a valuable source of insight, enabling developers and designers to understand UX, identify areas for improvement and address potential issues. Regular and constructive feedback not only contributes to the continuous

improvement of the chatbot's functionality but ensures its alignment with evolving user expectations. Expert 2 emphasised the significance of feedback, stating: "Feedback: I am used to giving a type of 'Like'/'Dislike' feedback to such tools. It is a design principle, but not generally accessible/visible." Ultimately, incorporating user feedback is integral to the iterative design process, fostering a user-centric environment that prioritises responsiveness and effectiveness in meeting the educational needs of its users (Figure 6.6).

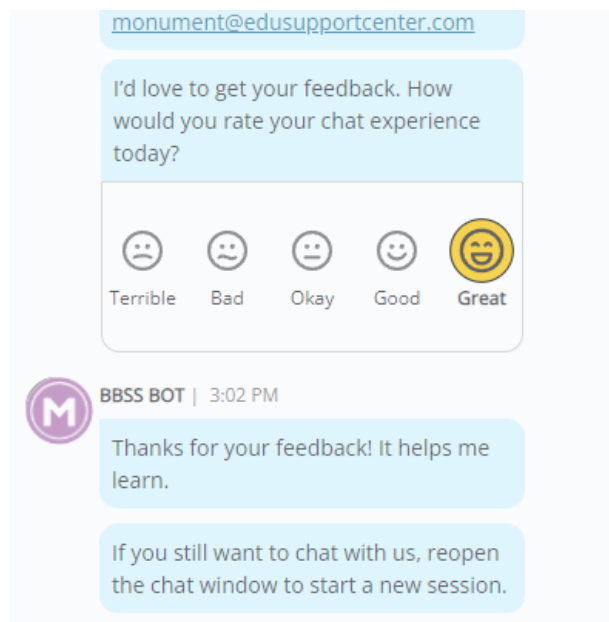


Figure 6.6: Feedback

6.4.6 Unobstructed user interface

Expert 2 underscored the importance of ensuring that the chatbot's interactions and layout do not obstruct access to essential information, advocating a user-friendly and unobtrusive UI design. Expert 1 stressed the importance of the chatbot seamlessly blending into the page to avoid obstructing essential information, thereby enhancing the overall UX. The experts' direct attention to the UI layout particularly emphasised content structure and readability. This feedback emphasised the significance of refining the UI to enhance the presentation of information, especially in cases involving extensive data.

6.4.7 Mental health awareness

The importance of mental health support within the LMS must be accentuated, as indicated by three out of the four experts. Most participants emphasised the crucial role of the LMS chatbot in providing accurate information and facilitating connections to mental health resources. Despite this divergence, the majority consensus underscored the significance of

addressing mental health within the LMS. Mental well-being is intricately linked to academic success, student welfare and overall staff well-being. Incorporating mental health support into the LMS chatbot is aligned to the holistic needs of users, fostering a supportive environment where students and educators can access vital resources and assistance. Acknowledging mental health within the LMS demonstrates a dedication to user well-being, thereby enriching the educational experience with a comprehensive and user-centric approach. Expert 3 evaluated the mental health support offered by the real-life LMS chatbot. Figure 6.7 reveals that the real-life LMS chatbot failed to provide relevant assistance for this aspect of LMS user needs.

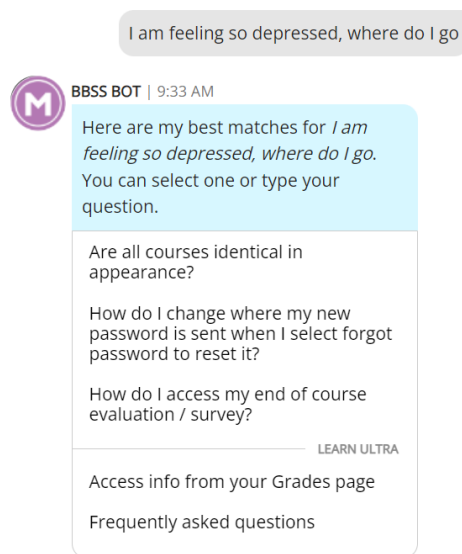


Figure 6.7: Mental health awareness

It is crucial to note that the LMS chatbot will function solely as a supportive agent, directing LMS users to recommended and relevant sources. Expert 2 expressed concern, stating: "I find the addition of mental health support confusing. It totally skews how I would answer the question. Accurate information and link to resources Rating 1. Mental health support is not part of an LMS chatbot's function; in my opinion, 5."

Brown and Halpern (2021) extensively explore the limitations of chatbots in the realm of mental healthcare, emphasising the irreplaceable role of human interaction. Their article underscores three critical aspects that are often overlooked by chatbot alternatives: compromised self-advocacy, the significance of empathic communication and the social connections fostered at in-person clinics. These aspects highlight ethical concerns and reinforce the essential role of humans as primary providers of mental healthcare.

6.4.8 Enhancing campus navigation with LMS chatbot integration

Users consistently express a preference for chatbots that can identify their physical location on campus and provide navigational assistance. The integration of image processing, as proposed by Dimo, Janse van Vuuren, and Janse van Vuuren (2022), and Sweidan, Abu Laban, Alnaimat, and Darabkh (2021), significantly enhances the chatbot's utility in guiding users to their desired locations.

In response to user needs and preferences, Expert 3 provided comprehensive feedback, highlighting the necessity for improvements in the navigation and location-related capabilities of the LMS chatbot. This recommendation specifically focuses on incorporating navigation services within the chatbot, aiming to guide students to specific venues on a university campus.

The importance of integrating navigation services into the LMS chatbot is grounded in addressing the practical needs of individuals navigating a university campus. Given the often large and complex layouts of university campuses, encompassing various buildings, departments and facilities, navigation can pose a challenge for both staff and students, particularly newcomers or those unfamiliar with the campus layout. The incorporation of navigation services into the chatbot addresses this challenge by providing LMS users with easily accessible guidance on directions, locations and specific venues within the university. This feature proves invaluable during events, classes or meetings, offering users quick and accurate assistance in finding their way. By streamlining the navigation process, it

significantly reduces the likelihood of users getting lost, ultimately enhancing their overall campus experience (Figure 6.8).

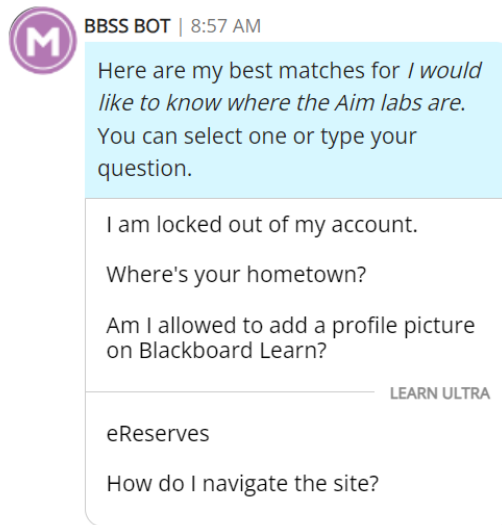


Figure 6.8: Campus navigation query

6.4.9 Enhancing communication effectiveness through short responses and pronoun consistency

In the realm of LMS chatbot interactions, the strategic use of pronouns and the adoption of concise responses play a pivotal role in optimising communication effectiveness.

Direct addressing with pronouns

Research by Wang and Chiu (2008) highlighted the positive impact of addressing users directly by using pronouns such as “we,” “he” and “she” in the communication process. Incorporating such pronouns, as suggested by Expert 3, not only enhances the establishment of a personal connection with the user, but also positively influences their willingness to engage with the chatbot. This aligns with the user-centric approach of the LMS chatbot’s UX.

Concise responses for information clarity

The recommendation for concise responses emphasises the importance of delivering information succinctly. This approach is crucial for preventing information overload and ensuring that users receive the necessary information without unnecessary verbosity. By providing concise responses, the chatbot contributes to a streamlined interaction, allowing users to quickly obtain the information they seek without being overwhelmed.

Consistent pronoun usage for communication flow

Similarly, the emphasis on the consistent use of pronouns highlighted the need for uniformity in language throughout the chatbot's interactions. Inconsistencies in pronoun use can lead to confusion and disrupt the flow of communication. By maintaining a consistent language style, the chatbot fosters a smoother and more intuitive conversation. This is essential to create a coherent and user-friendly experience, enabling users to follow the conversation seamlessly and understand the context of the chatbot's responses.

Alignment with user-centric experience

These recommendations align with the broader principle of providing a seamless and user-centric experience. The combination of concise responses and consistent pronoun use ensures that users can efficiently obtain information while experiencing a coherent and understandable conversation. Both elements contribute synergistically to an improved UX, as depicted in Figure 6.9.

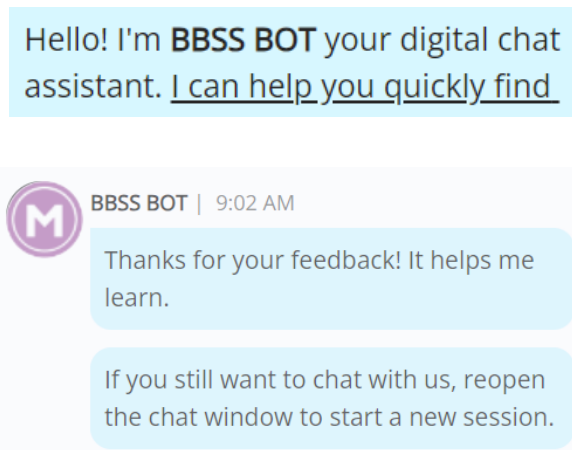


Figure 6.9: Consistent use of pronouns

6.4.10 Engaging personality and anthropomorphic elements

Expert 4 highlighted that, although the chatbot begins the conversation with a greeting, the feedback tends to become generic once a user inputs a question. This leads to a perceived deficiency in personality within the chatbot's responses. It is worth noting, however, that literature emphasises the significance of a chatbot possessing an engaging personality and incorporating anthropomorphic elements.

Ensuring a soft tone

It is imperative that a chatbot adopts a soft and approachable tone in its interactions. The incorporation of humour into chatbot responses has been identified as a key factor in increasing user motivation and enjoyment during engagements (Jain et al., 2018; Liao et al., 2018). According to these studies, a chatbot's ability to provide diverse and amusing responses, including jokes, would contribute to heightened conversational enjoyment. This positive experience significantly influences users, fostering a greater willingness to engage with the chatbot. Moreover, as technology advances, chatbots can evolve to incorporate humour, enhancing the overall learning experience (Xie et al., 2024).

Significance of anthropomorphic design

Rietz et al. (2019) and Nguyen et al. (2023) found that anthropomorphic design features play a crucial role in shaping users' perceptions of usefulness, exhibiting an impact four times stronger than that of functional design features. In chatbot design, anthropomorphic elements entail the integration of human-like attributes into the appearance and behaviour of the chatbot, which includes features such as an emotional tone of voice, human-like appearances and cultural awareness (Yu & Zhao, 2023). Incorporating visually appealing elements like avatars (Foster, McLelland, & Wallace, 2022) or button interaction (Haugeland et al., 2022) enhances user engagement.

Effective use of emojis and smileys

The use of emojis and smileys can significantly contribute to establishing and conveying a chatbot's personality. Advocated by Yu and Zhao (2023) and Namkoong, Park, Park, and Lee (2023), emojis can enhance the emotional expression of the chatbot. Similarly, studies by Liu (2023) and Nguyen et al. (2023) underscore the effectiveness of smileys in expressing emotions. However, the appropriateness of using emojis depends on the context, particularly in more formal interactions. Contextual awareness is crucial to determining when and how to incorporate these elements to maintain a professional tone.

6.4.11 Opt-out function

Expert 3 advocates for clear options to navigate the chatbot, such as continue, exit or start a new session in the conversation, emphasising the importance of user choice and control (autonomy). In reference to Design Principle 4, the need for options to continue a

conversation or opt out is noted, as the absence of such choices may lead to user frustration. Additionally, providing polite and user-friendly ways to exit a conversation is emphasised. As highlighted in Design Principle 16, allowing users to easily transition between conversations while retaining conversational context can significantly enhance the UX. The following is a direct quote from Expert 3's questionnaire: "DP6: So, after the bot responded, I typed "I am happy with your answer." The bot was supposed to recognise that is a thank you, and reply "Thank you, is there anything else I can assist you with?", while DP4: And now there is no option to opt out except for the X. Which is a rude way of exiting a conversation. At least it understood "bye" (Figure 6.10).

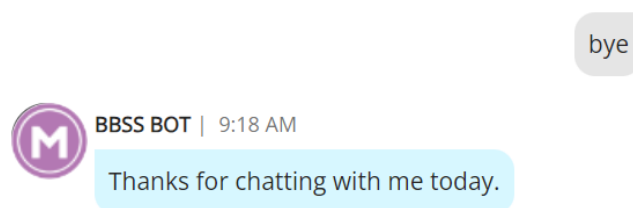


Figure 6.10: Opt-out function and autonomy

Expert 1 also found the chat-ending behaviour to be somewhat awkward, proposing that the chatbot should either maintain an open text box for continuous interaction or automatically close the chat window. Expert 3 believed she was not yet done with the chat, but the chatbot assumed that she was happy with the response (Figure 6.11).

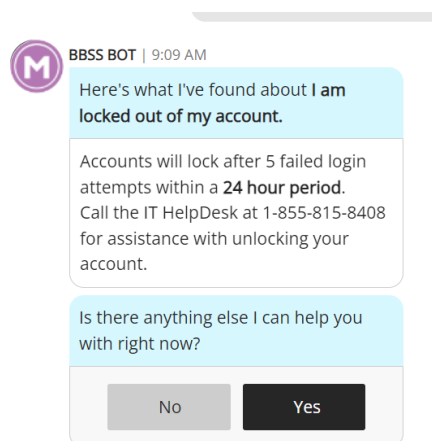


Figure 6.11: Assumption that the user was satisfied with the answer

6.4.12 NLU

Expert 3 pointed out that the chatbot did not recognise the input of her text, providing her with irrelevant answers (Figure 6.12). NLU is crucial for an LMS chatbot due to its pivotal role in facilitating meaningful and context-aware interactions between the chatbot and users. NLU enables the chatbot to understand, interpret and respond to user queries in a contextually aware manner. This capability not only elevates the quality of interactions, but also contributes to the overall UX.

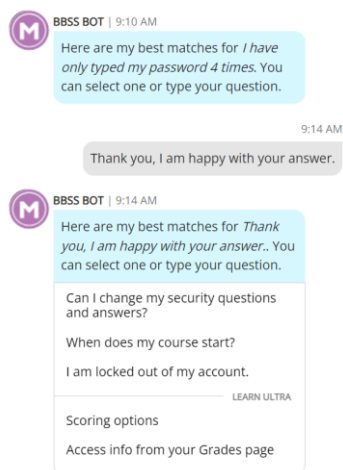


Figure 6.12: NLU

6.4.13 Progress tracking and recommendations

Learning analytics and reporting play a pivotal role in shaping effective teaching and learning strategies, as underscored by Abari and Akintoye (2021) and Qazdar et al. (2022). These tools provide valuable insights into student progress, enabling educators to make informed decisions. The accurate and timely identification of students at risk is crucial for early intervention. This is a concept supported by Santos and Henriques (2023). They propose a course-agnostic early prediction of student performance based on LMS logs, demonstrating a proactive approach that facilitates timely interventions to enhance student success.

Furthermore, according to Prahani et al. (2022), advanced tracking is a critical aspect within LMSs. The integration of chatbot assistance can streamline and simplify this tracking process. By leveraging chatbots, monitoring LMS user registration and access becomes more manageable, as emphasised by Steindal et al. (2021). This collaborative approach not only enhances the efficiency of progress tracking, but also provides an additional layer of user support through the chatbot's assistance. The synergy between advanced tracking

mechanisms and chatbot facilitation contributes to a more seamless and comprehensive learning environment.

6.4.14 Multilingual support and localised chatbot names for enhanced user engagement

Design Principle 9 underscores the pivotal role of providing multilingual support to enhance user satisfaction and inclusivity. Allowing users to choose their preferred language not only improves accessibility, but also ensures that the chatbot addresses diverse linguistic needs, thereby promoting effective communication (Rocio & Wesley, 2020). Expert 3 recommends incorporating a multilingual option as a “nice-to-have” feature, empowering users to interact with the chatbot in their preferred language and fostering inclusivity and accessibility. Furthermore, Expert 4 emphasises the significance of language support by highlighting the chatbot’s ability to gracefully handle encounters with unrecognised languages. In such cases, the chatbot should politely inform the user of the language issue and suggest switching to a common language or seek assistance from a human agent. Criticism arises when the chatbot fails to recognise languages beyond English and lacks a language-switching feature, as illustrated in Figure 6.13.

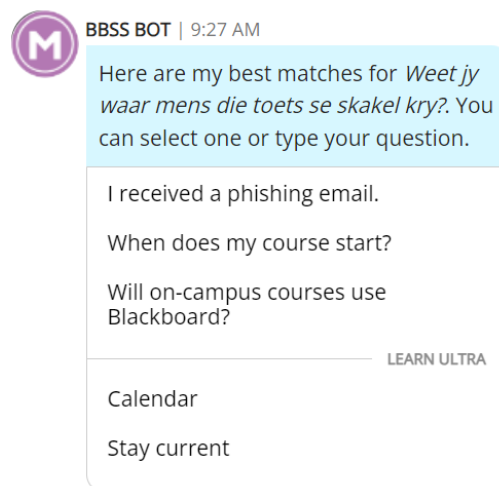


Figure 6.13: Multilingual support

To ensure a positive UX, the chatbot must maintain accuracy and cultural sensitivity in its knowledge base and responses for each supported language. This helps prevent misunderstanding or cultural insensitivity that may arise due to language variations. The choice of a chatbot’s name is equally crucial in influencing user engagement and satisfaction. To enhance this aspect, it is recommended that chatbot names are localised based on the

location of users. Research by Man et al. (2023), along with findings from Bastiansen, Kroon, and Araujo (2022), and Feine, Gnewuch, Morana, and Maedche (2019), suggested that opting for simple, yet comprehensive names, aligned with global rankings and gender stereotypes, is preferable. This approach ensures a more personalised and culturally sensitive interaction with users, contributing to increased user engagement and satisfaction.

Expert 3 noted the following: “DP9: Do not make provision for various languages. DP13, could have say that he does not understand the language and maybe the person can try communicating in English? Or it could have referred the person to a human (DP14).”

The abovementioned quote indicates the need to discuss Design Principle 13: error handling and graceful recovery.

6.4.15 Error handling and graceful recovery and human-agent handover

Expert 3’s insightful comment underscores the interconnectedness and importance of two design principles, Design Principle 13 (error handling and graceful recovery) and Design Principle 14 (human-agent handover).

Design Principle 13 focus on the chatbot’s ability to handle misunderstandings and errors gracefully, which play a pivotal role in maintaining a positive UX (Figure 6.12). By providing informative error messages and suggesting alternative solutions, the chatbot minimises user frustration during interactions, ensuring a smoother and more effective user journey. Importantly, this principle aligns with the participant’s suggestion in Design Principle 9, illustrating the need for the chatbot to address language-related misunderstandings by either attempting communication in English or seamlessly transitioning to human support (Design Principle 14) when faced with language barriers. The integration of design principles 13 and 14 not only enhances the chatbot’s robustness in handling diverse user scenarios but underscores the user-centric approach that is essential for a successful LMS chatbot design.

The expert feedback underscores various key aspects for refining the tentative LMS chatbot’s design principles to create a more engaging chatbot personality and enhance the overall UX.

6.4.16 Ensure 24/7 availability

Ensuring that an LMS chatbot is available 24/7 is of paramount importance in the context of educational environments. The continuous availability of the chatbot ensures that users, including students, instructors and administrators, have unrestricted access to support and information whenever they need it. Given the varied schedules and time zones of individuals engaged in education, having a chatbot that is available 24/7 accommodates users from different parts of the world and diverse time frames. Moreover, the availability of the chatbot is aligned with the dynamic nature of educational activities, where students might engage with course material or seek information outside traditional working hours. In essence, an LMS chatbot that is available 24/7 enhances the overall accessibility and responsiveness of the educational support system, fostering a user-centric and inclusive learning environment, while also offering alternative support (Figure 6.14).

