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A CONCEPTUAL MODEL FOR E-LEARNING SUPPORTING TOOLS DESIGN BASED ON CUE MODEL AND KANSEI ENGINEERING

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ABSTRACT

The Covid-19 pandemic has triggered changes in learning due to the practice of social distancing to curb the spread of the virus. E-learning platforms have become the main platform for learning throughout the pandemic. However, e-learning does have challenges when it comes to ensuring student's optimum participation throughout the learning experience that require extensive research about techniques and methods for an optimum e-learning experience. This includes various e-learning supporting tools that provides easy communication and immediate assistance to enhance user experience. The supporting tools or software usability and functionality design determined as imperative in enhancing the e-learning user experience. Thus, this research proposes a conceptual model for designing the e-learning supporting tools based on the CUE Model, integrated with Kansei Engineering for optimum user experience that can serve as a guideline for the e-learning supporting tools designer. The outcome of this research will create new research fields that incorporate multiple domains, including the e-learning domain, software and supporting tools design, emotions and user experience.

Keywords: *E-learning, user experience, chatbot, CUE model, Kansei engineering*

1 INTRODUCTION

With the emergence of the Covid-19 pandemic, a pressing need has emerged to adopt a new technique for optimising the hybrid learning approach by utilising the internet platform (Coman et al., 2020). E-learning enables students, trainers and instructors to obtain, enhance and maintain critical skills and knowledge using contemporary educational technologies (Hamidi et al., 2020). The e-learning technique has the potential to enhance the teaching and learning quality as it supports face-to-face instruction. It allows learners to study and acquire information through

existing methods as well as from technology and the internet (Kimkong Heng & Koemhong Sol, 2020).

The rapid pace in technological change has a direct impact on the relationship between the instructor and students, as well as the design of e-learning supporting user interfaces tools (Mamani et al., 2019). For instance, students lose motivation during the teacher's efforts to deliver the planned activity since they are unable to "be present" when students may require assistance with learning (Coman et al., 2020). Students regularly experience feelings of confusion and loneliness due to the physical absence of their classmates and their inability to correctly answer the questions asked during lessons (Mitral et al., 2019). Multiple studies have shown that supporting tools or software are a significant advancement in the field of e-learning, emerging as the most innovative solution for bridging the gap between technology and education (Mamani et al., 2019; Mitral et al., 2019; Ramachandiran & Jomhari, 2015). Hadiana emphasised that the "usability" aspect must be the main key in designing an e-learning module and user interface. However, users desire persuasiveness more than usefulness and functional usability (Hadiana, 2015). Simultaneously, the research of (Redzuan, Mohd. Lokman, et al., 2011) and (Adnan & Redzuan, 2016) indicated that connecting the user emotion component with supporting tools capability is more effective for enhancing e-learning in terms of user experience (UX).

This study proposes a conceptual model to further enhance the design of E-learning supporting tools based on the CUE Model, integrated with Kansei Engineering (KE). The proposed conceptual model will be able to provide a guideline for the designers to design supporting tools that able to improve user experience or also known as UX. In this ongoing study, the e-learning supporting tool that we choose as the scope for discussion is the chatbot. The structure of this paper is as follows: Section 2 presents a brief overview along with the definition of UX and e-learning. This section also highlights other studies on the roles of chatbot as e-learning supporting tool, the CUE model and application of KE techniques in e-learning. Section 3 proposes a conceptual framework developed for the enhancement of UX in e-learning. Section 4 discusses the recommendations for future endeavours, and Section 5 presents the conclusion and future work of this paper.

2 BACKGROUND

E-learning is increasingly popular and widely employed in current education. Many higher learning institutions, such as universities, embrace e-learning platforms as younger students are more familiar with new technology and may be drawn to e-learning as an education platform. The term e-learning includes online learning, virtual learning or distributed learning (Arkorful & Abaidoo, 2015). It is conducted on the internet where students can access their learning materials online at any time or place (Kimkong Heng & Koemhong Sol, 2020). Moreover, students often access online learning materials such as recorded lectures, presentations, reading lists, activities and assignments through the offered platforms.

Several studies have demonstrated the benefits and advantages that may be gained through the use of e-learning technologies (Shahzad et al., 2021), (Wu et al., 2020). Other benefits mentioned in previous studies are students' perspectives regarding the reduced time spent on

learning (Coman et al., 2020), the reduced energy needs for travelling to attend classes (Wu et al., 2020) and the ease in which students can monitor all activities conducted in the classroom and listen to teachers repeatedly as necessary (Arkorful & Abaidoo, 2015). However, e-learning has several drawbacks and limitations. According to Redzuan et al. (Redzuan, Mohd. Lokman, et al., 2011), the e-learning issue can be separated into three categories. The first is related to design, with emphasis on the e-learning design itself. The second is the course design and the third is the online learning material design. A study in (Kimkong Heng & Koemhong Sol, 2020) indicated that e-learning courses have not been well designed to address pedagogical issues. There is less interaction between users when it comes to applying the knowledge that students have learned. The applied practical skills are reduced, and the course materials are of lesser quality. According to a study, e-learning characteristics are essential information for instructional designers as they allow them to build and create personalised instructions for a target group (Suarta & Suwintana, 2015). Numerous user characteristics can be employed to measure individual differences, but the most explored research variable in e-learning is the learning style (Blakey et al., 2000). User characteristics such as the demographic factor (which includes the name, gender, language and age) have influenced different learning experiences. Educational data including years of study, name of college/university and skills have been examined to determine how user characteristics influence e-learning behaviour (Almahri et al., 2019).