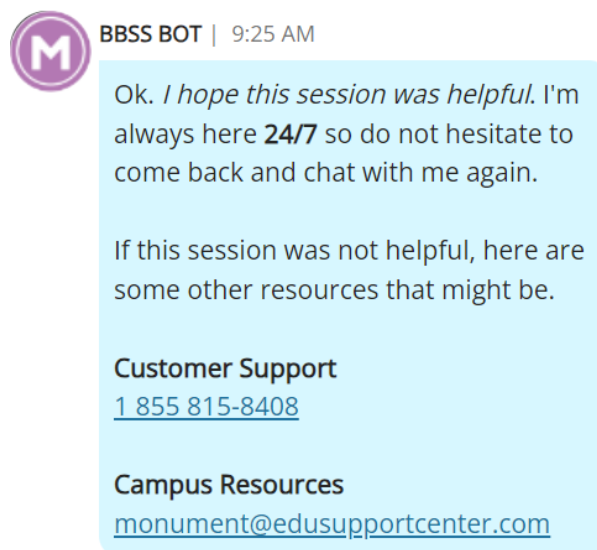


Figure 6.14: 24/7 availability

6.5 RECOMMENDATION FOR CONSIDERING A NEW DESIGN PRINCIPLE

The experts' response to the comprehensiveness of the existing list of design principles were positive. In general, there was consensus among them that the current set of design principles were quite comprehensive, addressing a broad spectrum of user needs and expectations. However, valuable recommendations were made for consideration.

The experts brought up recommended “nice-to-have” features within the design guidelines for an LMS chatbot. Expert 1 suggested the incorporation of voice input capabilities, like the

popular virtual assistants Siri, Alexa or Google Assistant, to enhance accessibility. The integration of multimodal input, particularly verbal/speech input, has proven to significantly enhance user interaction with chatbots. Research by Jeon, Lee, and Choe (2023), along with prior studies by Abdul-Kader and Woods (2015) and Kim, Goh, and Jun (2018), underscores the effectiveness of spoken interaction. Grigore et al. (2016) and Terblanche, Wallis, and Kidd (2023) further accentuate the distinct preferences and benefits associated with both voice and text interactions. Building on these insights, Expert 4 presented a compelling proposition for an expansion in design principles, specifically advocating for “multiple modes of input”. This addition seeks to empower users to interact with the chatbot using both text and voice inputs, fostering inclusivity and accessibility for individuals with diverse needs. Furthermore, this approach aligns with contemporary research, offering a more personalised and flexible UX. The recommendation to include “multiple modes of input” into the set of design principles for LMS chatbots is indeed valuable, reflecting the evolving landscape of chatbot design. Accommodating various communication modalities is recognised as a strategy to enhance efficacy and user satisfaction. Expert 1 has suggested: “That would be nice like “Siri or Alexa or Google”. Hi Bbbot – how do I do X and it audibly tells me...”.

However, it is crucial to consider the perspective raised by Expert 1, as discussed in Section 6.4.14 regarding the necessity of multilingual support. Expert 1 highlighted the potential misalignment with predominantly English-based help documentation and raises concerns about varying AI translation effectiveness leading to user frustration. While the importance of multilingual support is acknowledged in modern chatbot design to cater for diverse user bases, it is imperative to carefully address potential challenges and variations in translation effectiveness. The incorporation of multilingual support should be approached with diligence, ensuring alignment with user expectations and delivering a seamless experience across languages.

This addition would enable users to interact with the chatbot through voice commands, rendering the interaction more intuitive and user-friendly, thereby enhancing accessibility and convenience. The expert also identifies a potential issue with the mobile version of the chatbot, where a “change content” button at the bottom appears non-functional. This underscores the importance of ensuring consistent functionality across various devices and platforms. Expert 2 did not list any “nice-to-haves”. Expert 4 proposed a feature that permits

users to personalise the chatbot's appearance, including options to alter the colour scheme and select an avatar or icon. Such customisation features would instil the chatbot with a personalised touch, making interactions more engaging and enhancing the overall UX.

In summary, these expert recommendations for “nice-to-have” features encompass various input modalities (speech/text), multilingual support and customisation options for the chatbot's appearance. These enhancements could lead to a more adaptable and user-friendly chatbot, catering to a broader spectrum of user preferences and needs. The experts' feedback provides valuable insights into additional functions and features that could enhance the LMS chatbot's effectiveness and UX. These include context awareness, page-related assistance, feedback mechanisms, integration with student support services, progress tracking and the capability to initiate live conversations with a human agent, although not necessarily available 24/7. Integrating these suggestions into the chatbot's design would make it more robust, user-friendly, and aligned with the evolving needs of users within the LMS environment.

6.5.1 Experts' suggestions to refine the tentative set of design principles

The idea of combining or consolidating specific design principles for the LMS chatbot received a positive response from the participants. Expert 1's response, which was unrelated to this question, has been omitted from this discussion. However, Expert 2, for example, recommended the practical approach of categorising these principles into four categories, including technical, language, UX and feedback. The goal is to establish a more structured framework for these design principles. Expert 3 also supported the notion of merging certain principles, highlighting responsive interaction (Design Principle 1) and ensure 24/7 availability (Design Principle 8) as potential candidates for consolidation. Expert 3 further suggested that these two principles might have overlapping components that could be streamlined for greater efficiency. This can be confirmed in the following screenshot (Figure 6.15).

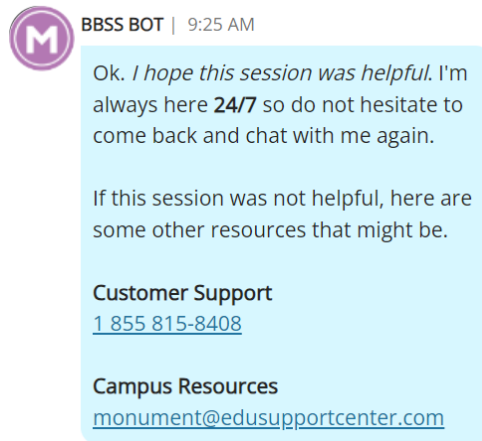


Figure 6.15: Responsive interaction and ensure 24/7 availability

Furthermore, Expert 4 suggested combining several design principles, specifically design principles 5, 7 and 16, into a more comprehensive category focused on UX, echoing Expert 2's suggestion to group the design principles. This proposal by Expert 4 implies that merging the design principles collectively will contribute to enhancing the overall UX of the design principles. This, in turn, can promote clarity and simplicity for service providers, designers and developers, making it easier for them to interpret and implement.

The feedback and insights shared by the experts regarding specific design principles for the LMS chatbot offer valuable observations. Expert 1's input is particularly insightful, as he expressed a desire for the chatbot to automatically recognise the user's role. Expert 1 also acknowledged that prompting the user to choose "instructor" or "student" when outside of the course is an acceptable solution. Notably, Expert 1 highlighted an issue where the chatbot fails to respond when the user chooses "else" without typing a new response. Additionally, he mentioned a preference for the chatbot to retain displayed questions and suggestions for better continuity.

Expert 4 provides a constructive critique of Design Principle 8, which focuses on ensuring 24/7 availability. She suggested that Design Principle 8 seems to emphasise technical aspects, analytics and metrics, rather than considering the user's perspective. To address this, Expert 4 recommended refining the name or description of Design Principle 8 to better convey its meaning and purpose. Expert 4 argued that the availability feature for users is already covered in Design Principle 1. It is worth noting that Expert 2 did not provide specific feedback or insights regarding any design principle, and Expert 3 had already included their comments in a previous question. Overall, these insights present an opportunity to fine-tune

and clarify specific design principles for the LMS chatbot, ensuring that they are aligned with user expectations and are accurately reflected in their descriptions.

When prompted to provide comments or observations about the design principles, the experts elaborated. It became evident that their insights were both insightful and practical. Expert 1 described the chatbot as “nice and quick” and generally providing correct answers. However, it was also mentioned that the chatbot struggles with more complex questions, suggesting room for improvement in handling advanced queries.

The experts provided a few design principles that they consider to be a challenge to put into practice. Despite their value and potential impact, these principles often encounter various obstacles in the real world of design. Expert 1 identified a challenging design principle, specifically Design Principle 12 – progress tracking and recommendations. Expert 1 pointed out that the chatbot may lack the essential user information required for the effective implementation of this principle, primarily serving as a generic “answer machine”. This suggested a potential limitation in using user data for progress tracking and personalised recommendations. Expert 2 highlighted challenges experienced with several design principles, including Design Principle 6 – NLU, Design Principle 9 – embrace multilingual support, and Design Principle 13 – simulation of problem solving. Expert 2 pointed out that the chatbot struggles with complex queries and problem solving when users are unclear about their needs. Expert 2 also questioned the utility of multilingual support when the underlying information base is not multilingual, suggesting a potential inconsistency.

Expert 3 focused on Design Principle 7 – engaging visual elements, acknowledging that it may be challenging to implement. However, Expert 3 did not provide specific details or reasons for this observation. Expert 4 addressed multiple design principles, including Design Principle 2 – focused conversation, Design Principle 9 – embrace multilingual support, Design Principle 16 – engaging personality, and Design Principle 14 – human-agent handover. Expert 4 noted that the chatbot sometimes provides general feedback rather than direct instructions, indicating room for improvement in maintaining a focused conversation.

Additionally, the chatbot was seen as lacking personality in subsequent interactions. It faces difficulties in directing users to human agents or support channels, potentially hindering efficient issue resolution.

The experts' feedback reveals several challenges in implementing various design principles for the LMS chatbot, particularly related to NLU, multilingual support, maintaining focused conversations and providing engaging interactions. These insights are crucial for refining the chatbot's design and functionality to better meet user needs and expectations.

6.5.2 Consolidating and combining the tentative set of design principles

Based on the insights provided by the experts, it is evident that several design principles are considered critical for the success of the LMS chatbot. These principles have been identified and, in some instances, supported by multiple experts. The LMS experts listed the following ten design principles as being the most critical:

- **Design Principle 1: Responsive interaction:** Ensuring that the LMS chatbot promptly responds to user input, thereby minimising response time, is essential for optimising the UX. This principle underscores the significance of offering timely and useful information to users.
- **Design Principle 2: Focused conversation:** Effective conversation management is pivotal in maintaining a conversation on the intended topic and preventing unnecessary diversions. This principle underscores the importance of sustaining a coherent and purposeful dialogue with users.
- **Design Principle 3: Transparency on capabilities and limitations:** Clearly stating the chatbot's capabilities and limitations to manage user expectations is indispensable. Users should understand what the chatbot can and cannot do to avoid frustration.
- **Design Principle 6: NLU:** The implementation of advanced NLU techniques holds immense importance in naturally comprehending and interpreting user queries. This enhances the chatbot's capacity to provide pertinent and accurate responses, even when dealing with synonyms, paraphrases and context.
- **Design Principle 9: Embrace multilingual support:** Offering multilingual support enables users to interact with the chatbot in their preferred language, thereby enhancing inclusivity and accessibility.
- **Design Principle 10: Seamless integration into an LMS platform:** The seamless integration of the chatbot into the LMS platform, along with other tools and data sources, elevates the overall UX. This approach fosters a unified and efficient environment for users.
- **Design Principle 12: Privacy and data security:** Create an LMS chatbot that adheres to data protection regulations and maintains the privacy and security of user information.

The chatbot should be transparent by communicating data usage and storage policies to establish trust and confidence among users, ensuring that their data is handled responsibly and securely.

- **Design Principle 13: Error handling and graceful recovery:** The chatbot's ability to handle misunderstandings and errors gracefully by providing informative error messages and suggesting alternative solutions is essential. This approach minimises user frustration during interactions.
- **Design Principle 14: Human-agent handover:** Recognising situations where the chatbot's capabilities are limited and smoothly transitioning to human support is vital. This prevents user frustration and ensures that users receive the necessary assistance when required.
- **Design Principle 16: Engaging personality:** Developing a friendly and approachable personality in the chatbot contributes to a positive and engaging UX. This fosters a stronger connection between users and the chatbot.
- **Design Principle 17: Information and resources:** Create an LMS chatbot that provides accurate, relevant and reliable information. This feature supports users in finding the necessary resources and support for their needs.

Expert 3 provided an innovative suggestion to link Design Principle 11 (progress tracking and recommendations) with Design Principle 17 (information and resources for mental health conditions, coping strategies and available resources). This linkage would enable the chatbot to identify students at risk based on their academic performance, and then offer relevant resources such as guidelines, articles, helplines, on-campus human student support services or websites.

The suggested categories provided by Expert 2 in Section 6.5.1 serve to organise the previously listed design principles according to their technical, language-related, UX and feedback-focused aspects (Table 6.3). The researcher believes that such categorisation will enhance the user-friendliness of the set of design principles. In Section 6.6, the researcher intends to incorporate the recommendations derived from the expert evaluation, refining the tentative set of design principles to ultimately present a finalised version.

Table 6.3: Categorising the design principles according to Expert 2's recommendation

Category	Design principles (DPs)
Technical	Responsive interaction (DP1) + Ensure 24/7 availability (DP8)
	Seamless integration into an LMS platform (DP10)
Language	NLU (DP6)
	Embrace multilingual support (DP9)
UX	Focused conversation (DP2)
	Error handling and graceful recovery (DP13) + human-agent handover (DP14)
	Engaging personality (DP16)
	Progress tracking and recommendations (DP11) + information and resources (DP17)
Feedback	Transparency on capabilities and limitations (DP3)

In conclusion, the critical design principles for the success of the LMS chatbot, as identified and supported by multiple experts, encompass responsiveness, maintaining focused conversations, ensuring transparency, implementing advanced NLU, offering multilingual support, seamless integration, effective error handling, human-agent handover, cultivating an engaging personality and providing access to information and resources. These principles collectively contribute to a chatbot that is aligned with user needs and expectations within the context of an LMS.

Most experts (Expert 1, Expert 2 and Expert 4) believe that the listed design principles are straightforward and user-friendly, making them easy to comprehend and implement. However, Expert 3 raises a valuable point about the need for a guide to clarify the meaning of each design principle, especially in cases where the interpretation may differ from the initial understanding. Additionally, Expert 2 emphasised that, while the principles may be easy to understand, implementing more technical aspects might require specialised expertise. Overall, ensuring that the design principles are both clear and accessible to a wide range of designers is crucial for the successful development of the LMS chatbot.

6.6 FINAL SET OF LMS CHATBOT DESIGN PRINCIPLES

After employing the CCA method (Section 4.4) and thoroughly reviewing all the data gathered during the design thinking workshop, along with insights derived from the experts' evaluation, the researcher formulated the following final set of LMS chatbot design

principles. The suggested set, as discussed in Table 6.3, is presented in the first column of Table 6.4, while the refined final set of LMS chatbot design principles is presented in the second column.

Table 6.4: Final set of design principles compared to the suggested set of design principles

Suggested consolidated and combined design principles	Refined final set of LMS chatbot design principles
Responsive interaction (DP1) + Ensure 24/7 availability (DP8)	Responsive interaction and availability (DP1)
Seamless integration into an LMS platform (DP10)	Seamless integration into an LMS platform (DP2)
NLU (DP6)	NLU (DP3)
Embrace multilingual support (DP9)	Embrace multilingual support with multiple input modalities (DP4)
Focused conversation (DP2)	Focused conversation (DP5)
Error handling and graceful recovery (DP13) + human-agent handover (DP14)	Intelligent error handling and human-agent handover (DP6)
Engaging personality (DP16)	Engaging personality (DP7)
Progress tracking and recommendations (DP11) + information and resources (DP17)	Progress tracking and personalised recommendations (DP8)
Transparency on capabilities and limitations (DP3)	Transparency on capabilities and limitations (DP9)
	Privacy and data security (DP10)

By categorising the design principles, as suggested by Expert 2, it is easier to identify and focus on specific aspects related to technical mechanisms, language usage, UX and feedback mechanisms. Some of the design principles belong to more than one category. This structured framework enhances the overall clarity and accessibility of the principles, making it simpler for stakeholders and implementers to grasp the key considerations within each category.

Table 6.5: Categorised final set of LMS chatbot design principles

Category	Design principle (DP)
Technical	DP1: Responsive interaction and availability
	DP2: Seamless integration into an LMS platform
	DP6: Intelligent error handling and human-agent handover
	DP8: Progress tracking and personalised recommendations
	DP10 Privacy and data security
Language	DP3: NLU
	DP4: Embrace multilingual support with multiple input modalities
	DP5: Focused conversation
	DP7: Engaging personality

UX	DP1: Responsive interaction and availability
	DP2: Seamless integration into an LMS platform
	DP5: Focused conversation
	DP7: Engaging personality
	DP8: Progress tracking and personalised recommendations
	DP9: Transparency on capabilities and limitations
Feedback	DP6: Intelligent error handling and human-agent handover

The following section offer a more comprehensive discussion, following the layout and structure of Table 6.5. Sections 6.7 to 6.10 discusses the design principles according to the relevant categories. It is important to note that the researcher has utilised the components of the design principle schema (Gregor et al., 2020) following the structure outlined in Table 3.2. Each of the design principles is crafted according to the following components: implementer, aim, and user, context, mechanisms, subsidiary components or artefacts and rationale.

Note: Due to the categorisation of the design principles, there is some overlap among the groupings. The overlapping design principles are only discussed upon their initial encounter.

6.7 TECHNICAL CONSIDERATIONS

In the ever-evolving landscape of LMSs, achieving optimal functionality and user satisfaction demands stakeholders to pay close attention to technical considerations. This section delves into key aspects, ranging from ensuring responsive interaction and uninterrupted availability to seamless integration within the LMS platform, intelligent error handling, human-agent handover, progress tracking, personalised recommendations and the paramount concern of privacy and data security. As the researcher explored these technical considerations, the overarching goal remained clear: to fortify the LMS chatbot's capabilities to deliver a seamless, supportive and secure learning experience for users.

6.7.1 Design Principle 1: Responsive interaction and availability

To achieve responsive interaction and ensure 24/7 availability in the context of LMS chatbot interactions, the chatbot developer should employ mechanisms such as NLP algorithms, the prioritisation of FAQs, predictive typing, involving enactors like the chatbot's algorithmic decision-making system and user engagement analytics, with the aim of minimising response time and optimising the UX. Simultaneously, the system administrator should utilise redundant server infrastructure, automated backup and recovery processes, and real-

time monitoring, involving enactors like automated system monitoring tools and administrators, to guarantee uninterrupted access, minimise downtime and maximise accessibility. This holistic approach, driven by the rationale of enhancing user satisfaction and conversational efficiency, ensures that users receive timely and helpful information at any time, thereby boosting the overall effectiveness and reliability of the chatbot.

6.7.2 Design Principle 2: Seamless integration into an LMS platform

To seamlessly integrate other platforms or software into the LMS platform, the chatbot developer should employ various mechanisms. These include implementing robust application programming interface (API) connections to the LMS platform and other relevant tools and data sources, ensuring compatibility with standard LMS protocols for smooth data exchange, and adopting a modular and scalable architecture to facilitate easy integration with future updates or additions. This integration process involves the collaborative efforts of the chatbot's development team, LMS administrators responsible for system compatibility checks and updates, and end-users who provide feedback on the integrated experience. The primary aim of this seamless integration, conducted within the context of the LMS environment, is to enhance the overall UX. By becoming an integral part of the existing LMS resources and tools, the chatbot strives to create a cohesive and efficient environment. This approach is guided by the rationale to streamline access to information and support, contributing to an improved UX for users within the LMS platform.

6.7.3 Design Principle 6: Intelligent error handling and human-agent handover

In pursuit of creating an effective LMS chatbot, the development team should design and implement an intelligent error handling and graceful recovery system, coupled with a seamless human-agent handover. This initiative is aimed at addressing misunderstandings and errors with finesse within the context of user interactions. To achieve this goal, the development team should focus on implementing specific mechanisms. Firstly, an advanced error detection system should be put in place to recognise and comprehensively understand user errors or ambiguous queries. This system ensures that the chatbot is skilled at identifying and addressing potential misunderstandings during interactions. Moreover, informative error messages and alternative solutions should be incorporated to guide users when faced with uncertainties. This aspect, managed by UX specialists, ensures that users receive clear and helpful guidance, preventing frustration and enhancing the overall UX.

Additionally, a seamless human-agent handover system should be integrated, identifying situations where the chatbot's capabilities may be limited. This enables the chatbot to transition seamlessly to human support through methods such as emails to the service desk or live human support within office hours. The service desk personnel play a crucial role in facilitating this smooth transition. The rationale behind this comprehensive design principle lies in the overarching goal of preventing user frustration. By intelligently handling errors, providing informative guidance and seamlessly transitioning to human support when necessary, this approach ensures that users receive the necessary assistance to overcome challenges during their interactions with the LMS chatbot.

6.7.4 Design Principle 8: Progress tracking and personalised recommendations

The development team should design a feature that is focused on progress tracking and personalised recommendations for students. This design principle is aimed at creating a dynamic and supportive environment for users within the context of their interactions. To bring this vision to life, the development team should focus on implementing specific mechanisms. Firstly, a progress monitoring system should be developed to actively track users' performance and preferences, providing valuable insights into their learning journey. Building on this, algorithms must be put in place to generate personalised recommendations based on individual performance and preferences. These recommendations serve as tailored guidance, directing users towards resources and opportunities that align with their unique needs and goals. One of the key features of this design principle is the incorporation of a system that links users to accurate, relevant and reliable information and resources. This encompasses a wide array of offerings, including study methods, training opportunities, tutoring services and courses that promote personal growth and well-being, such as mental health awareness. Enactors who actively participate in this process may include, a psychologist and instructors who would contribute insights into effective study methods and training opportunities. Moreover, students also play a pivotal role by providing feedback on the usefulness and relevance of the personalised recommendations. The rationale behind this design principle is deeply rooted in the goal of supporting users to find the necessary resources and support, tailored to their specific needs within the LMS platform. By actively monitoring progress, offering personalised recommendations and providing access to relevant information and resources, the chatbot aims to empower students, helping them

stay focused, continuously enhance their presence, knowledge and skills, and fostering a positive and enriching learning experience within the dynamic LMS environment.

6.7.5 Design Principle 10: Privacy and data security

The development team should focus on establishing robust measures for privacy and data security within the context of user interaction. To accomplish this goal, the development team should dedicate efforts to implementing specific mechanisms. Firstly, there is a commitment to adhere to data protection regulations, ensuring that the chatbot complies with the legal requirements that govern the handling of user data. Transparency is a key element, and communication specialists play a crucial role in conveying clear information about data usage and storage policies to empower users with a comprehensive understanding of how their data will be utilised and stored, establishing a foundation of transparency and trust. The implementation of encryption and secure protocols is another critical mechanism, ensuring the privacy and security of user information during both storage and transmission. The active involvement of users in providing feedback is an integral part of the process, contributing to the continuous improvement of privacy and security features. The rationale behind implementing privacy and data security is rooted in the overarching goal of instilling user trust and confidence. Through adherence to data protection regulations, the transparent communication of data policies and the implementation of robust security measures, the development team aims to handle user data responsibly and securely, creating an environment of trust.

6.8 LANGUAGE CONSIDERATIONS

The development of a proficient LMS chatbot involves several key design principles that are aimed at enhancing the UX. In the realm of NLU, advanced algorithms ensure a more natural and intuitive interaction, supported by a context-aware system for accurate and contextually relevant responses. Multilingual support and diverse input modalities, including voice-to-text, are advocated to ensure inclusivity and accessibility. Focused conversation management techniques prioritise purposeful and coherent interactions by employing algorithms to track context, applying NLU techniques to determine user intent, and filtering information effectively. Lastly, the incorporation of an engaging personality, characterised by a soft tone, humour, visual cues and personalised guidance, aims to foster a positive and enjoyable UX, emphasising a connection between the LMS chatbot and its users.

6.8.1 Design Principle 3: NLU

In pursuit of creating a proficient LMS chatbot, the chatbot developer should undertake the task of employing advanced NLU techniques. The primary objective within the LMS context is to enhance the UX by facilitating more natural and intuitive interactions. This endeavour involves the implementation of various mechanisms, such as the development team focusing on utilising state-of-the-art NLU algorithms. These algorithms aim to comprehend and interpret user queries in a natural manner, allowing for smoother interactions. Additionally, linguistic experts contribute to the creation of a comprehensive database of synonyms and paraphrases, broadening the chatbot's understanding of diverse user inputs. Moreover, the development team should work on implementing a context-aware system. This system enables the chatbot to consider the context of ongoing conversations, ensuring more accurate and contextually relevant responses. This collaborative effort involves enactors such as the development team, linguistic experts and a feedback loop from users. The feedback loop ensures continuous refinement of the NLU capabilities based on user interactions and evolving linguistic nuances. The rationale behind the incorporation of advanced NLU techniques is rooted in the goal of providing users with more fluid and intuitive interactions. By comprehending synonyms, paraphrases and context, the chatbot strives to offer relevant and accurate responses, ultimately enhancing its capability to understand and effectively address user needs within the dynamic LMS environment.

6.8.2 Design Principle 4: Embrace multilingual support with multiple input modalities

In the endeavour to create a comprehensive LMS chatbot, the development team should focus on embracing multilingual support and enhancing accessibility through various input modalities, including voice-to-text. The primary objective, within the context of user interactions, is to cater for individuals who prefer engaging in various languages. This involves the implementation of specific mechanisms, such as incorporating a multilingual option within the LMS chatbot interface, which accommodate diverse linguistic preferences. Developing language selection functionality allows users to effortlessly choose their preferred language during interactions, and integrate a language recognition system to adapt the chatbot's responses based on the user's selected language, ensuring a seamless and personalised interaction experience. Enactors involved in this process include the development team, a UX specialist who is dedicated to optimising language selection interfaces, and a diverse user base, representative of the location, providing valuable feedback on language preferences

and usage. Furthermore, the inclusion of multiple input modalities, such as voice-to-text, enhances the overall UX. The rationale behind embracing multilingual support, along with multiple input modalities, is deeply rooted in the goal of enhancing inclusivity, accessibility and cultural sensitivity within the LMS environment. By empowering users to interact in their preferred language and through various input methods, including voice-to-text, the chatbot strives to create a more accessible and user-friendly experience.

6.8.3 Design Principle 5: Focused conversation

In pursuit of creating an effective LMS chatbot, the development team should implement focused conversation management techniques. This initiative is aimed at maintaining a purposeful and coherent interaction within the context of user engagements. To achieve this objective, the development team should focus on the implementation of specific mechanisms. First and foremost, conversation tracking algorithms should be employed to keep a vigilant eye on the ongoing conversation's context and focus. This ensures that the chatbot remains aligned with the user's intent throughout the interaction. Additionally, NLU techniques should be applied to discern the user's intent effectively, allowing the chatbot to guide the conversation in a manner that addresses the user's needs accurately. Moreover, a robust system for filtering and prioritising information should be developed, ensuring that only relevant details are introduced during the conversation, preventing the introduction of unnecessary information or distractions. This collaborative effort involves not only the development team, but also UX specialists who are dedicated to optimising user interface cues, and a diverse user base that provides valuable feedback on the effectiveness of focused conversations.

The rationale behind the implementation of focused conversation management lies in the overarching goal of ensuring a purposeful and coherent interaction with users. By preventing the introduction of unnecessary information or distractions, the chatbot strives to meet user needs and address queries accurately within the dynamic and evolving LMS environment.

6.8.4 Design Principle 7: Engaging personality

In pursuit of creating an interactive LMS chatbot, the development team should develop an engaging personality to enrich UX during interactions. This design principle emphasises the incorporation of specific features to create a friendly and approachable persona. To achieve this goal, the development team should focus on implementing various mechanisms. Firstly, a soft tone should be infused into the chatbot's language and responses, aiming to establish

a welcoming and comfortable atmosphere for users. Adding a touch of humour to the chatbot's interactions creates a more enjoyable UX. Visual engagement is enhanced through the incorporation of emojis and avatars, making the interaction not only informative, but also visually appealing and relatable. The chatbot should go beyond mere information provision by offering comprehensive support, but actively foster user engagement and interaction, and provide personalised guidance. Enactors actively involved in this process include the development team responsible for shaping the chatbot's personality, content creators dedicated to integrating humour and personality, and users offering valuable feedback for continuous refinement. The rationale underlying the development of an engaging personality is rooted in the overarching goal of fostering a positive and enjoyable UX. By incorporating a soft tone, humour, emojis, avatars, comprehensive support and personalised guidance, the chatbot seeks to establish a robust and positive connection with users.

6.9 UX

In the realm of UX, the researcher explored various key aspects focused on enhancing interactions and satisfaction. Central to providing a seamless experience for LMS users was the prioritisation of quick responses and 24/7 availability. Recognising the significance of the seamless integration of other types of software into the LMS platform, the emphasis is on optimising user access across diverse platforms and services. Users expressed a desire for the chatbot to engage in purposeful and focused conversations within the dynamic landscape.

Moreover, there is a collective call from users to infuse human-like characteristics into the LMS chatbot, encompassing a friendly tone, humour and visual elements. This integration aims to establish a positive connection and foster an enjoyable UX. Users further emphasised the importance of tracking performance and receiving tailored guidance to enrich the learning, teaching and administrative journey. Clear communication about the chatbot's capabilities and limitations is a crucial factor for users to feel well informed, contributing significantly to a positive and informed UX. Collectively, these components blend into a comprehensive strategy that is aimed at elevating the overall LMS UX.

6.9.1 Design Principle 1: Responsive interaction and availability

See Section 6.7.1

6.9.2 Design Principle 2: Seamless integration into in LMS platform

See Section 6.7.2

6.9.3 Design Principle 5: Focused conversation

See Section 6.8.3

6.9.4 Design Principle 7: Engaging personality

See Section 6.8.4

6.9.5 Design Principle 8: Progress tracking and personalised recommendations

See Section 6.7.4

6.9.6 Design Principle 9: Transparency on capabilities and limitations

The development team should focus on creating transparency regarding the chatbot's capabilities and limitations. This design principle is centred around ensuring clear communication with users within the context of their interactions. To achieve this objective, the development team should be dedicated to implementing specific mechanisms. Firstly, a clear and concise communication strategy must be developed to effectively convey the chatbot's capabilities to users. This strategy should aim to provide users with a comprehensive understanding of the chatbot's functionalities.

Complementing this, a robust system should be established to clearly articulate the limitations of the chatbot's functionalities. This transparency feature would help manage user expectations by openly communicating the areas where the chatbot may have limitations. To further enhance user understanding, user-friendly prompts and responses should be incorporated, optimising the UX and ensuring that users are well informed about the chatbot's capabilities and limitations. Enactors who are actively involved in this process include the development team and UX specialists, who play a key role in optimising user prompts and responses. Additionally, user feedback is regarded as a valuable component in refining and improving the effectiveness of the transparency features. The rationale

behind implementing transparency on capabilities and limitations is firmly grounded in the goal of managing user expectations effectively. By clearly communicating what the chatbot can and cannot do, this feature aims to prevent user frustration and disappointment, ultimately fostering a more positive and informed UX.

6.10 FEEDBACK

User feedback acts as a valuable resource for stakeholders to identify areas for improvement, ensuring that the LMS chatbot remains user-friendly and effective in addressing user needs.

6.10.1 Design Principle 6: Intelligent error handling and human-agent handover

See Section 6.7.3

6.11 SUMMARY OF CHAPTER 6: EVALUATION

This chapter was dedicated to the examination of expert questionnaire responses, preceding the refinement of the tentative artefact. Employing an exploration through the CCA principles, the researcher uncovered invaluable suggestions aimed at refining and enhancing the tentative set of design principles. These findings offer not only constructive recommendations in the format of a final set of LMS chatbot design principles, but also lay the groundwork upon which future research and decision making can confidently rely. In the final chapter, the insights extracted from this analysis will play a pivotal role in shaping and guiding Chapter 7, providing a foundation for the formulation of meaningful conclusions and recommendations.

CHAPTER 7: CONCLUSION

In this study, the focus has been on the critical role of LMSs in HEIs and the potential enhancement of UX through the integration of chatbots. The rapid evolution of technology and the dynamic educational landscape have necessitated a continuous effort to optimise LMS design and support systems.

The study aimed to contribute valuable insights to existing literature by formulating a set of design principles for chatbots integrated into LMSs within higher education. This aligns with the overarching goal of facilitating optimal utilisation and enhancing UX. The research adopted the DSR methodology, leveraging activity theory as a framework to develop LMS chatbot design principles. The DSR model proposed by Vaishnavi and Kuechler (2008) was employed, following the five-phase iterative process. These phases include awareness of the problem, suggestion, development, evaluation and conclusion, as explained by Vaishnavi and Kuechler (2008). Although the methodology is detailed in Chapter 4, for ease of reference, a summary of the phases is provided in Figure 7.1.

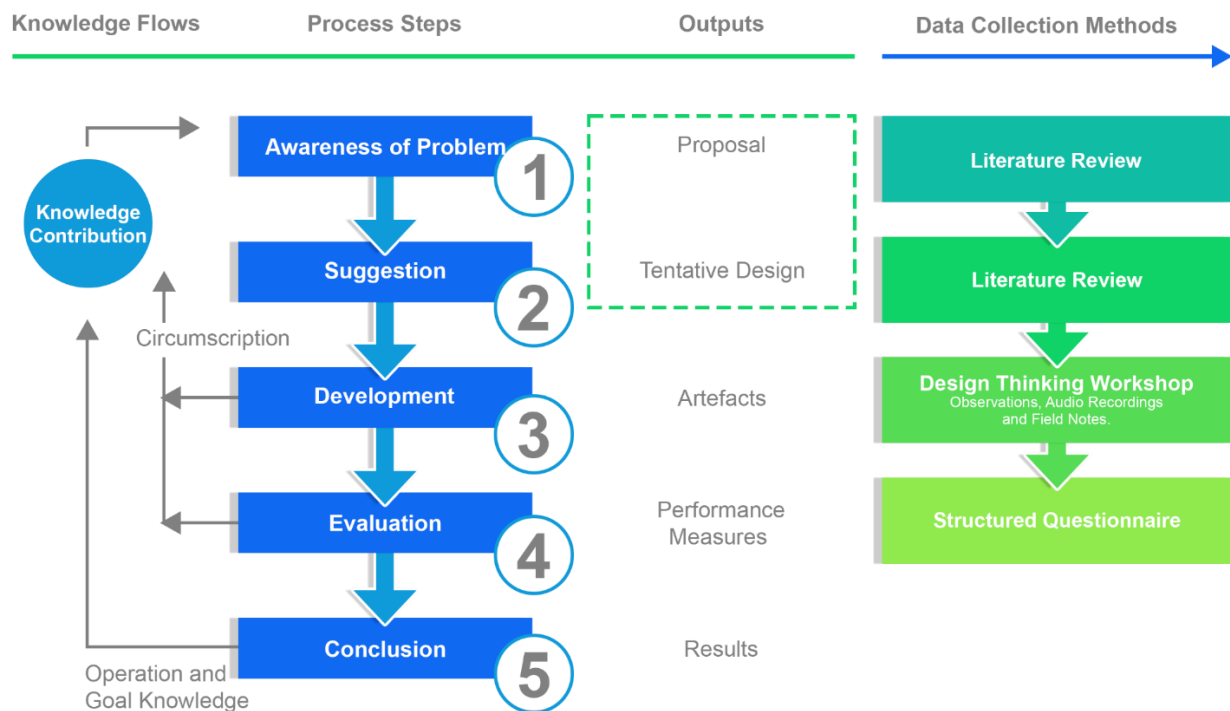


Figure 7.1: DSR process model as adapted from Vaishnavi and Kuechler (2008)

The research questions will be revisited according to the phases of the DSR method.

7.1 SUMMARY OF FINDINGS

The following subsections provide a summary of the answers to the seven subresearch questions and main research question.

7.1.1 SQ1: Awareness

How do LMS service providers support LMS users?

This section aims to delve into SQ1, elucidating the ways in which LMS service providers support users. The discussion unfolds as follows:

When examining how LMS service providers extend support to their users, it becomes evident that these platforms are intricately designed to furnish a comprehensive array of features and functionalities. Khalaf et al. (2022) accentuate this comprehensive feature set, which encompasses communication, content delivery, evaluation, application and integration. The overarching objective is to fashion a flexible learning environment that transcends the traditional constraints of time and location, as articulated by Bervell and Umar (2017) and Saleh et al. (2022).

A notable strength of LMS platforms lies in their adeptness at centralising and automating various administrative tasks. This proficiency extends to supporting self-directed learning opportunities and efficiently managing the collection and delivery of learning materials, as underscored by Al-Handhali et al. (2020). Features such as content portability, adherence to standards, quizzes, the creation of transcripts and notifications for student activities enhance the efficacy of this centralisation and automation process (Asamoah, 2021; Carvus & Alhih, 2014).

Beyond administrative efficiency, LMS platforms actively cultivate an environment that is conducive to user engagement and academic success. Students are empowered to enrol in courses, complete assignments, participate in online evaluations, track their progress and receive timely, course-related announcements, fostering a dynamic and interactive learning experience (Bezverhny et al., 2020; Ghazal et al., 2018).

The integration capabilities of LMS platforms stand out as a pivotal feature, enabling connectivity with other platforms and systems, a subject discussed by Khalaf et al. (2022). This integration proficiency supports data migration and ensures the transfer of existing data into

the LMS, thereby enhancing overall system interoperability (Ilyas et al., 2017; Twakyondo & Munaku, 2012).

LMSs prioritise data security through the implementation of advanced safety protocols and encryption measures (Kooli, 2023; Ochoa-Orihuel et al., 2020). Furthermore, their reliability ensures uninterrupted access, addressing concerns raised by Ghosh et al. (2019) and Kraleva et al. (2019).

Recognising the diverse needs of users, LMS platforms are designed to be mobile-friendly and accessible across various devices (Aldiab et al., 2019; Kasim & Khalid, 2016). This adaptability ensures a smooth UX, regardless of users' device preferences.

Communication and collaboration tools that are embedded within LMS platforms, such as forums, chats, messaging and groupwork functionalities, facilitate interaction among users, as noted by Kahu et al. (2022) and Khalaf et al. (2022). Instructors find effective support in designing and managing courses through LMS features that are dedicated to course creation and management (Arora et al., 2022; Singh, 2022).

LMSs offer flexibility through open source or commercially licensed options, providing users with choices based on customisability, flexibility and security preferences (Hasan, 2019; Lima et al., 2019).

Beyond the essential features, additional elements contribute to an enhanced UX. Single sign-in, smart scheduling or calendar tools, and the integration of social learning tools all play a role in creating a user-friendly and enriching LMS experience (Brandtzaeg et al., 2015; Spirin et al., 2022; Yilmaz & Yilmaz, 2022).

Crucially, LMS service providers ensure ongoing support mechanisms for users. This includes features like online chatbots for immediate assistance, webinar functions for interactive sessions and virtual classrooms that are equipped with recording and video conferencing capabilities (Fabito et al., 2021; Nimasari et al., 2023; Ranveera et al., 2021).

The identified gap pertains to how LMS service providers support LMS users. While the existing literature extensively describes the various features and functionalities offered by LMS platforms, illustrating their positive impacts on user engagement, administrative efficiency and overall learning experiences, it lacks a detailed exploration of challenges or limitations faced by users in effectively utilising these extensive features.

The identified gap suggested that, while the positive aspects of LMS platforms are well documented, there is a need to investigate the opposing side of UX: the difficulties or obstacles users may encounter when interacting with the rich feature sets of LMS platforms.

Addressing this gap was crucial for a comprehensive understanding of the UX within LMS environments and how LMS service providers support LMS users. Research focused on exploring the challenges faced by users offered insights into areas for improvement, potential refinements to the design of LMS features and strategies to enhance user satisfaction and effectiveness.

7.1.2 SQ2: Awareness

How can the UX of an LMS be improved?

UX design is a multidisciplinary field that incorporates science, social studies and creative disciplines. It involves various aspects, such as interaction design, information architecture, usability, human-computer interaction and user interface design. UX has become increasingly important in education, marketing, health and other domains (Rico-Olarte et al., 2018).

The positive induction of UX holds particular significance for software technologies. Positive UX not only enhances application enjoyment and efficiency, but it also plays a pivotal role in user acceptance and motivation. It encompasses perceptions, responses and feelings during interaction with a design, representing a subjective, dynamic and context-dependent aspect of human-computer interaction (Følstad & Brandtzaeg, 2020; Hassenzahl, 2008).

Going beyond usability, UX considers emotions, motivations and the entirety of the user's experience, which is crucial for enhancing product usability, interactivity and productivity (Abbas et al., 2022a). Prioritising UX in design mitigates user complaints, reduces brand switching and enhances customer satisfaction (Olaleye et al., 2017).

Various factors influence UX, including accessibility, aesthetics, ease of use, functionality, personalisation, complexity and system stability (Al-Mahmood, 2012; Cozlov & Zadorojnii, 2022; Demir et al., 2022; Wenzel & Moreno, 2022). In the context of LMS, where the emphasis on UX has grown significantly (Gunawan et al., 2021; Saleh et al., 2022), technological advances, internet growth and user demands have driven the shift to digital learning environments (Araka et al., 2021). However, challenges like unresponsive design and a lack of quick mobile access can impede LMS success (Abdul Lasi, 2021; Turnbull et al., 2023).

UX in LMSs is influenced by factors such as ICT infrastructure, internet access and device availability (Legarde, 2022; Sobaih et al., 2016). In LMS development, a nuanced understanding of usability and user acceptance is crucial, acknowledging diverse interpretations within the field of UX (Pretorius et al., 2015). Studies that compare LMSs like Moodle and Blackboard underscore the need to prioritise UX in online learning environments (Machado & Tao, 2007). Positive UX not only fosters better user satisfaction and loyalty (Ibrahim & Aziz, 2022), but is intricately tied to the design quality and maintenance of an LMS, significantly influencing the overall UX (Maslov et al., 2021). Continuous UX measurement and feedback mechanisms are essential to identify and rectify experiential issues, ultimately elevating the overall UX quality of the product (Feng & Wei, 2019).

Within the LMS context, achieving a good UX involves addressing every facet of user interaction, from ensuring the intuitiveness of the interface to guaranteeing scalability and adaptability. This is accomplished by adhering to specific design principles that guide and shape how users engage with these systems (Pappas & Zaharias, 2018). Consequently, the enhancement of UX in LMSs is a multifaceted process that requires a holistic approach and continual evaluation.

Literature indicates a notable gap concerning the improvement of UX in LMSs. While the significance of enhancing UX within LMSs is acknowledged, there is a lack of clear guidance on how to address the existing challenges and limitations. Despite acknowledging the importance of UX in domains like education, there is a gap in providing concrete methods, principles or approaches that are tailored to LMS contexts. Literature implies that there is a need for specific strategies and methodologies to improve the UX of LMSs.

7.1.3 SQ3: Awareness

How are chatbots used to support LMS users?

The integration of chatbots into LMSs plays a multifaceted role in enhancing the UX. Chatbots offer valuable support to LMS users by addressing a variety of needs and challenges, and covers a broad spectrum of applications, spanning education, health, e-commerce and productivity (Chaskopoulos et al., 2022). In LMSs, they serve functions beyond traditional customer service, ranging from addressing common queries to acting as digital tutors in some platforms, facilitating self-paced learning and providing personalised guidance.

Within LMSs, chatbots contribute significantly to customer service, which is integral for user satisfaction. The real-time nature of chat services has redefined customer support, providing fast and accessible help and contributing to increased satisfaction and trust (Følstad et al., 2018). Furthermore, the 24/7 availability of chatbots ensures that users can receive the necessary support at any time, contributing to the accessibility and flexibility of educational resources (Wadhawan et al., 2023). Moreover, automated customer service through chatbots offers benefits such as increased efficiency, reduced costs and enhanced customer experience (Meuter et al., 2005).

In the educational context, chatbots are not merely customer service models, but can serve as tutors and teaching assistants in some instances. They contribute to a personalised learning experience by offering support, sharing knowledge and adapting to individual learning styles (Kuhail et al., 2023). Chatbots can guide students to access emotional support from professionals, such as psychologists, thereby fostering increased motivation, engagement and mental well-being (Viduani et al., 2023).

The use of chatbots in LMSs is not static. Rather, it evolves with technological advancements and user needs. Ongoing research and studies continue to explore innovative applications and best practices to integrate chatbots into educational platforms, ensuring continuous improvement in their functionality and effectiveness.

The integration of chatbots into LMSs positively influences UX by providing diverse functionalities, improving customer service, facilitating personalised learning and ensuring continuous accessibility to educational resources. While acknowledging the potential benefits, it is crucial to consider the unique characteristics of the education environment, ensuring that chatbots are designed to meet the specific needs of LMS users.

The identified gap in the literature centres around a lack of comprehensive exploration into the specific methods, best practices and optimal strategies for utilising chatbots to support LMS users. While the literature acknowledges the multifaceted role of chatbots in enhancing the UX within various domains, including LMS environments, there is a notable absence of detailed insights into how chatbots are effectively deployed and integrated to address the diverse needs and challenges of LMS users.

Summary of the awareness phase

The existing literature highlighted a persistent issue of inadequate customer support for LMS users, as consistently observed in various studies (Rana & Rana, 2020; Winter et al., 2021). This deficiency in customer support often results in the suboptimal utilisation of LMSs, a problem acknowledged in Section 2.4.

Emphasising the pivotal role of UX in enhancing product usability and interactivity, Abbas et al. (2022a), in Section 2.6.1, and Machado and Tao (2007), in Section 2.6.3, underline the importance of improving UX to optimise the utilisation of the LMS. The incorporation of chatbots is proposed as a solution to enhance the UX of systems, as discussed in Section 2.9.1 with examples provided by Følstad and Brandtzaeg (2020), Følstad and Skjuve (2019) and Nguyen (2019), particularly within the context of LMSs.

Section 2.8.4, represented by Shukla and Verma (2019), suggested that chatbots can address some challenges in customer support for LMSs. Existing literature indicates that chatbots contribute to improving the utilisation of LMSs (Murad et al., 2019; Villegas-Ch et al., 2020). However, despite the inclusion of chatbots in LMSs, there is a lack of guidelines, especially those grounded in empirical evidence (Jung et al., 2020). Furthermore, none of these studies establish a clear link between the integration of chatbots and improved UX.

The researcher justifies the significance and relevance of the research problem addressed in the DSR study, asserting that guidelines in the form of design principles are essential to develop effective chatbots that enhance the UX of LMS, consequently improving their utilisation.

7.1.4 SQ4: Suggestion

Drawing from the principles of activity theory, how do various user groups interact with an LMS?

To address the problem raised in the awareness phase, insight is needed into various user groups' interaction with an LMS. Activity theory provides a framework to understand these interactions by emphasising the social and cultural aspects that shape human activity. Below is an explanation of how different LMS user groups (administrators, instructors and students) interact with an LMS within the context of activity theory:

a) Administrator activity system

- **Role and responsibilities:** Administrators, who are situated at the top of the hierarchy, play a pivotal role in managing the overall LMS. Their responsibilities include server preparation, software installation, problem solving and ensuring the smooth operation of the entire system.
- **Tools and artefacts:** Administrators use tools to manage curriculum data, semester years, instructors, students and subjects, and can enrol new users, assign roles and associate users with courses.
- **Object and outcome:** The object of their activity is the effective functioning of the LMS. The outcome is the successful management and administration of the educational platform.

b) Instructor activity system

- **Role and responsibilities:** Instructors focus on teaching-related activities, such as creating, uploading and managing course content, choosing teaching strategies and monitoring student progress.
- **Tools and artefacts:** Instructors use tools to create online lessons, adding various types of resources and activities, and accessing data on student progress and results reports.
- **Object and outcome:** The object is effective teaching and learning, and the outcome is the successful delivery of educational content and monitoring of student engagement.

c) Student activity system

- **Role and responsibilities:** Students, with the least power in the hierarchy, engage with the LMS by accessing enrolled courses, viewing calendars, announcements and messages from instructors, and submitting assignments.
- **Tools and artefacts:** Students use tools to download course materials, complete assignments, and access progress reports and online assessment results.
- **Object and outcome:** The object is successful learning, and the outcome is the completion of assigned tasks and the acquisition of knowledge.

Within the interconnected activity systems, conflicts may arise, such as between tools and the division of labour. These tensions can be beneficial, leading to further development and improvements in the LMS.

Activity theory served as both a descriptive lens and an analytical tool to understand how different user groups engage with the LMS. It assisted the researcher to understand and explore motivations, goals and contextual factors that influence interactions.

Summary of the suggestion phase

Apart from using activity theory to understand the different users, literature on design principles and design features were considered. To address the problem raised during the awareness phase, the following was suggested:

The need to formulate a set of design principles for LMS chatbots to enhance UX has been established through empirical evidence. The suggested approach involved formulating these design principles to address existing gaps in LMS chatbot guidelines, drawing from the empirical findings outlined in Section 3.3. To enrich these principles, design features were incorporated, aligning with Gregor et al.'s (2020) schema for designing design principles (Table 3.2). The considerations extend to various user activities identified in LMS activity systems, as discussed in Section 3.5. Furthermore, Morville's (2004) UX Honeycomb Model, detailed in Section 2.7.3, was integrated to enhance the overall UX.

7.1.5 SQ5: Development

What design principles guide the development of LMS chatbots?

The influence of activity theory had an impact on the sampling strategy during the invitation of LMS users. Furthermore, in organising the different design teams, a deliberate effort was made to distribute users so that each group included a representative from the relevant LMS user category. This strategic alignment with activity theory principles ensured the integration of diverse perspectives, enriching the collaborative design process.

Upon examining the data collected during the design thinking workshop, the researcher discerned a considerable overlap in the needs of the various LMS user groups. This realisation prompted a departure from presenting design principles and findings tailored to each user group (administrators, instructors and students). Instead, the outcomes were articulated as general guidelines, reflecting the shared requirements that emerged from the workshop.

In summary, administrators, instructors and students engage with an LMS, guided by their distinct roles and responsibilities. The design principles and findings derived from the design thinking workshop are presented as universal guidelines, acknowledging the common needs identified across user groups.

Table 7.1 outlines key design principles governing the development and deployment of an LMS chatbot. The design principles are the outcome of a rigorous design process using the schema of Gregor et al. (2020) for designing design principles (Table 3.2). These design principles are structured to enhance the chatbot’s effectiveness in providing responsive interaction and availability, seamless integration into the LMS platform, NLU, multilingual support, focused conversation, intelligent error handling, engaging personality, progress tracking, personalised recommendations, transparency on capabilities and limitations, and privacy and data security. Each design principle delineates specific criteria and expectations, offering a comprehensive framework for the design and implementation of an LMS chatbot that prioritises UX.

Table 7.1: The final set of LMS chatbot design principles that guide the development of LMS chatbots (Also Table 6.5)

Category	Design principle
Technical	DP1: Responsive interaction and availability
	DP2: Seamless integration into an LMS platform
	DP6: Intelligent error handling and human-agent handover
	DP8: Progress tracking and personalised recommendations
	DP10: Privacy and data security
Language	DP3: NLU
	DP4: Embrace multilingual support with multiple input modalities
	DP5: Focused conversation
	DP7: Engaging personality
User experience	DP1: Responsive interaction and availability
	DP2: Seamless integration into an LMS platform
	DP5: Focused conversation
	DP7: Engaging personality
	DP8: Progress tracking and personalised recommendations
	DP9: Transparency on capabilities and limitations
Feedback	DP6: Intelligent error handling and human-agent handover

In conclusion, the final set of LMS chatbot design principles (Table 6.5 and Sections 6.6 to 6.6.10) provides a comprehensive framework for the development of a user-centric LMS

chatbot. By integrating principles such as responsive interaction and seamless integration into the LMS platform, NLU, multilingual support, focused conversation management, intelligent error handling, engaging personality, progress tracking, personalised recommendations, transparency on capabilities and limitations, and privacy and data security, the envisioned chatbot emerges as a dynamic and supportive tool for users within the dynamic LMS environment.

The emphasis on responsiveness and availability ensures a seamless and timely UX, while seamless integration into the LMS platform contributes to an efficient and cohesive learning environment. NLU, multilingual support and multiple input modalities enhance inclusivity and cultural sensitivity, fostering a user-friendly experience. Focused conversation management prevents information overload and distractions, promoting purposeful interactions. Intelligent error handling and human-agent handover mitigate user frustration, contributing to a smoother user journey.

Moreover, the incorporation of an engaging personality adds a human touch to interactions, making the learning experience enjoyable. Progress tracking and personalised recommendations cater for individual needs, promoting a personalised and enriching learning journey. Transparency on capabilities and limitations manages user expectations effectively, while robust measures for privacy and data security instil trust.

In essence, these design principles collectively aim to elevate the LMS chatbot beyond a mere information provider, transforming it into a valuable companion that actively supports users in their learning endeavours. The principles are aligned with the overarching goal of creating a positive, inclusive and secure environment, fostering a meaningful and enriching learning experience within the dynamic LMS landscape.

7.1.6 SQ6: Development

Which actionable guidelines in the form of design features address LMS user needs and inform the development of a chatbot to enhance LMS UX?

Table 7.2 presents a comprehensive set of principles and functionalities, guiding the development and deployment of an LMS chatbot. Encompassing ten distinct design principles (illustrated in Table 7.1), the table delineates specific design features that contribute to the chatbot's responsiveness, adaptability and user-centric engagement. This

structured framework provides a roadmap to craft an LMS chatbot that not only addresses functional requirements, but also prioritises ethical considerations, continuous improvement and – ultimately – UX. The design features are based on data obtained during the design thinking workshop.

Table 7.2: Design features

<p>Design Principle 1: Responsive interaction and availability</p> <ul style="list-style-type: none"> • The chatbot must acknowledge the query within seconds by confirming that it is processing the request. • The chatbot must understand the questions posed and provide accurate responses within seconds. • The chatbot should inform the user politely and suggest alternative sources or actions when it encounters a query it cannot answer. • The chatbot should maintain context and reference prior interactions so that the user does not have to repeat the question. • The chatbot should proactively offer additional resources or assistance when it detects that the user is struggling. • The chatbot should be available 24/7, ensuring that the user can access help and information whenever needed. • The chatbot should be hosted on a trusted and reliable infrastructure, capable of handling increased user load without performance degradation during peak usage times. • The chatbot should implement load balancing and failover mechanisms to ensure redundancy across multiple servers or cloud instances, reducing the risk of downtime due to server failures. • The chatbot should regularly conduct automated health checks to monitor its system and components, promptly detecting and addressing any issues that may arise to minimise service interruptions. • The chatbot should implement a 24/7 monitoring system that alerts administrators to any glitches or performance issues, enabling rapid response and issue resolution. • The chatbot should provide advance notice to users and gracefully redirect them to alternative support channels or resources during the downtime.
<p>Design Principle 2: Seamless integration into an LMS platform</p> <ul style="list-style-type: none"> • The LMS chatbot should seamlessly integrate with the existing LMS infrastructure and other platforms, tools and data sources, ensuring compatibility and smooth communication. • Users should be able to access a wide range of information and services through the chatbot, including academic and social announcements, progress reports, marks, financial statements, proof of registration and other relevant resources. • Users should regularly update and maintain the integration to accommodate changes in the LMS environment, ensuring ongoing compatibility and functionality.
<p>Design Principle 3: NLU</p> <ul style="list-style-type: none"> • The chatbot should be equipped with advanced NLU algorithms that enable it to accurately identify and understand common abbreviations and acronyms. • The chatbot should possess a robust synonym database, allowing it to recognise and interpret synonymous terms used by users, ensuring accurate comprehension. • The chatbot should exhibit the ability to interpret paraphrased queries and requests, providing relevant responses, even when users express themselves differently.
<p>Design Principle 4: Embrace multilingual support with multiple input modalities</p> <ul style="list-style-type: none"> • The chatbot’s interface should include a language selection option that is prominently displayed, allowing users to easily choose their preferred language from a list of supported languages. • The chatbot should support a diverse range of languages commonly used by the LMS’s user base, ensuring that users can interact in their native or preferred language. • The chatbot should immediately switch its responses to that the selected language, ensuring that all subsequent interactions occur in the chosen language.

- The chatbot should ensure that its knowledge base and responses are accurate and culturally sensitive in each supported language, avoiding misunderstandings or cultural insensitivity. The chatbot should support multiple input modalities, including voice-to-text functionality.

Design Principle 5: Focused conversation

- The chatbot should be capable of recognising and addressing off-topic user inputs, gently guiding the conversation back to the intended subject matter.
- The chatbot should maintain a coherent conversation flow by referencing previous user queries and responses, creating a sense of continuity in the discussion.
- The chatbot must sustain conversation context, recalling previous interactions and incorporating this knowledge into responses to ensure coherent and context-aware conversations.
- The chatbot should respond to each question separately and logically, avoiding confusion when multiple questions are asked within a single message,
- The chatbot should refrain from introducing unrelated content during the conversation, focusing solely on providing relevant support and information.
- The chatbot should respond with a polite refusal when a user attempts to introduce inappropriate or offensive content.

Design Principle 6: Intelligent error handling and human-agent handover

- The chatbot should have an error detection mechanism to identify ambiguous queries or misunderstandings during user interactions.
- The chatbot should provide informative error messages that clearly identify the issue and explain why the query cannot be processed as-is.
- The chatbot should employ a friendly tone in error messages, avoiding language that may come across as dismissive or unhelpful.
- The chatbot should implement a user feedback loop to collect user input on the effectiveness of error messages, utilising this feedback to continually enhance the chatbot's error-handling capabilities.
- The chatbot should adapt to language nuances to recognise and address common language or terminology misunderstandings, adapting its responses to align with the user's intended meaning.
- The chatbot should continuously refine error-handling algorithms through machine learning and NLU techniques, enhancing the chatbot's ability to handle diverse user queries and nuances over time.
- The chatbot should gracefully handle multi-turn conversations, maintaining context and guiding the conversation back on track.
- The chatbot should implement a threshold mechanism to identify when it cannot adequately address a query or when the request falls outside its capabilities.
- The chatbot should facilitate human support handover and politely inform the user when human support is required, providing a seamless transition process for users to request assistance from the service desk.
- The chatbot should automatically generate an email to the service desk, including relevant details of the user's query and chatbot responses, ensuring a smooth handover and minimising the need for users to repeat information.
- The chatbot should notify users about the handover and that assistance will be provided via email shortly.
- The chatbot should provide information on human support availability by advising the user that human support is not available 24/7.
- The chatbot should issue a reference or ticket number, allowing users to track the progress of their support request with the service desk.
- The chatbot should continuously monitor and evaluate its limitations and the effectiveness of transitions to human support, using user feedback and metrics to improve the transition process and minimise the need for such transitions over time.
- The chatbot should ensure operator and staff training to handle transitioned requests effectively, providing a seamless and responsive human support experience.

Design Principle 7: Engaging personality

- The chatbot should have a friendly and approachable personality, incorporating a soft tone of voice, language style and demeanour to align with creating a positive UX.

- The chatbot should use conversational elements such as greetings, expressions of empathy and polite language, along with the inclusion of appropriate emojis and avatars, to make users feel valued and respected during interactions.
- The chatbot should enhance personalised interactions by addressing users by name (obtained from integrated systems) and referencing prior conversations to maintain continuity and build rapport.
- The chatbot should utilise humour or light-hearted language when contextually relevant and appropriate, along with the integration of engaging emojis, to add an enjoyable and interactive dimension to the conversation.
- The chatbot should actively listen to users, demonstrating understanding and empathy when users' express concerns or frustrations, ensuring a comprehensive support experience.
- The chatbot should continuously monitor and analyse user feedback, incorporating emoji reactions and assessing the chatbot's personality to gauge its impact on user engagement and satisfaction.
- The chatbot should regularly undergo training of its NLU algorithms by the designers to fine-tune its conversational skills, ensuring personalised guidance and maintaining an engaging and user-friendly personality.
- The chatbot designers should collaborate with language and communication experts to refine the chatbot's personality, incorporating avatars and emojis, and ensure alignment with the desired UX.

Design Principle 8: Progress tracking and personalised recommendations

- The chatbot should be integrated with LMS analytics and data tracking systems, enabling real-time access to students' online activity, including course participation, assignment submissions and assessment results.
- The chatbot should implement machine learning algorithms to analyse students' activity and performance data, identifying trends, strengths and areas for improvement. This information should be used to create personalised profiles for each student.
- The chatbot should proactively engage with students by offering personalised recommendations and suggestions based on their profiles and preferences. These recommendations may include additional study material, relevant courses, peer collaboration opportunities, time management tips, summarising achievements and highlighted areas for improvement. Updates should be accessible through the chatbot and, if desired, sent via email or notifications.
- The chatbot should be capable of answering questions related to students' performance, academic standing and progress towards their goals, providing transparency and clarity.
- The chatbot should implement data privacy and security measures to safeguard students' personal and academic information, ensuring compliance with relevant regulations.
- The chatbot should develop a comprehensive knowledge base, including accurate and up-to-date information on various mental health conditions, symptoms, coping strategies and available resources within the institution.
- The chatbot should implement NLU capabilities to effectively interpret user enquiries related to mental health, and provide relevant responses.
- The chatbot should offer users access to a range of resources, including articles, guides and documents, providing valuable information on mental health topics and strategies to cope with stress, anxiety, depression and other conditions.
- The chatbot should provide contact information for on-campus mental health support services, including counselling centres or mental health professionals, as well as help lines or crisis intervention services.
- The chatbot should direct users to reputable external websites or organisations that offer additional mental health resources and support, ensuring access to a diverse range of information and assistance.
- The chatbot should maintain a compassionate and supportive tone when discussing mental health topics, avoiding judgment and stigma, and encourage users to seek help when needed.
- The chatbot should implement privacy and confidentiality measures to protect user data, ensuring that sensitive information related to mental health is handled with care and security.

Design Principle 9: Transparency on capabilities and limitations

- The chatbot should provide an initial greeting message that includes a brief, but clear description of its role and purpose within the LMS.
- The chatbot should proactively clarify its capabilities and limitations by stating what types of queries it can answer and the areas in which it can provide support.
- The chatbot must suggest alternative resources or contacts for assistance when it cannot aid.

- The chatbot should explicitly communicate when it cannot provide assistance or when human intervention may be necessary.
- The chatbot should periodically remind users of its role and limitations to ensure that expectations remain aligned with its capabilities throughout the conversation.

Design Principle 10: Privacy and data security

- The chatbot should have a friendly and approachable personality, including a tone of voice, language style and demeanour that aligns with creating a positive UX.
- The chatbot should incorporate conversational elements such as greetings, expressions of empathy and polite language to make users feel valued and respected during interactions.
- The chatbot should enhance personalised interactions by addressing users by name (obtained from the integrated systems) and referencing prior conversations to maintain continuity and build rapport.
- The chatbot should utilise humour or light-hearted language when appropriate and contextually relevant to add an enjoyable and engaging dimension to the interaction.
- The chatbot should actively listen to users, demonstrating understanding and empathy when users' express concerns or frustrations.
- The chatbot should continuously monitor and analyse user feedback to assess the chatbot's personality and its impact on user engagement and satisfaction.
- The chatbot designers should regularly train the chatbot's NLU algorithms to fine-tune its conversational skills and ensure that its personality remains engaging and user-friendly.
- The chatbot designers should collaborate with language and communication experts to refine the chatbot's personality and maintain alignment with the desired UX.

7.1.7 SQ7: Evaluation

To what extent does the set of design principles guide the design of an LMS chatbot to satisfy the UX needs of LMS users?

This question is addressed in two parts. Part 1 focuses on the feedback from experts during the evaluation of the tentative design principles. Part 2 demonstrates how the final set of LMS chatbot design principles ensures an improved UX for the LMS.

Part 1

The tentative set of design principles were evaluated by LMS experts and refined to ensure their effectiveness. Design thinking is not a rigid, one-size-fits-all approach. It is a flexible and adaptable framework that empowers researchers and designers to navigate the uncertainties and complexities of problem solving. By embracing this iterative process, design teams can uncover solutions that address the most challenging and ambiguous problems.

The analysis of the tentative design principles for an LMS chatbot, after incorporating the expert evaluation's suggestions, reveals a comprehensive and thoughtful approach to creating an effective, user-centric tool. The emphasis on responsive interaction, focused conversation and transparency regarding capabilities and limitations highlighted the

importance of delivering timely and relevant information to users, while managing their expectations (Mozafari, Weiger, & Hammerschmidt, 2022). By incorporating an opt-out functionality and utilising appropriate tone and language, the chatbot respects users' autonomy and preferences, fostering a positive and engaging UX. Additionally, it utilises features such as progress tracking, personalised recommendations and value as a learning companion (Santos & Henriques, 2023). The focus on privacy, data security, error handling and human-agent handover instils trust in users and ensures that their interactions are secure, smooth and effective. Regular feedback-based improvements and an engaging personality further contribute to a positive user perception and ongoing enhancement of the chatbot's capabilities. Overall, this comprehensive set of design principles creates an intelligent and user-friendly LMS chatbot that not only supports students' learning, but also fosters a sense of empowerment, engagement and inclusivity in the educational environment.

It can be interpreted that students invest considerable time engaging with the LMS for the purpose of their studies. As highlighted during the design thinking workshop, there exists a demand for social information alongside mental health support. The integration of an LMS chatbot equipped with functionalities specifically designed for mental health support offers a promising approach to augment the educational journey while attending to students' mental well-being, thereby facilitating a holistic experience. This mutually beneficial pairing offers a range of advantages. It grants students immediate access to mental health support, only if there is a psychologist on board, eliminating constraints tied to appointment scheduling and response times. Moreover, it contributes to reducing the stigma that is often associated with seeking personal assistance for mental health concerns, as students might find it more comfortable to discuss their issues with an AI-driven system than with a human, considering factors of shame, embarrassment or being labelled.

Part 2

In the development and design of a user-centric LMS chatbot, the application of well-defined design principles serves as a guiding compass. These design principles were developed to adhere to the diverse needs of LMS users, with the overarching goal of enhancing the overall LMS UX. As the researcher delved into the exploration of how these principles shape the design of an LMS chatbot, the analysis was anchored in the UX Honeycomb Model by Peter Morville (2004). Evaluating each design principle and its alignment with the model's facets, the researcher aimed to unravel the intricate relationship between these guiding principles

and the holistic satisfaction of LMS users' UX needs. From usability and desirability to accessibility and value, this examination seeks to illuminate the significance of design principles in sculpting an LMS chatbot that transcends mere functionality, delivering a truly user-centric experience.

a) Useful

- **Design Principle 3: NLU:** This principle focuses on the chatbot's ability to comprehend user queries naturally, ensuring meaningful interactions. It significantly contributes to the usefulness of the chatbot by enhancing its capability to provide relevant and accurate responses, thereby improving the overall UX of the LMS.
- **Design Principle 4: Embrace multilingual support with multiple input modalities:** Multilingual support and diverse input modalities contribute to usefulness by accommodating a wide range of user preferences. This ensures that users can interact with the chatbot comfortably in their preferred language and through various input methods, ultimately enhancing the overall UX of the LMS.
- **Design Principle 8: Progress tracking and personalised recommendations:** By actively monitoring user progress and offering personalised recommendations, this principle enhances usefulness and tailors the UX based on individual preferences. It guides users toward resources that are aligned with their unique needs and goals, contributing to an improved overall UX of the LMS.
- **Design Principle 9: Transparency on capabilities and limitations:** Transparency ensures that users have a comprehensive understanding of the chatbot's functionalities and limitations. This clarity contributes to usefulness by effectively managing user expectations, preventing frustration and fostering a positive and informed UX of the LMS.

b) Usable

- **Design Principle 1: Responsive interaction and availability:** Usability is emphasised by providing quick responses and continuous accessibility. This design principle ensures a seamless experience for users, minimising response time and optimising the overall effectiveness of the chatbot, thus contributing to an improved UX of the LMS.

- **Design Principle 5: Focused conversation:** Usability is maintained by implementing mechanisms for focused and coherent interactions. This prevents unnecessary distractions within the dynamic LMS environment, ensuring that users can efficiently navigate and achieve their goals, ultimately contributing to an enhanced overall UX.

c) Desirable

- **Design Principle 7: Engaging personality:** Creating an engaging personality adds a human touch to interactions, making the overall UX enjoyable. This contributes to desirability by establishing a positive connection with users and fostering a more engaging and relatable interaction within the LMS.

d) Findable

- **Design Principle 2: Seamless integration into an LMS platform:** Findability is enhanced by seamlessly integrating the chatbot into the LMS platform. This ensures that users can easily locate and access the chatbot within the existing resources and tools, streamlining access to information and support, and contributing to an improved UX.

e) Accessible

- **Design Principle 4: Embrace multilingual support with multiple input modalities:** Accessibility is improved by embracing multilingual support and various input modalities. This ensures that a diverse user base can access and interact with the chatbot comfortably, promoting inclusivity within the LMS environment, ultimately contributing to an enhanced UX.

f) Credible

- **Design Principle 10: Privacy and data security:** Ensuring privacy and data security establishes credibility. This principle safeguards user information, building trust and confidence in the chatbot's reliability and credibility, ultimately contributing to an improved UX.
- **Design Principle 9: Transparency on capabilities and limitations:** Transparency also contributes to credibility by clearly communicating the chatbot's capabilities and limitations. Users appreciate honesty, and transparent

communication helps manage their expectations effectively, contributing to an overall enhanced UX.

g) Valuable

- **Design Principle 1: Responsive interaction and availability:** Responsiveness and availability ensure that the chatbot provides value by offering timely and helpful information to users at any time, contributing to an effective and reliable UX.
- **Design Principle 2: Seamless integration into an LMS platform:** Seamless integration adds value by making the chatbot an integral part of the LMS environment. This facilitates a cohesive and efficient UX by streamlining access to information and support, contributing to an enhanced overall UX.
- **Design Principle 8: Progress tracking and personalised recommendations:** The active monitoring of progress and provision of personalised recommendations add value by supporting users in their learning journey. This enhances the overall educational experience within the LMS platform, and contributes to an improved UX.
- **Design Principle 10: Privacy and data security to safeguard user information:** Privacy and data security ensure the value of user information, creating a trustworthy environment. This principle contributes to the chatbot's overall value proposition by prioritising user data protection and, consequently, enhancing the UX.
- **Design Principle 6: Intelligent error handling and human-agent handover:** Intelligent error handling adds value by preventing user frustration and ensuring a smooth UX. The human-agent handover feature enhances value by seamlessly transitioning to human support when needed, providing additional assistance and support for an overall enhanced UX.

In summary, the set of design principles aligns with the UX Honeycomb Model, addressing usability, accessibility, credibility, findability, desirability and value within the LMS chatbot's UX. Each principle plays a crucial role in enhancing specific facets of UX, ensuring a comprehensive and satisfying interaction within the dynamic landscape of LMSs.

7.2 CONTRIBUTION TO KNOWLEDGE

In this section, the study's contributions are outlined, summarising three distinct yet interconnected aspects: practical, theoretical, and methodological. Each facet enriches and extends the existing body of knowledge within the IS field. Collectively, these contributions serve as the foundation of this study, aiming to make a meaningful contribution to the broader discourse and advancement of knowledge within the IS domain.

7.2.1 Practical contribution

Within the framework of DSR, this study's primary objective centres around its potential to craft practical solutions with real-world applicability. The most significant practical contribution of this research lies in the development of tailored design principles for LMS chatbots. These principles are intended to guide service providers in creating chatbots that are not only effective, but also user-friendly, thereby optimising the UX and enabling end-users to harness the full potential of LMS capabilities.

The expected contribution to knowledge is rooted in the creation of an artefact that plays a pivotal role in enhancing the effectiveness of products, processes and services in line with the core tenets of DSR. A set of design features (Table 7.2), which accompany the design principles provided (Table 7.1), is expected to ease the implementation of the design principles.

7.2.2 Theoretical contribution

During the awareness phase, it became evident that there was a need for LMS design principles grounded in empirical evidence. Additionally, none of the existing design principles in education clearly establish a link to the improved UX of the LMS. This research contributes on a theoretical level by proposing a set of design principles for the development of chatbots for LMSs, derived from data obtained during a design thinking workshop. The design principles were formulated using the CCA method, following an inductive approach. Furthermore, the design approach that was employed aligns with the well-established framework of Gregor et al. (2020), and all users' activities were considered by incorporating activity theory.

7.2.3 Methodological contribution

The methodological contribution of this study is evident in its distinctive approach during the development phase of DSR. Notably, the study employed a design thinking workshop, aligning with the Stanford d.school design thinking process, to foster innovation and creativity in formulating design principles. The utilisation of CCA ensured a rigorous and systematic examination of data, thereby enhancing the reliability of the findings. Furthermore, the study innovatively incorporated Gregor et al.'s (2020) components of the design principle schema, providing a structured framework to accurately formulate the design principles. Additionally, the study stands out for its pragmatic use of existing technology, specifically the Blackboard Chatbot, for expert evaluation, eliminating the need to create a new chatbot. This methodological amalgamation contributes to the robustness and uniqueness of the research methodology, offering valuable insights for future studies in the field of design science.

Moreover, the inductive approach that was employed to develop design principles, rooted in real-world data, has the potential to generate new theoretical propositions or refine existing theories related to chatbot design, LMS utilisation and potential LMS UX optimisation.

In conclusion, the insights and design principles generated by this study can serve as a foundation for future research in the field of chatbot development for LMS usage. As AI technology continues to evolve, one can anticipate the emergence of increasingly sophisticated LMSs. This research lays the groundwork to explore advanced chatbot applications and their impact on learning and UX.

Figure 7.2 illustrates the practical contribution to the environment, theoretical contribution to the knowledge base and methodological contribution to research within the field of DSR. To achieve these contributions, the research leveraged practical knowledge derived from the environment, incorporating insights from participants and research contexts to ensure relevance. Furthermore, the study utilised theories and concepts from the knowledge base to guide the design of a set of pertinent design principles for LMS chatbots.

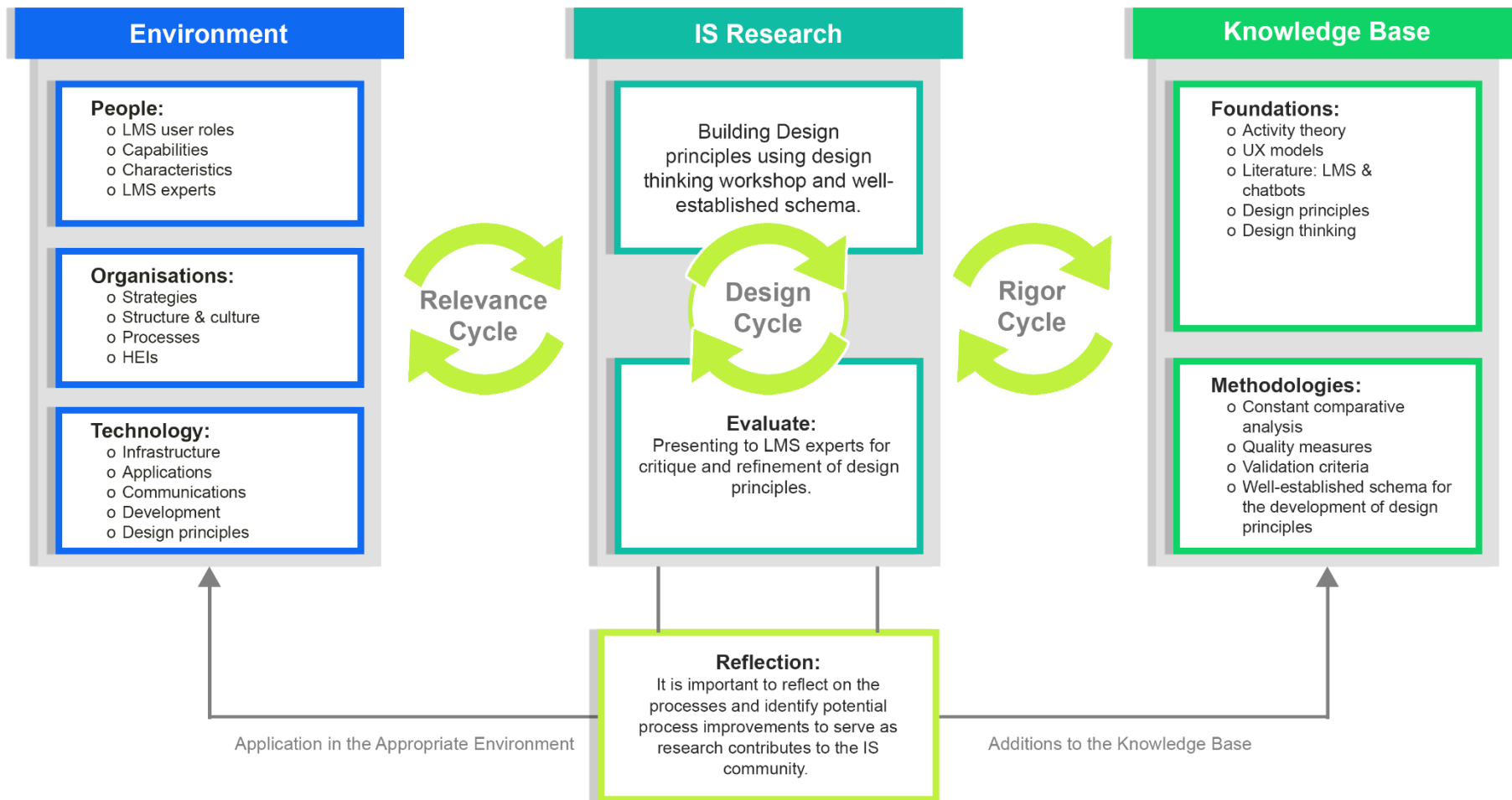


Figure 7.2: The DSR cycles applied to this research (Adapted from Hevner et al., 2004)

7.3 EVALUATION OF THE RESEARCH

Part 1

When conducting DSR, guidelines should be followed. This study followed the guidelines put forward by Hevner et al. (2004) (Table 7.3).

Table 7.3: Evaluation of the research according to Hevner et al.'s (2004) guidelines

Guideline	Description	This study
Design as an artefact	Design science research must generate a sustainable artefact in the form of a construct, a model, a framework, a method or an instantiation.	This study produced a set of LMS chatbot design principles as an artefact. The design principles will guide LMS service providers, designers and developers to create an LMS chatbot to be used at an HEI.
Problem relevance	The objective of DSR is to create technology-based solutions to significant and relevant business problems.	The focus of this study is on the potential of chatbots as an effective way to facilitate the exploitation of an LMS's potential and improved UX of the LMS at HEIs. Therefore, by implementing LMS chatbots, optimal LMS use can be obtained. The DSR, as suggested by IS researchers, was used. As such, the solution is technology-based, but has not been developed in a business environment. The solution was developed in an HEI environment. The problem is relevant because LMS users at HEIs are not effectively utilising the LMS, leading to minimal utilisation of its features. This, in turn, has an impact on teaching, learning and administrative tasks.
Design evaluation	Use well-executed evaluation methods to test an artefact's utility, quality and efficacy.	The utility and efficacy of the tentative set of design principles were evaluated by four experts. A structured questionnaire was used by LMS experts to evaluate the artefact (design principles) in the context of an existing interactive LMS chatbot environment, specifically the Blackboard Chatbot. The artefact (set of LMS chatbot design principles) also meets the objectives put forward in Section 1.4.
Research contributions	Effective design science research produces clear and verifiable contributions to the design artefact, design foundations, and/or design methodologies.	The research was guided by and followed the suggested phases of the DSR process. The study employed a design thinking workshop, aligned with the Stanford d.school design thinking process, to foster innovation and creativity in formulating design principles. The utilisation of CCA ensured a rigorous and systematic examination of data, thereby enhancing the reliability of the findings. Furthermore, the study incorporated Gregor et al.'s (2020) components of the design principle schema, providing a structured framework to accurately formulate the design principles (Section 3.1).

<p>Scientific rigour</p>	<p>Design science research is based on the use of rigorous methods in both the construction and evaluation of the design artefact.</p>	<p>The scientific rigour of the research is discussed in Section 4.5.5.</p> <p>Credibility was achieved by methodological triangulation, using multiple data sources. To ensure credibility, multiple truths and realities were captured in this study, such as the use of different data collection instruments, as discussed earlier. The researcher further considered rich contextualised detail in each stage of the research methodology. To ensure accuracy, the transcripts of the design thinking workshop were checked against the audio recordings and reread multiple times.</p> <p>Reliability was achieved through transferability, (Section 4.5.5). The researcher diligently provided a rich and detailed account of the research methodology employed. The methodology was thoroughly contextualised based on literature. A comprehensive description of the paradigmatic assumptions and perspectives that guided this study can be found in Sections 4.2.1 to 4.2.4.</p> <p>The set of LMS chatbot design principles can be applied and used by any LMS service provider, designer or developer in any HEI environment.</p>
<p>Design as a search process</p>	<p>The search for an effective artefact necessitates the use of available means to achieve desired ends while adhering to the laws of the problem environment.</p>	<p>The researcher explored a wide base of literature and obtained insights from LMS users from different HEIs using different LMSs. The researcher employed the pragmatic use of the available means by using existing technology, specifically the Blackboard Chatbot, for expert evaluation. This eliminated the need to create a new chatbot, while still adhering to the laws of the problem environment.</p>
<p>Communication of research</p>	<p>Design science research must be effectively presented to both technology-oriented and management-oriented audiences.</p>	<p>The set of LMS chatbot design principles were not designed or developed for a technology-based, management-oriented audience. However, these principles should also be applicable when utilising the same set of LMS chatbot design principles for training purposes, including teaching and learning, in a corporate training environment. This is a possible suggestion for future research endeavours. Furthermore, the DSR process followed was clearly communicated throughout the thesis and will continue to be communicated in future publications.</p>

Part 2

Feine, Morana and Maedche (2020) discussed the design of interactive chatbot development systems, proposing three design principles that are grounded in the interactivity effects model to enhance the involvement of domain experts in the chatbot

development process. Their approach involved conducting an online experiment to assess the impact of the proposed design. The results of the study revealed a significant increase in both subjective and objective engagement. Notably, perceived interactivity emerged as a mediating factor that influenced these effects. This research offers prescriptive insights for designing interactive systems and introduces a novel artefact – a comprehensive interactive chatbot development system, outlined in Table 7.4 (also presented in Table 3.6).

Table 7.4: Interactive chatbot design principles (Feine, Morana and Maedche, 2020)

Design principle (DP)	
DP1:	An interactive chatbot development system should enable users to directly manipulate the objects of interests to increase the engagement of domain experts.
DP2:	An interactive chatbot development system should contingently respond to any user input to increase the engagement of domain experts.
DP3:	An interactive chatbot development system should collect and visualise interaction metrics to increase the engagement of domain experts.

The study conducted by Feine, Adam, Benke, Maedche, and Benlian (2020) focused on investigating design principles for enterprise chatbots. Employing a comprehensive approach, the researchers gathered insights from previous studies to formulate a set of six design principles that were aimed at guiding the development of effective and user-friendly enterprise chatbots. These principles are outlined in Table 7.5 (and presented in Table 3.7).

Table 7.5: List of enterprise chatbot design principles (Feine, Adam, Benke, Maedche, and Benlian, 2020)

Design principle (DP)	Definition
DP1: Sociability	Provide the enterprise chatbot with the ability to adapt its conversation style to communicate in the user's preferred way.
DP2: Flexibility	Provide the enterprise chatbot with conversational flexibility to react to changing contexts, tasks and data requests.
DP3: Transparency	Provide the enterprise chatbot with functional transparency so that users can understand its functions and decisions.
DP4: Usability	Provide the enterprise chatbot with user-friendly interactive capabilities to create an effective, efficient and satisfying communication experience.
DP5: Proactive communication	Provide the enterprise chatbot with the ability to use proactive messages to automatically notify users about changes.
DP6: Error handling	Provide the enterprise chatbot with the ability to handle errors of any kind and save them for future improvements.

Jung et al. (2020) made a valuable contribution by exploring design principles for educational chatbots, drawing insights from empirical studies on human-chatbot interaction.

Their analysis focused on the multifaceted roles of chatbots in educational settings, leading to the proposal of design principles for chatbots serving as tutors, evaluators, respondents, communicators and fellow students. Table 7.6 (also presented in Table 3.8) outlines the educational chatbot design principles derived from Jung et al. (2020). These principles highlight categories such as consistency, shortening, feedback, conversation, problem response and recognition.

Table 7.6: Educational chatbot design principles (Jung et al., 2020)

Category	Design principles
Consistency	Use the UI components of the chat platform uniformly
	Optimise for all users and usage
Shortening	Support a way to solve problems faster
	Provide button and button-type replies to help quick selection in limited circumstances
Feedback	Minimise the waiting process and make the user aware of the waiting state
	Provide notifications in appropriate situations
Conversation	Organise the flow of words and contexts naturally, and maintain the standards of dialogue
	Provide appropriate humour
Problem response	Provide opportunities to respond to failures
	Provide the ability to go back and cancel
Recognition	Let users know clearly how to use the chatbot
	Make intuitive awareness of the chatbot's UI components

Table 7.7 presents a comprehensive overview of the final set of LMS chatbot design principles that were categorised into four categories: technical, language, UX and feedback. These design principles address key aspects, such as responsive interaction, integration into LMS platforms, language understanding, multilingual support, focused conversation, engaging personality, progress tracking, personalised recommendations, transparency on capabilities and limitations, and intelligent error handling and human-agent handover.

Table 7.7: Final set of LMS chatbot design principles compared to the suggested set of design principles (Also Table 6.5)

Category	Design principle
Technical	DP1: Responsive interaction and availability
	DP2: Seamless integration into an LMS platform
	DP6: Intelligent error handling and human-agent handover
	DP8: Progress tracking and personalised recommendations

Category	Design principle
	DP10: Privacy and data security
Language	DP3: NLU
	DP4: Embrace multilingual support with multiple input modalities
	DP5: Focused conversation
	DP7: Engaging personality
UX	DP1: Responsive interaction and availability
	DP2: Seamless integration into an LMS platform
	DP5: Focused conversation
	DP7: Engaging personality
	DP8: Progress tracking and personalised recommendations
	DP9: Transparency on capabilities and limitations
Feedback	DP6: Intelligent error handling and human-agent handover

Analysing Table 7.4 (Feine, Morana and Maedche, 2020), Table 7.5 (Feine, Adam, Benke, Maedche, & Benlian, 2020), Table 7.6 (Jung et al., 2020) and Table 7.7 (the final set of LMS chatbot design principles) reveals both commonalities and distinctions among the design principles proposed by Feine, Morana and Maedche (2020) and Feine, Adam, Benke, Maedche, and Benlian (2020) and Jung et al. (2020) and the final set of LMS chatbot design principles according to the findings of this study. Table 7.8 offers a visual representation of the comparison.

Table 7.8: Summary of comparison between the final set of LMS chatbot design principles and design principles as suggested by Feine, Morana and Maedche (2020); Feine, Adam, Benke, Maedche, and Benlian (2020), and Jung et al. (2020)

Final set of LMS chatbot design principles (Table 7.7)		Feine, Morana and Maedche (2020) (Table 7.4)	Feine, Adam, Benke, Maedche, and Benlian (2020) (Table 7.5)	Jung et al. (2020) (Table 7.6)
Category	Design principle			
Technical	DP1: Responsive interaction and availability	✓	✓	✓
	DP2: Seamless integration into an LMS platform			
	DP6: Intelligent error handling and human-agent handover		✓	✓
	DP8: Progress tracking and personalised recommendations		✓	
	DP10: Privacy and data security			
Language	DP3: NLU	✓	✓	✓
	DP4: Embrace multilingual support with multiple input modalities	✓		✓
	DP5: Focused conversation	✓	✓	✓
	DP7: Engaging personality	✓	✓	✓
UX	DP1: Responsive interaction and availability	✓	✓	✓
	DP2: Seamless integration into an LMS platform	✓		
	DP5: Focused conversation	✓	✓	
	DP7: Engaging personality	✓	✓	✓
	DP8: Progress tracking and personalised recommendations			
	DP9: Transparency on capabilities and limitations		✓	✓
Feedback	DP6: Intelligent error handling and human-agent handover		✓	✓

7.3.1 Similarities

The design principles listed below align with the existing sets of design principles (Feine, Adam, Benke, Maedche, & Benlian, 2020; Feine, Morana, & Maedche, 2020; Jung et al., 2020) and are illustrated in Table 7.8. They collectively acknowledge the following aspects:

Technical

- **DP1: Responsive interaction and availability:** Emphasising the importance of responsive interaction and availability.

Language

- **DP3: NLU:** Highlighting the importance of NLU for effective communication.
- **DP5: focused conversation:** Recognising the significance of maintaining a focused conversation.
- **DP7: Engaging personality:** Acknowledging the importance of an engaging personality.

UX

- **DP1: Responsive interaction and availability:** Signifying the importance of responsive interaction and availability.
- **DP7: Engaging personality:** Recognising the important role of an engaging personality across all datasets.

Feedback

- **DP6: Intelligent error handling and human-agent handover:** Emphasising the importance of intelligent error handling and human-agent handover.

7.3.2 Differences

Technical

- **DP2: Seamless integration into an LMS platform:** The final set of LMS chatbot design principles explicitly emphasises the seamless integration into the LMS platform, which is not addressed by Feine, Adam, Benke, Maedche, & Benlian (2020); Feine, Morana, & Maedche (2020) or Jung et al., (2020).

- **DP10: Privacy and data security:** The final set of LMS chatbot design principles explicitly recognises the importance of privacy and data security, which is not explicitly mentioned by Feine, Adam, Benke, Maedche, & Benlian (2020); Feine, Morana, & Maedche (2020) or Jung et al., (2020).

UX

- **DP8: Progress tracking and personalised recommendations:** The final set of LMS chatbot design principles explicitly acknowledges the importance of progress tracking and personalised recommendations, which is not explicitly mentioned by Feine, Adam, Benke, Maedche, & Benlian (2020); Feine, Morana, & Maedche (2020) or Jung et al., (2020).

These differences underscore that the final set of LMS chatbot design principles explicitly introduces additional considerations, especially in the realms of seamless integration into the LMS platform, progress tracking, personalised recommendations, and the critical aspects of privacy and data security, compared to the other sets of design principles. Notably, all three these distinctive design principles are tailored to the unique requirements of the LMS environment.

LMS users have explicitly expressed the need to integrate the LMS platform with various types of software to enhance their overall UX, including navigation, student well-being support, financial systems, Turnitin and other tools.

Moreover, adhering to global policies, the privacy and data security of LMS user data emerge as paramount concerns. Such as, users' personal information, encompassing marks, contact details, passwords, should be handled with privacy and security.

In the context of the relationship between privacy and data security, LMS users have articulated a need for the progress tracking of user performance, encompassing the identification of students at risk and grading statistics. This tracking facilitates the LMS chatbot in making personalised recommendations, connecting LMS users to support services, tutors, counsellors, and others, thus enhancing the overall LMS UX and the LMS user's holistic well-being.

7.4 LIMITATIONS

This study has some limitations that should be considered. Since the literature review was constantly being revised and worked on, the researcher was aware that new insights could lead to alternative views and different approaches to the study as it proceeded.

The researcher acknowledged the possibility that participants' satisfaction or dissatisfaction with the unique features of the LMS utilised in their HEIs could have influenced both their responses and the research outcomes, thus introducing potential bias. Additionally, the researcher was also mindful of the fact that participants might have held specific perceptions and fixed opinions regarding the LMS (potentially stemming from past experiences with a different platform), which could have influenced their contributions to the study.

The Blackboard chatbot that was used to guide the experts in their evaluation was not designed on the proposed set of design principles. An important assumption is, therefore, that, despite this, the provided chatbot could at least assist the evaluators in evaluating the design principles by providing some concrete system to work with.

7.5 FUTURE RESEARCH

In conclusion, while the menu-driven/predetermined conversational path chatbot used in this study had limitations, recent technological advancements have paved the way for more advanced chatbot architectures. These new models, incorporating NLU and machine learning, offer greater flexibility, adaptability and comprehension. As a result, chatbots can now provide a more personalised and satisfying UX, effectively addressing the limitations of earlier designs. It is therefore recommended that the findings of this study be implemented with an AI chatbot, such as the Chat Generative Pre-Trained Transformer (Chat GPT), a large language model-based chatbot.

The researcher believes that the final set of design principles for LMS chatbots provided in Table 7.7 presents a unique set of design principles that are tailored for educational AI chatbots. It builds upon prior research, incorporating elements of technical functionality, language considerations, UX, privacy and personalised learning features. The comprehensive nature of these principles makes them applicable in diverse HEI settings, filling a specific niche in the broader landscape of LMS chatbot development.

7.6 CONCLUDING REMARKS

These findings align with prior research on user motivations and preferences related to chatbot utilisation. In their study on chatbot user motivations, Brandtzaeg and Følstad (2018) discovered that productivity was the primary motivator for most users, followed by entertainment. Additionally, Medhi Thies et al. (2017) found that potential chatbot users prefer a chatbot personality that reflects both productivity and engagement. Consequently, for chatbot service providers, it may be advantageous to design for both pragmatic and hedonic chatbot attributes, especially when the application area permits.

Optimally using an LMS allows instructors to adopt a constructivist strategy where users can actively contribute to their learning (Kitchen & Berk, 2016). Users can collaborate through group chats, monitor their grades and progress, participate in online discussions and take assessments (Asenahabi et al., 2022).

While incorporating the features mentioned above can contribute to a more positive UX, research findings by Nguyen, Sidorova and Torres (2022) suggest that chatbots did not fully achieve the desired level of perceived autonomy compared to traditional menu-based interfaces. Therefore, it is essential to consider these findings and potentially address the factors that may have led to the lower perceived autonomy in chatbot interactions.

Like the work of Bezverhny et al. (2020), the integration of advanced NLU techniques in this study enhances the chatbot's ability to comprehend user queries naturally, enabling more fluid and intuitive interactions. Engaging visual elements, seamless 24/7 availability and multilingual support (Bezverhny et al., 2020) contribute to a more inclusive learning experience, accommodating diverse user needs and preferences. Considering context awareness and integration into the LMS platform ensures a cohesive and efficient environment, seamlessly supporting users in their learning journey.

This study holds significant value in the context of higher education. As a lecturer actively engaged in daily LMS interactions, the researcher's dual role as a PhD student, instructor and researcher uniquely positions her to empathise with the challenges faced by both students and instructors navigating the complexities of these systems. The study underscores the importance of seamless integration and responsive interactions within the LMS, addressing the frustrations users encounter and the desire for instant, yet humanised, support. The global connectivity experienced today underscores the need for a unified LMS

platform guided by a chatbot, capable of incorporating diverse features and functions. Users not only seek instant satisfaction and answers, but also a human touch, emotional support and access to mental health resources.

This research study contributes to the ongoing dialogue surrounding LMS enhancement, emphasising the need for user-centric solutions that align with the evolving expectations and challenges faced by the academic community in the digital age.

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APPENDIX A: ETHICAL CLEARANCE



Faculty of Engineering, Built Environment and Information Technology

Fakulteit Ingenieurswese, Bou-omgewing en
Inligtingtegnologie / Lefapha la Boetsenere,
Tikologo ya Kago le Theknoloṡi ya Tshedimošo

16 November 2022

Reference number: EBIT/246/2022

Mrs MM Swanepoel
Department: Informatics
University of Pretoria
Pretoria
0083

Dear Mrs MM Swanepoel,

FACULTY COMMITTEE FOR RESEARCH ETHICS AND INTEGRITY

Your recent application to the EBIT Research Ethics Committee refers.

Conditional approval is granted.

This means that the research project entitled "Enhancing the users experience of a Learning Management System within Higher Education: Chatbot design principles for service providers" is approved under the strict conditions indicated below. If these conditions are not met, approval is withdrawn automatically.

Conditions for approval:

If any organization (HEI)-specific information obtained during the interview these will need to be removed from data set.

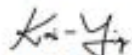
This approval does not imply that the researcher, student or lecturer is relieved of any accountability in terms of the Code of Ethics for Scholarly Activities of the University of Pretoria, or the Policy and Procedures for Responsible Research of the University of Pretoria. These documents are available on the website of the EBIT Ethics Committee.

If action is taken beyond the approved application, approval is withdrawn automatically.

According to the regulations, any relevant problem arising from the study or research methodology as well as any amendments or changes, must be brought to the attention of the EBIT Research Ethics Office.

The Committee must be notified on completion of the project.

The Committee wishes you every success with the research project.



Prof K.-Y. Chan

Chair: Faculty Committee for Research Ethics and Integrity
FACULTY OF ENGINEERING, BUILT ENVIRONMENT AND INFORMATION TECHNOLOGY

APPENDIX B: LANGUAGE EDITING CERTIFICATE



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18 January 2024

Language editing

This serves to confirm that the thesis "Enhancing users' experience of a learning management system within higher education: Chatbot design principles for service providers", submitted by Maria Magrietha Swanepoel (23051478) of the Faculty of Engineering, Built Environment and Information Technology at the University of Pretoria in fulfilment of the requirements for the PhD (Information Systems) degree, was edited for language use, spelling and grammar by a qualified language editor.

Kind regards

A handwritten signature in black ink, appearing to read "Janine Smit", written in a cursive style.

Janine Smit
Bachelor of Arts (University of Pretoria – 1983)
Postgraduate Diploma in Translation (University of South Africa – 1990)

Conducting publication excellence

APPENDIX C: PARTICIPANT WORKSHEET 1: INTERVIEW 1

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Student

- about to do:*
1. Assignments to students on any questions asked
 2. Interactive chatting - providing guidance to students
 3. Guidance on what is open next. Provide info on the next class time + how getting students to do pre-work for next class
 4. Provide next class info
- About not:*
1. Not provide subject work.
 2. Highlight errors when referencing internet

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

use frequently track the number of students from classes

- (How)
- increase bandwidth
 - give instant feedback to multiple students

1 Interview with ... Student

1. Use different languages - detect spelling errors
 2. 24/7 assistance
 3. file directory auto spell checker
 4. Voice recognition
 5. no limits (unsupervised learning) (multi display)
 6. ~~track~~ cookies to keep track
 7. tutorials to use LMS
- ≠ limit the time period.

- ≠ restart canvas / can't last activity
- ≠ put them in a queue

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Student

- multi-lingual detect spelling error
- understand different languages & correct
 - offer 24/7 assistance
 - File directory → e.g. study guide
 - Voice recognition
 - Provide file directory
 - Not limit unsupervised learning/st
 - Pre-determined question
 - track digital footprint
 - Not use provide material on how to use LMS
 - ~~password~~ - number 5 on the line
 - Short period of login - automatic logout
 - Remember the conversation across the system
 -
- How
- immediate feedback
 - tolerance to handle a lot of queries & the same
 - ability to provide feedback on numbers/grades digital footprint
 - user friendly
 - auto-related saving of the conversation
 -

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Student

- Glossary
- Registered - (online)
- Career info
- Prerequisites for course
- Indicate exemptions
- Support
- Hotline - mental health
- Should not give direct answers
- Guide to independent learning

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Student

- ① Use different languages
 - offer 24/7 assistant
 - file directory
 - Voice recognition
 - ~~Alert~~ correct spelling errors
- ② No limited time period
 - Do not restart conversations when the network fails/ documents uploading
- by increasing bandwidth to handle large number of students
- Instant feedback when student access it simultaneously

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Student

- ① Ask (understand) questions
 - should be aware that update student about frequently ask questions if how it was answered
 - make Collaboration/Interaction in class.
 - Alerts to class generated content.
- ② Do not expect?
 - Should not give a lesson, just overview
 - Do not do corrections for the student but highlight it.
- Body Language (perfect)
 - Question (perfect)
 - Confidence (perfect)
 - Body Language (perfect)

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ... *Student* (Dig deeper)

Why do you need a chatbot?

- Aid with learning → guidance navigation support
- Chatbot is always available to ask questions

Should not replace social interaction with peers + instructors

To provide online objects on chatbot

Too much reliance not healthy

Mobile and PC/Laptop availability

Learning through collaboration

Challenges: More flexibility in filter info + notifications

→ learners of deadlines

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... *Student*

- * Navigation within subjects/courses
- * Classify → basic concepts → Revising → guidance to ...
- * Navigation to various functions → registration etc.
- * Pre-requisites of a subject
- * Credits (subjects) → changing courses → transfer
- * Immediate support
- * Social events
- * Mental health

Guidance rather than planned replies

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Instructor

- What to do:
1. Provide answers to any questions
Knowledgeable in the field of the possible questions
 2. FAQs & Commonly asked questions
Knowledge database
 3. Make a provision for visually-impaired or any disability conditions
 4. Language formulation ability
 5. Feedback Service - in the case where the bot is unable to answer the question
 6. Question Tracking & user updates
- What not:
1. Inactive on exams for subjects using proctoring
 2. Not able to answer any subject related questions
 3. Give students, instead of providing help on subjects

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Student

- What to do:
- Provide answers to any questions
 - Turn over to
 - Users & Instructors or administrators
 - Students or users of the system
 - Access to some educational content?
 - Provide Grades - How to view them?
 - Content/Instructor needs or requirements?
 - Content/Instructor requirements
- What not:
- Don't provide any help or support or other (support)

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Instructor

- + Solve queries
 - + Provide files previous papers
 - + Give immediate feedback
 - + Allow instructors to customize & assess feedback
-
- Not
- + Give memo
 - + Post comments (students should not give teachers others feedback)
-
- For me files. Over study content
- + Registered students to post charts (based on data)
 - + Allow both voice & text



What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Instructor

- Give student queries
 - Provide files - Previous question paper, study guide
 - Give feedback
 - Allow instructor to assess feedback & customize student
- Not do

 - Must not allow student to post comments/answer each other
- Provide file for study content
 - Allow registered student to post chat
 - Allow both audio & text input

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Instructor

- ① - resolve student queries
 - ② - provide file: study guide of questions
 - ③ - feedback (?)
 - Assess and customize
- ≠ no memos → not do private chat
 ≠ no comments btw students
- How = provide files for study content
 Both audio and ^{text} input
 Register student chats

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Instructor

- resolve content
 - resolving (content)
- How far to go to extend LMS?
 to provide (resources) → use of existing resources/content (e.g. video) + student support
 to provide (resources) → use of existing resources/content (e.g. video) + student support
 [Same design between LMS and Canvas]
- not tutor (more time required)
 (more time glossing)
- LMS support (glossing tool) for learners
 - checklist (quantity of LMS)

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... "instructor"

What?

- Gee antwoorde (moontlike)
- Algemene vrae beantwoord
- Nodige kennis voldoen
- Knowledge data base
- Alle leerstyle accommodeer
- Language translation services

What should it not do?

- Antwoorde gee op vraestelle
- Nie die meik les gee nie, net in oorsig

How?

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... ~~Student~~ Instructor

- ① Needs to be available always - 24/7
- ② Accessible on all levels
- ③ Needs to full fill and retain
- ④ Don't to right space on the LMS - Navigation
- ⑤ Should appear same to instructor & student
- ⑥ Should not act like a tutor, just focus on navigation
- ⑦ Clearing access
- ⑧ Provide access to help & support (+ mental health)
- ⑨ Provide links to some info & underlying knowledge
- ⑩ LMS Support & tutorials
- ⑪ ID standards / Course standards + templates support
- ⑫ Provide explanation on terms
- ⑬ Provide a course quality check list

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Admin

- ⊕ Include multimedia & simulations
 - Provide template to develop or edit LMS
 - Support Maths queries $\frac{1}{2} = x +$
 - generate different files formats pdf, doc, ppt
 - allow instructional designer to create activities that can be assigned to students groups of subjects
 - generate authentic types of questions
- ⊗ It should not slow down the process of multimedia files
 - Not to have unlimited access as admin
- ⊕ Should be user friendly by giving tips for users
 - by generating reports, monitoring students access
 - by giving alerts ⚠
 - Input through audio, text, file
 - Limit access and permission to data

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Administrator

- ⊕ Ask Question (Understand ⊕)
 - Guide the student on what to prepare for the next class.
 - Guide the student where to find the material
 - Support the system to enable integration/Integrated with the Registration system
 - Remind student about upcoming test.
 - Anti-Reset password.
 - Minimize Scheduling steps for Admin
- ⊗ NO ⊕ ⊕
 - Should not display test that are not finished.
 - Should not override admin permission.

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Administrator

- + Do you need a chatbot? → Yes!
- + Campus info help + support } generic info for students
- + for subject/courses → create navigation within a subject/course
- + Access to Registration System (slow)
- + Integrity
- + Support for students (struggling students)
- + FAQ - page

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Admin

- + Allow different access levels
- + Generate reports on user reports (Track & Monitor student)
- + Able to provide admin template, different templates for diff subject, cater for engineering, IT, math
- + Generate text files, can be translated to LMS
- + Analyse & design interactive design to accommodate diff teaching styles
- + Generate question on diff Blooms task questions
- + Authentic questions + Include Multimedia
- + Allow interactivity
- + Slow down with files. (Product Integration)
- + Have unlimited access
- + Input through audio, type, upload files
- + Providing files & multimedia
- + Simulations
- + User friendly
- + Provide review of the course (module) & Lecture
- + Print report

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... ADMINISTRATION

What:

- Supportive - not just the interface
- User experience
- Efficiency of the system
- Knowledge of user needs
- Flexibility (easy to update)
- Accessibility (mobile)
- Content management system (CMS) and user interface
- User training to the system

What not:

- Support for user experience
- User interface to the system

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Admin

- needed
- require support
- help and support resources
- navigation icons

access to select down the university's
following rights

- central location of content
- limited uploads integrity
- Study support
- supporting medical certificates?
- FAQs → answer refers

What do you expect from a chatbot in an LMS?

Some leading questions:

- What should it be able to do for you?
- What should it not do?
- How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... Admin

Important for Admin ✓
Support / generic help
Do you need tech, navigation
Access to Admin - grades
- time tables
- viewing rights
Basic rules for whole Uni on LMS
Not in every module
Study Support
Emotional Support for Students
FAQ
They don't know what they don't know.
@vul bot

What do you expect from a chatbot in an LMS?

Some leading questions:

- 1. • What should it be able to do for you?
- 2. • What should it not do?
- 3. • How should it do this?
 - As a student
 - As an instructor
 - As an administrator

1 Interview with ... administrateur

1. • Integrasie - Interak
- Meer as een paging
- Hoe om 'n nuwe wagwoord op te stel.
- Stappe minimaliseer om skedules op te stel.
2. • Studente moet nie toegang hê tot die administrateur se werk nie

APPENDIX D: PARTICIPANT WORKSHEET 1: INTERVIEW 1

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

Student
(Dig deeper)

2 Interview 2 with ...

Why?

- update overtime
- ~~enable~~ use to have more time to attend
- Student student that needs time
- Time management, enhance student assistance
- To clarify important points incase chatbot can not answer, to easy scheduling
- DO NOT Expect
- For student to do his/her part.
- Enhance learning.
- Chatbot must reduce waiting time.
- avoid student asking the same question.
- Reduce Replication of question.
- Push the student to ~~leave~~ lead if they have missed the class
- Less interference from student to one another.
- To improve ~~time~~ incomplete work
- To assist with revision class generated content
- For accuracy of information (assist with Research information access)
- Multiple views on info

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

Student
(Dig deeper)

2 Interview 2 with ...

Why?

- Reduce human intervention to clarify any uncertainties → the case where the chatbot cannot provide answers.
- Easier to schedule appointment.
- Reduce waiting time.
- Show questions & answers to all students to keep all students informed to reduce replication of questions. eg. shy students who are too shy to ask.
- If a student is not in class, it will prompt them to investigate or study further.
- Less interference amongst students, interfering with each other's study time.
- To improve time management & reduce incomplete work.
- Assist with revision - class generated work/content.
- Accuracy of info-providing legit information & content.
- Reduce everyone's workload.

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ...Student (Dig deeper)

- Why different languages
- to assist student & lecturers who english is their medium language
 - This will help them to improve their english and gain confidence
 - * Why Auto Spelling error
 - when student attempt to do voice recording the app should put in correct english
 -
 - * Why directory
 - for students who do not have storage devices or lost their storage devices
 - * Limitation of tracking
 - since this will help to make sure student ask relevant question by auto deleting irrelevant data
 - Limit student to access to their subject content
 - * Why should include tutorials?
 - to train students on how to use a system
 - class tutorials

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ...Student (Dig deeper)

- ②
- ~~Provides a safe space to ask questions~~
 - Shouldn't replace social learning & interaction, discussions
 - Online etiquette and 'How to work online'
 - Too much reliance on a chat bot would be negative
 - Preference for mobile & laptop
 - ~~the~~ nudges & analytical info
 - Filters on what to be communicated to about
 - events
 - workshops
 - Discussion groups are not that well used

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ... ^{Student} (Dig deeper)

To clarify info & confirm info:
 Case scenarios:
 Reduce waiting time.
 Always able to see it, helps the user person to get info.
 Reduce ? being asked multiple times.
 Avoid confusion of present students.
 Time management to complete content on time.
 "Accompany" requests:
 Assist with registration of content, completed in class, reduces workload of all.
 Accuracy of info. ✔/update news to info.
 Access into system. CA

 To reduce time to those who need help.

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ... ^{Student} ~~Admin~~ (Dig deeper)

① A navigation tool on the LMS (within subjects)
 ② Provide a list of terms/glossary
 ③ Direct towards links, explainers
 ④ " " FAQ'S - on all types of aspects
 - registration, course info, programme
 - process
 - delays, credits, exemptions
 - accurate contact information
 ⑤ Info on social events
 ⑥ Asking for and booking help/mental health sessions
 ⑦ Access to help lines
 ⑧ Ability to ask for, look and be reminded of counselling sessions
 ⑨ Focus on guidance as opposed to answers

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**


2 Interview 2 with ... Student (Dig deeper)

Because come from different background - but speak or write English
 - No boundaries is Language/Equality and empowerment
 => For confidence on student
 => Student will attempt to get in English with lots of error the chatbot should be able to detect and correct spelling
 2. 24/7 = student flexibility, no procrastination work at their own time
 3. File directory = students do attend orientation so they should have access
 4. No limits unsupervised learning = not course related question only. No adaptive release
 5. Digital footprint => In case of failure storing recordings
 6. Tutorials - a sign of failure.

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... Student (Dig deeper)

Student needs to ask anonymous
 Must be limited with knowledge/info
 Must allow collaboration.
 Areas:

 Chatbot for whole school or specific module
 Pick up problematic areas
 Address lecturer where the most problems occur

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with **Instructor** (Dig deeper)

- Why Solve queries?
- + Reduce physical consultation
 - + Help student get feedback immediately
 - + Use time admin work
 - + Have a lot of workload, help student getting feedback even at night, anywhere anytime, save them time, stop precastinating the lecturer.
 - + Help student to consult with ~~consultation~~
- Why Provide files?
- + Why Give them files ~~files~~ & download them
 - + Get enough content
- Why Immediate feedback
- + Allow students to study anytime
 - + To see students progress
 - + Aware with their performance.
 - + Catch-up class & offer consultations

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with **Student** (Dig deeper)

- ① Vary of students, haven't yet learnt to study in english → equality → compares students to speak out → rectify language errors, even if they attempt a different language.
- ② 24/7 assistance → students keep odd hours - flexibility no need to bring hurdles to the learning process - remove barriers
- ③ file directory - all documents in one place
- ④ ~~no limits~~ / supervised learning → limits you to the course but not adaptive release, but not to the content.
- ⑤ trace your digital footprint, staying cookies (limit memory)
- ⑥ intimidated to use new software - afraid of failure

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ... Instructor (Dig deeper)

1. Reduce physical contact with students.
 - Help students to get feedback immediately and the instructor to use the time to do admin work.
 - Allow the instructor to use the time to do research, marking, and other teaching duties to do research, marking, and other teaching duties.
 - Access to information at anytime & anywhere and influence them in learning because students like to interact with learning.
 - = Help student who are afraid to interact with them.
2. Provide Files & File because ^{got PDF} content is there.
 - enough content
3. Monitor student progress
 - ↳ want to see if they pass so that you can have extra classes

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ... Instructor (Dig deeper)

- ① - Students forget what they want to ask, when they want to ask it.
 - Load shedding, Travel schedules, Data Ai.
 - Removing admin cluttering
 - Improve concentration time - for lecturers
 - Could create time for research initiatives
 - Guiding students to become independent
 - Must be an extension of the instructor - not a replacement
 - Intro to the AI and the chatbot & what it can do - able
 - Help to clarify questions - promoting independent thinking
 - Chatbot could help connect various community discussions happening at same time
 - Could be aligned to learning analytics to report and notify lecturers on areas students are asking questions about
 - Pick up problematic areas

Instrukteer

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ...

(Dig deeper)

- To limit student queries, so you have more time to invest in students the pod could not assist.
- Muet leerders op 'n daaglikse basis kan bestaan.
- Heeltyd opgedateer word, vir alle nodige inligting wat nuut is.
- Tydsbestuur.
- Akkuraatheid.
- Maak inklusiwiteit moontlik.
- Taal - dat alle leerders by die les kan baatvind.
- Verwysing om deur 'n instrukteer gehelp/gelei te word.
- Studente moet hulle eie werk doen (Proctano)
↳ studente hulle deel kan bring

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... *Instrukteer* (Dig deeper)

- Why*
1. To limit student queries - so you have more time to invest in students that the bot could not assist.
 2. Bot should be updated on a regular basis (on-going) to ensure any new queries arising are added onto the database of questions.
 3. To reduce wasting of lecturer's time. Better improve time management.
 3. Inclusive students - improve ease of learning.
 4. Limit the language barrier.
 3. To ultimately assist the student - ensuring that the database is ~~kept~~ further developed.
 6. To ensure updating of the Bot database.
- What not*
- To ensure the student has done his own work and to enhance learning.

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... *Instructor* (Dig deeper)

- reducing admin and consultation time
- more time for research.
- guiding students to be self-reliant.
- admin extension of lecture
 - ↳ lecturer FAQ
- Intro to AI and chatbots in general.
- analytics to provide feedback to Instructors.
- chatbot can have prompt to ask for module code.
- overall limited use that provides assistance ~~and~~ but does not make students lazy.

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... *Instructor* (Dig deeper)

- ① to reduce physical consultation → to help students get immediate feedback - save time for lecturers → you have a lot to do → why immediate feedback → odd hours → shy → better interaction with technology.
- ② download PDF → to make sure they get enough content.
- ③ why → asynchronous study → monitor the student's progress → aware of pitfalls → interventions.
- ④ improve student success rate

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ...Admin (Dig deeper)

Why, multimedia & simulation
 → Students will learn through videos, voice etc
 → will help in speed-up the process of students to learn or capture information.
 → to save time of typing text

Why you need different template
 → to use them on different module/department
 → be able to use lecturers customers templates
 → Templates should be different because different department has different preferences.

* Why maths queries should be supported
 → most maths instructors or students are not using LMS because their content is not supported
 → smart marking for equations etc

* Why user reports
 → To base decision on data

* Authentic types of questions
 → are needed to support lecturers when develop online ... critical skill

Why do you expect this from a chatbot in an LMS?

- Uncover opportunities, unexpected insights, and tensions
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ...Administrator (Dig deeper)

Why (24/7) → because of loadshedding
 → students travel
 → night out data

Why generic info? → Information overload
 Centralise
 reduce duplication

Why do you need a chatbot?
 → Cost → instructors
 → Freeing people from admin burden
 → Personalised experiences for students
 → Keep changes current
 → Professional development for instructors

Experiment with new technologies

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with Admin (Dig deeper)

• 24/7
• need to now
• why generic info? → centralise information.
↳ reduces duplication.

• cost - why
↳ no/less student support needed. eases admin burden on instructors.

• freeing instructors from admin
↳ personalised expert expertise for students.
↳ source of up to date info.

↳ helps admin things go away - can spend more time on other aspects

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with Admin (Dig deeper)

Why multimedia & simulation
+ Assist with materials
+ As a design tool, to speed up dev process
+ To save time
+ No time to waste, more time is free the more to be innovative
+ To be less stressed

Why templates
+ structure within the LMS for different departments
+ ~~So that the~~ because diff disciplines have diff requirements

Why support
+ to support STEM
+ smart marking
+ A lot of student will fail, to be fair.

Why user report?
+ To base decision on data

Why ~~interactive~~ authentic question
+ Support lecturers to ask real world based
+ make learning better, improve student learning
+ because the institution improves in terms of results if students become competitive

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... ^{ADMINISTRATOR} (Dig deeper)

Improve ease of use of system
 Challenge usage for both lecturer & students
 Limit reach-time of system
 Reduce time-wastage - to help students
 Reduce errors - (e.g. wrongs)
 Keys:
 - Point Unauthorised access & unauthorised changes -
 "

Enable timely & accurate info to students -
 minimise time to students -

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a **student**
 - As an **instructor**
 - As an **administrator**

2 Interview 2 with ... Admin (Dig deeper)

Need it 24/7, might forget what I want to ask.
 Why generic info?
 Limit duplication
 Why? - Cost, no human support (make it less)
 - No admin Q to lecturer
 - Updated info
 Help Lecturer be better professional
 Use technology better

Why do you expect this from a chatbot in an LMS?

- Uncover **opportunities, unexpected insights, and tensions**
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ...

Admin
(Dig deeper)

- To improve system access (Eas of use)
- To assist with student & lecturer knowledge
- Limit downtime System.
- Reduce time wastage / Reduce Rewrite.
- Integration will enable time management.
- Student will only focus on the upcoming test
- Do not
- Should not overwrite the admin rights. Why?
- To ensure that we avoid unauthorized access
- Do not play other test but the required one. So they can only write correct test.

Administrateur

Why do you expect this from a chatbot in an LMS?


- Uncover **opportunities, unexpected insights, and tensions**
 - As a student
 - As an instructor
 - As an administrator

2 Interview 2 with ...

(Dig deeper)

1. Easily access the system
 - Om die student en dosent te akkomodeer
 - Seker maak die stelsel is altyd beskikbaar.
 - Minimaliseer tydvermorsing.
2. Akkuraatheid verseker
(Regte persoon doen die regte ding op die regte tyd.)

APPENDIX E: PARTICIPANT WORKSHEET: POV STATEMENTS

 Student (Studying and Year Education)
User's name/description


needs the LMS chatbot to improve effective learning Experience
user's need

Surprisingly/because/but . . .
(circle one)

Easy access to lectures to ensure timely confirmation of correct information of correct info to ensure deadlines are met. Sharing of key information with all stakeholders
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 STUDENT: LEARNING (STUDYING AND YEAR EDUCATION)
User's name/description


needs the LMS chatbot to IMPROVE EFFECTIVE LEARNING EXPERIENCE
user's need

Surprisingly/because/but . . .
(circle one)

HAVE EASY ACCESS TO LECTURES TO ENSURE TO BE ABLE TO MAKE TIMELY CONFIRMATIONS OF ACCURATE INFO TO ENSURE DEADLINES TO BE MET. THIS WILL SHARE KEY INFO WITH ALL STAKEHOLDERS
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student
User's name/description


needs the LMS chatbot to empowered
user's need

Surprisingly/because/but . . .
[circle one]

You want to be in control of
Your own learning
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student
User's name/description


needs the LMS chatbot to navigate and support
user's need

Surprisingly/because/but because
[circle one]

to simplify information, customised info
relevant
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student
User's name/description


needs the LMS chatbot to Empowered
user's need

Surprisingly/because/but . . .
[circle one]

You want to be in control of
your learning
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student
User's name/description


needs the LMS chatbot to navigate/support/guide
user's need

Surprisingly/because/but . . .
[circle one]

Students need simplified, ^{centralised, customised} ~~clear~~ information
timely
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Masigo - student
User's name/description


needs the LMS chatbot to empowered
user's need

Surprisingly/because/but...
[circle one]

You want to be in control of your subject and be known by class teacher as excellent student
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student
User's name/description


needs the LMS chatbot to navigate, support & guide
user's need

Surprisingly/because/but...
[circle one]

Because they need simplification, clear info, timous, clear data & centralised, customised information to foster better academic activity
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Instructor
User's name/description


needs the LMS chatbot to assist and support
user's need

Surprisingly/because/but . . .
[circle one]

I want my work to be easier, students
will benefit as I have more time to
teach.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student (Second Year Education Moodle system)
User's name/description

needs the LMS chatbot to To improve effective learning experience.
user's need


Surprisingly/because/but . . .
[circle one]

- To ensure timely access of information
- ensure deadlines are met
- sharing of key information with all stakeholders
- Grants access to Lecturer.

insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Instructor
User's name/description


needs the LMS chatbot to Assist and support
user's need

Surprisingly/because/but . . .
[circle one]

Work to easily done
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Student Instructor
User's name/description


needs the LMS chatbot to assist & support
user's need

Surprisingly/because/but . . .
[circle one]

for work to be easy & interactive, so that
students to benefit
insight

POV statement:

- Specific user
- Deep need
- Surprising finding


 Instructor - Create & present the learning pathway.
User's name/description

needs the LMS chatbot to enhance the learning experience of the student
user's need

Surprisingly/because/but . . .
[circle one]
Continuously updating the knowledge database to ensure sharing of accounts & timely information to enhance inclusive education across language barriers This will guide students to do their own work.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding


 Instructor
User's name/description

needs the LMS chatbot to be supportive
user's need

Surprisingly/because/but . . .
[circle one]
Because it will help alleviate admin but it shouldn't make students too reliant on it for all parts of their activity.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Instructor
User's name/description


needs the LMS chatbot to support, analyse
user's need

Surprisingly/because/but . . .
[circle one] ↳ ↳ Provide feedback

could ~~assist~~ take away the admin burden
Provide assistance but limited so students are
not too reliant and
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Instrukteer: - ontwerp die werksopervlakke vir die leerders
User's name/description


needs the LMS chatbot to bevorder die leerervaring van die studente.
user's need

Surprisingly/because/but . . .
[circle one]

- Deurlopende opgedateerde werksopervlakke om
akkurate en effektiewe tydsbestuur asook
insight
inklusiwiteit te verseker. - Bevorder leer

POV statement:

- Specific user
- Deep need
- Surprising finding

 Administrator
User's name/description


needs the LMS chatbot to support
user's need

Surprisingly/because/but . . .
(circle one)

Instructors and students (all stakeholders) need
support, updated ^{information} ~~information~~ and efficiency in
insight its delivery.

POV statement:

- Specific user
- Deep need
- Surprising finding

 Administrator
User's name/description

needs the LMS chatbot to Support
user's need


Surprisingly/because/but . . .
(circle one)

Instructors and students need support
and current information/updates.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding



 ADMINISTRATOR THAT HAS TO USE SYSTEM (TO RESOLVE / SETUP SYSTEM)
User's name/description


needs the LMS chatbot to ASSIST WITH OPERATION & USE OF SUBJECT
user's need


Surprisingly/because/but . . .
(circle one)

IMPROVE TIME MANAGEMENT TO ENSURE THE EFFECTIVE & ACCURATE
SETUP & USAGE OF THE LEARNER EXPERIENCES
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Admin
User's name/description


needs the LMS chatbot to Support 
user's need

Surprisingly/because/but . . . instructors, Admin,
(circle one)
students need support, current + relevant info with regularly updates.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding



 Admin / Student (That uses the system to manage / Setup the system)
User's name/description


needs the LMS chatbot to To assist with operation and setup of subject.
user's need

Surprisingly/because/but . . .
[circle one]

- To improve time management to ensure the effective and accurate setup or usage of the learning experience.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Administrateur - Sisteem gebruik en op te stel.
User's name/description

needs the LMS chatbot to - Om seker te maak die sisteem word reg op gestel
user's need

- Word reg gebruik.
- Vir die regte doeleinde gebruik.


Surprisingly/because/but . . .
[circle one]

Impto Bevorder tydsbestuur

- Verseker effektiwige en akkurate opstel en gebruik van die stelsel van die leerders se ervaringe.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Admin
User's name/description


needs the LMS chatbot to knowledge
user's need

Surprisingly/because/but . . .
(circle one)

they are able to make improved decisions.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

 Admin
User's name/description

needs the LMS chatbot to Smart design x power
user's need

Surprisingly/because/but . . .
(circle one)

to design interactive LMS and make improved decisions.
insight

POV statement:

- Specific user
- Deep need
- Surprising finding

APPENDIX F: PARTICIPANT WORKSHEET: FINDINGS

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- Guidance
- Reliable
- Approachable
- Helpful
- Trustworthy
- Facilitator
- Informative
- Accurate

*Cross Language Barrier

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- Respectful
- Valued
- Fulfilled
- In Control

Stakeholder:

Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- Guidance
- Reliable
- Approachable
- Helpful
- Trustworthy
- Facilitator / hint
- Informative

Language Barrier Assistance
No delays in getting answers

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- Respectful
- Valued
- Fulfilled + fascinated
- In control

Stakeholder:

Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- accessible
- respectful
- responsible
- Clear/concise
- accurate
- one language only

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- reduces anxiety about learning & their place at the university
- feel supported & comfortable

Stakeholder:

Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- Empower ← multi ~~language~~ language learning
- Save time
- interactive
- Userfriendly
- Accessible

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- increase learning activities and easy to use

Stakeholder:

Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

→ navigate/support/navigate

→ accessible clear, ~~concise~~ concise
respectful accurate
responsive

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

empowering → reduces anxiety
comfortable with AI (techn.)

Stakeholder:

..... Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Stakeholder:

..... Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

navigate
support
Accurate
Respectful
English as language
concise / precise

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Supporting help
Comfortable with AI tech.
empowering - reduces anxiety
user friendly.

Stakeholder:

Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

empower ← language of choice / use level
Save time (flexible) waiting for people
user friendly.
~~remove~~ remove barriers (waiting for office hours)

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

increase learner autonomy
↳ life long learners

Stakeholder:

Student



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

Effective
Manage Time
Efficient
Accurate
Helpful
Accessible
Integration

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Friendly
Adaptable
Trustworthy
Approachable
Manageable
Do-able

Stakeholder:

Instructor



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

Convenient
Reusable
Approachable
Helpful
Trustworthy
Engaging/Useful
Supportive
Accurate

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Respectful
Value
Fulfilled
Facilitated
Integrative

Stakeholder:

Student



findings



Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- o support
- o elevate
- o be responsive
- o accurate
- o be updatable
- o responsive
- o relevant
- o helpful.

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- o encourage academic integrity
- o ~~student engagement~~
- o encourage academic engagement
- o problem solving skills (to identify what to ask)
- o relief (students are supported).

Stakeholder:

Instructor.....



findings



Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

interactive assist + support
collaborative
user friendly.

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

lecturers are overworked } free time
do administrative tasks } to focus on
cognitive load } student needs.

Stakeholder:

Instructor.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

Interactive
Collaboration
Assist and support
User friendly

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Overworked

Stakeholder:

Instructor.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

Interactive
Collaboration
assist and support
user-friendly

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Overworked

Stakeholder:

Instructor.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- * Effektief
- * ~~Bestuur~~ Bestuur tyd
- * Akkuraat
- * Doeltreffend
- * Hulpvol
- * Bekombaar / bruikbaar
- * Integrasie

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- * Gebruikers vriendelike terme
- * Aanpasbaar
- * Betroubaar
- * Bekombaar
- * Beheerbaar
- * Integrasie
- * Georganiseerd

Stakeholder:

Instrukteer.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- supportive
- responsive
- accurate & updatable/relevant
- helpful
- define problems & solutions

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- encourage academic integrity
- enabling deeper student engagement (academic)
- relief
- fulfilling (of teaching goals being achieved)

Stakeholder:

Academic Instructor



findings

Needs: things s/he needs the chatbot in the LMS to do/be like* *update*
*use verbs *rapidly communicate*
be user friendly
be respectful
understand
integrity
acceptable

Insights: new learnings about your user's feelings/worldview to leverage in your design*
*make inferences from what you heard
Easy to update
Trustworthy - content
Goal orientated

Stakeholder:
Admin.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*
*use verbs
PERSONAL *ACCEPTABLE*
EFFECTIVE
ACCURATE
MANAGE TIME
RELIABLE
ENHANCED LEARNING
ANSWERS

Insights: new learnings about your user's feelings/worldview to leverage in your design*
*make inferences from what you heard
PERSONAL
DESIGNATION FULLFILLED
ACCURATE
MANAGEABLE
KNOWLEDGEABLE

Stakeholder:
Administrators.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

Support
update
communicate

accessible
~~user~~ user-friendly
respectful
responsive
easy to update

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

Integrity
Trustworthy
Effective
Goal-oriented

Stakeholder:

.....Administrator.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

• support
• update
• ~~assist~~
• communicate

be available 24/7
↳ be user friendly
↳ be respectful
↳ be easy to update
↳ understand

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- still uphold integrity (regarding data and such).
- ^{trust}worthy
- goal-oriented

Stakeholder:

.....Administrator.....



findings



Needs: things s/he needs the chatbot in the LMS to do/be like*
*use verbs

- Power Users/admin → ~~innovative~~
- Accurate
- Accessible
- Manipulate data
- Knowledgeable

Insights: new learnings about your user's feelings/worldview to leverage in your design*
*make inferences from what you heard

- They need a tool that will allow them to be innovative and apply their creative skills.
- The tool that will help them to manipulate or manage data when reports are needed.

Stakeholder:
Admin.....



findings



Needs: things s/he needs the chatbot in the LMS to do/be like*
*use verbs

- Knowledgeable
- Controlled & filter and manipulate
- accurate
- timely
- Accessible

Insights: new learnings about your user's feelings/worldview to leverage in your design*
*make inferences from what you heard

- Frustration ← Lack of data / missing data (unmanageable data)
- Annoyance

Stakeholder:
Admin.....



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- * ~~Guide~~ Gids en is hulpvoel
- * ~~Betra~~baar
- * ~~Bekom~~baar
- * ~~Fasilite~~erder
- * ~~Bewonder~~ leer
- * ~~Versekerd~~
- * ~~Informatief~~
- * ~~Akkuraat~~
- * ~~Effektief~~
- * ~~Tyd~~bestuur

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- * ~~Respek~~vol
- * ~~Waarde~~vol
- * ~~Fassineer~~d
- * ~~In~~ beheer
- * ~~Pyn~~loos
- * ~~Beskib~~baar
- * ~~Beheer~~baar

Stakeholder:

Administrateur



findings

Needs: things s/he needs the chatbot in the LMS to do/be like*

*use verbs

- ~~painless~~ Accessable
- ~~Effective~~
- ~~Accurate~~
- ~~Time management~~ / ~~Dele~~verable
- ~~Enhance~~ learning
- ~~Knowledge~~able

Insights: new learnings about your user's feelings/worldview to leverage in your design*

*make inferences from what you heard

- ~~Painless~~
- ~~Delegation~~
- ~~Availability~~
- ~~Manageable~~
- ~~Knowledge~~able

Stakeholder:

Admin

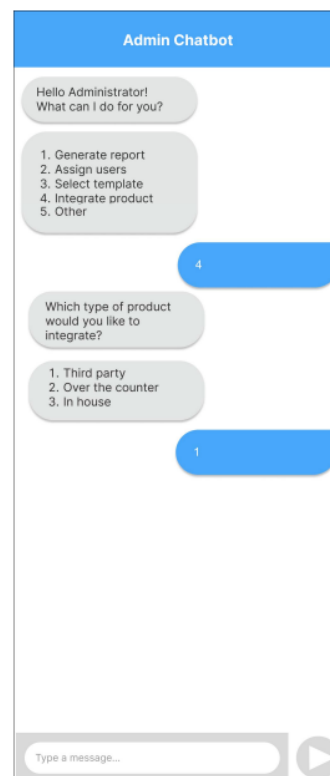
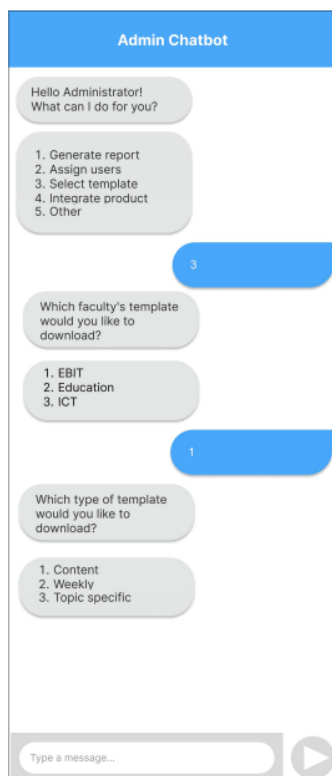
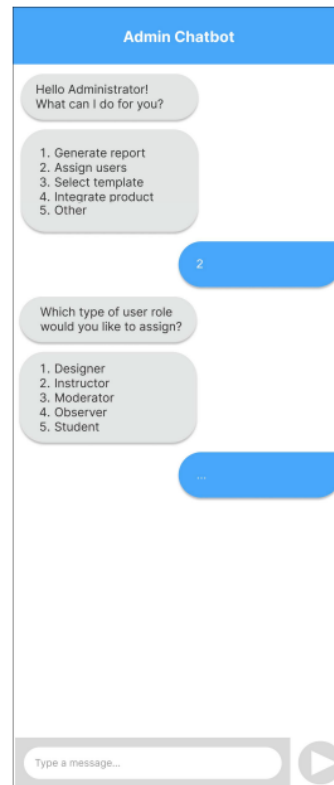
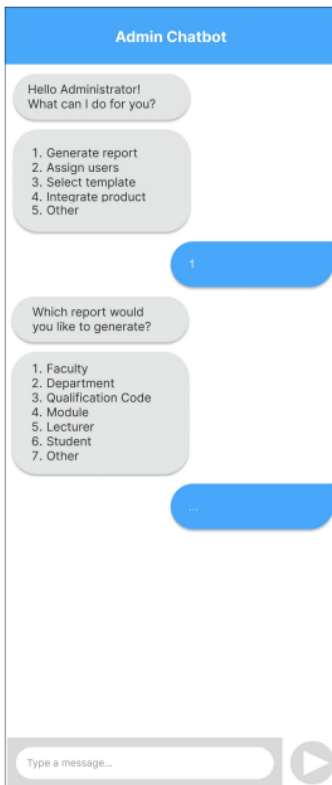


findings

Ngi ngaku Siza ngani?

- ① IA report (Success Rate)
- ② how to use Brightspace
- ③ monitor stud performance

APPENDIX G: FIGMA SCREENSHOTS



Instructor Chatbot

Hello Instructor! What can I do for you?

1. Provide 'how to' assistance
2. Draw report
3. Import template
4. Navigate to module

1

What assistance can I provide you with?

1. Activate intelligent agent
2. Build content
3. Create gradebook
4. Create assessments
5. Activate collaboration tools

Type a message...

Instructor Chatbot

Hello Instructor! What can I do for you?

1. Provide 'how to' assistance
2. Draw report
3. Import template
4. Navigate to module

2

Which report would you like to draw?

1. Module report
2. Student activity report
3. Student grade report
4. Class progress report

Type a message...

Instructor Chatbot

Hello Instructor! What can I do for you?

1. Provide 'how to' assistance
2. Draw report
3. Import template
4. Navigate to module

3

Which faculty's template would you like to download?

1. EBIT
2. Education
3. ICT

1

Which type of template would you like to download?

1. Content
2. Weekly
3. Topic specific

Type a message...

Instructor Chatbot

Hello Instructor! What can I do for you?

1. Provide 'how to' assistance
2. Draw report
3. Import template
4. Navigate to module

4

Which module would you like to navigate to?

1. Module A (modules linked to instructor)
2. ...

Type a message...

Student Chatbot

Howzit Student!

Please choose your preferred language:

1. English
2. isiZulu
3. Afrikaans
4. Setswana

1

How can I assist you?

1. Assist me with research resources
2. Tell me about events on campus
3. Tell me about available student services
4. Show me my upcoming assessments
5. Search for...

1

Which research resources can I assist you with?

1. EBSCOhost
2. Google scholar
3. ...
4. Referencing guide
5. Referencing managers
6. Plagiarism guides
7. Plagiarism checker
8. URL shortners
9. Grammar checker
10. Academic writing guides

Type a message...

Student Chatbot

Howzit Student!

Please choose your preferred language:

1. English
2. isiZulu
3. Afrikaans
4. Setswana

1

How can I assist you?

1. Assist me with research resources
2. Tell me about events on campus
3. Tell me about available student services
4. Show me my upcoming assessments
5. Search for...

2

Which events would you like to know about?

1. Academic
2. Social
3. Sport
4. Culture
5. Other

Type a message...

Student Chatbot

Howzit Student!

Please choose your preferred language:

1. English
2. isiZulu
3. Afrikaans
4. Setswana

1

How can I assist you?

1. Assist me with research resources
2. Tell me about events on campus
3. Tell me about available student services
4. Show me my upcoming assessments
5. Search for...

3

Which student services would you like to know about?

1. Student well-being
2. Faculty advisers
3. Student advisers
4. Clinical services
5. Security services

Type a message...

Student Chatbot

Howzit Student!

Please choose your preferred language:

1. English
2. isiZulu
3. Afrikaans
4. Setswana

1

How can I assist you?

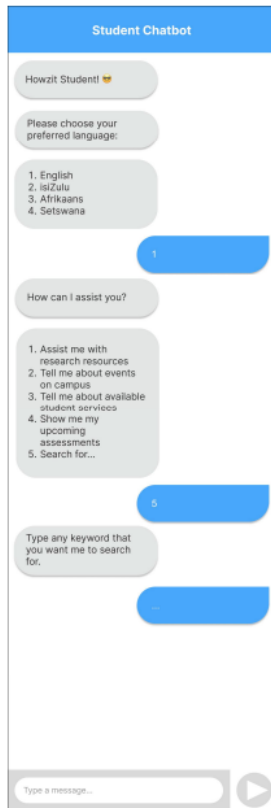
1. Assist me with research resources
2. Tell me about events on campus
3. Tell me about available student services
4. Show me my upcoming assessments
5. Search for...

4

For which module would you like to see your assessments?

1. Module A
2. ...

Type a message...



APPENDIX H: STRUCTURED QUESTIONNAIRE



Faculty of Engineering, Built Environment and Information Technology



Faculty of Engineering, Built Environment and Information Technology

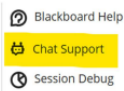
Dear LMS Expert,

I appreciate your willingness to participate in this crucial phase of my PhD research study, which marks the final evaluation stage of this Design Science Research project. Your expertise in the field of LMSs is invaluable, and I am excited to have you as a key contributor to my study. In this questionnaire, you will be immersed in an existing interactive LMS chatbot environment, where you will have the opportunity to explore and engage with the chatbot first-hand.

1. Start by accessing the Blackboard chatbot
2. Launch the Test Instance: <https://ultrabotstage.blackboard.com/>
3. **Username:** Marlisw
Password: ExpertEvaluation@1

Quick Guide on how to access the chatbot.

- On the Login screen, you'll notice a Chat icon located in the lower right corner of the webpage. Simply click on this icon to activate and try out the Chatbot for **Web**.
 - Click on the 'Help/Support' icon
 - Click 'Chat Support' to launch and test our Chatbot for **Learn**.



4. Engage with the chatbot and explore the platform.
5. Review the suggested design principles.
6. Fill out the questionnaire, which comprises three sections.
7. Remember to include screenshots of the feature when providing your feedback.

Your insights and expertise are called upon to evaluate the effectiveness of the proposed LMS chatbot design principles that have been created as part of this research endeavour. Your feedback and assessment will play an important role in validating and refining these design principles, ultimately advancing the field of LMS chatbot development. Your time and expertise are greatly appreciated, and I thank you for your invaluable contribution to this research.

Likert-Type Questions:

Please choose one of these options to indicate your level of agreement or disagreement with a statement or question, with "Strongly Disagree" representing the lowest agreement and "Strongly Agree" representing the highest agreement. The "Neutral" option is included to allow you to express neither agreement nor disagreement with the statement.

Response Categories	Scale
Strongly Agree	1
Agree	2
Neutral	3
Disagree	4
Strongly Disagree	5

These questions below are closely tied to the provided design principles. Please assign ratings accordingly based on your assessment of their importance. You can shade the chosen option.

1. How important is it for the LMS chatbot to provide timely and helpful responses to user input to optimise the user experience?	1	2	3	4	5
2. How important is it for the LMS chatbot to maintain a coherent and purposeful conversation with users, keeping it on topic and avoiding unnecessary distractions?	1	2	3	4	5
3. How important is it for the chatbot to clearly communicate its capabilities and limitations to manage user expectations effectively?	1	2	3	4	5
4. How important is it for the chatbot to provide an easily accessible opt-out function, allowing users to end conversations or change topics as desired?	1	2	3	4	5
5. How important is it for the chatbot to use a tone aligned with the context and user preferences to ensure a positive and engaging user experience?	1	2	3	4	5
6. How important is it for the chatbot to employ advanced Natural Language Understanding techniques to provide more fluid and intuitive interactions?	1	2	3	4	5

7. How important is it for the chatbot to integrate visually appealing elements to enhance engagement and interactivity?	1	2	3	4	5
8. How important is it for the chatbot to be highly accessible, ensuring uninterrupted user support?	1	2	3	4	5
9. How important is it for the chatbot to offer multilingual options to enhance inclusivity?	1	2	3	4	5
10. How important is it for the chatbot to seamlessly integrate with the LMS platform and other platforms, tools, and data sources to enhance the overall user experience?	1	2	3	4	5
11. How crucial is it for the chatbot to track student progress and offer personalised recommendations?	1	2	3	4	5
12. How important is it for the chatbot to prioritise user data privacy and security?	1	2	3	4	5
13. How important is it for the chatbot to handle errors gracefully and provide alternative solutions?	1	2	3	4	5
14. How important is it for the chatbot to identify situations requiring human support and facilitate handovers?	1	2	3	4	5
15. How important is it for the chatbot to gather user feedback for continuous improvement?	1	2	3	4	5
16. How important is it for the chatbot to have a friendly and engaging personality?	1	2	3	4	5
17. How important is it for the chatbot to provide accurate information and link to resources, especially regarding mental health support?	1	2	3	4	5

Yes / No questions:

18. Did you experience frustration or irritation when the chatbot is slow to respond?	Yes	No
19. Would you like to know the chatbot's capabilities and limitations during user interactions? Such as: "I can assist you with some administrative tasks, but changing your course enrolment isn't within my capabilities. This requires manual intervention by the system administrator or academic advisor. I recommend contacting the relevant department".	Yes	No
20. Did the opt-out function offer you a sense of control?	Yes	No
21. Do you think that the chatbot's tone aligned with context and user preferences are important for a good user experience? For example,	Yes	No

Greeting to a Student: Chatbot: "Hello there! How can I assist you today?"		
Greeting to an Instructor: Chatbot: "Good day, instructor. How may I be of assistance with your teaching or administrative tasks?"		
22. Do you think that multilingual support would improve the user experience?	Yes	No
23. Do you feel that there are too many design principles?	Yes	No
24. While using the LMS chatbot, could you recognise any of the suggested design principles that were mentioned as you interacted with it?	Yes	No

Open-Ended Questions:

Please answer the following questions as comprehensively as possible, with detailed answers where requested.

1. Are there any specific recommendations for the refinement of the design principles to create a more engaging chatbot personality and user experience?

2. Are there additional design principles that you would suggest for the LMS chatbot that may not have been covered in the existing list?

3. What are your thoughts on the idea of merging or consolidating some of the design principles for the LMS chatbot? Please provide an example if answered yes.

4. Could you provide any specific feedback or insights regarding a particular design principle for the LMS chatbot?

5. Do you have any general comments or observations about the design principles for the LMS chatbot?

6. From your perspective, which design principles seem challenging to put into practice for the LMS chatbot?

7. In your opinion, which design principles do you consider to be the most critical for the LMS chatbot's success?

8. Did you encounter any interesting or new LMS chatbot functions or features during your interactions with the chatbot, that was not addressed or covered in the design principles provided? Kindly offer an explanation along with screenshots to illustrate it.

9. Follow up on question 8: Do you think it's important for the researcher to ensure that these abovementioned functions or features are taken into consideration when developing design principles?

10. Do you believe that the listed design principles are straightforward and user-friendly, making them easy for designers to comprehend and implement for the LMS chatbot? Please provide your insights.

11. Have you encountered any aspects or features in the interactive chatbot platform that were not addressed in the existing design principles that is worth considering? Please provide an explanation and a screenshot.

12. Is there a particular "nice-to-have" feature you would like to suggest for the LMS chatbot?