2.1 Relationship between Emotion and User Experience (UX)

A comprehensive definition of emotion should encompass emotional experience or conscious feeling, brain and nervous system processes and visible emotional expression patterns (Adnan & Redzuan, 2016). E-learning also applies the use of emotional recognition. A learner's emotional state may indicate a change in presentation style and increased interaction to provide successful tutoring (Mehta et al., 2019). The aim is to make them feel part of a team, rather than just one individual. According to a study, positive emotions have been linked to enhanced e-learning experience (Adnan & Redzuan, 2016). To facilitate learning, the learner's attention must first be engaged and emotional responses utilised to positively 'trigger' the learner's attention (Adnan & Redzuan, 2016). Research by Redzuan identified emotions of enjoyment, pleasure, pride, satisfaction and engagement to be positively associated with e-learning (Redzuan, Lokman, et al., 2011). If a learner is enthusiastic and not stressed, learning will take place. If the surroundings are unfavourable and the learner lacks the feeling of security, learning will not occur. This is supported by a study that negative emotions such as anxiety, bewilderment, fear, anger, sadness, boredom and frustration have been frequently linked to negative feelings (Redzuan, Lokman, et al., 2011). Research on the physiological factor of the learner based on the traditional classroom face-to-face learning has been accomplished (Sandanayake & Madurapperuma, 2009). Meanwhile, UX is a modern concept that refers to people's perception of a product design including emotions, beliefs, preferences, cognitive impressions, physical and psychological reactions, behaviours as well as achievements before, during and after use (Minge et al., 2017). According to Hornbæk (Hornbæk & Hertzum, 2017), UX is concerned with how a product or service functions on the outside when an individual comes into contact with it. It is assumed that basic human needs are key drivers of product use and quality perception. UX is also defined as the feeling of satisfaction resulting from the usability experience. A blanket definition of UX is that

it encompasses all of a user's experiences and reactions, whether assessed subjectively or objectively (Baumgartner et al., 2020). Hassenzahl (Zardari et al., 2021) define the term 'appeal' as the moment when a product may cause pleasing emotional reactions of attractiveness. The appeal was also defined as "the tangible side of the online environment which represents a website's appearance and feel of perceived beauty". Likewise, UX includes elements that can translate users' implicit emotions and needs into design schemes to support designs in terms of reaching a level of "pleasure" (Díaz-Oreiro et al., 2019). On the other hand, emotions have a significant impact on product and service design. If the user experiences pleasant emotions, they will more likely keep utilising the product or service. UX also can be represented in terms of separate components that interact with one another in a particular way. This interaction attempts to complete a given purpose which takes place in a certain setting and extends over a limited time (Yazid & Jantan, 2019). The instrumental qualities of the two categories are firmly linked to the usefulness and utility of a system. The non-instrumental qualities are the result of its appeal and attractiveness. Both qualities are significantly dependent on the third component, the emotions that accompany user engagement with the system (Minge & Thüring, 2018). Based on previous research, we can conclude that UX encompasses the effect on the emotions experienced, visual appeal, usability and function of a product. The importance of this study is to embed the UX effect, particularly for the use of chatbot, to enhance e-learning and enable a positive learning experience. Similar studies, such as in (Ramachandiran & Jomhari, 2015), have promoted positive engagement and connectivity for e-learners to prompt the desire to acquire knowledge and skills from a virtual learning environment. Thus, this study evaluates the usefulness of functions in the e-learning realm by considering emotions to determine an acceptable chatbot design. Emotions can enhance the UX of e-learning to be more attractive to learners, as emphasised in (Ismail & Lokman, 2020) and (Hamidi et al., 2020). When the user exhibits the attractiveness of learning, positive engagement or experience will then take place and learning will be much easier.

2.2 Component User Experience (CUE) Model

Thüring & Mahlke conducted a series of experiments to uncover the relationship between usability, aesthetics and emotion on the overall judgement that influences users' future decisions and behaviours (Yazid & Jantan, 2019). UX is associated with the interaction between humans and technology and has a significant impact on the user's evaluation of the system. UX can also be described as distinct components interacting with each other in a particular way. The CUE model illustrates three components of interaction: i) perception of instrumental characteristics; ii) perception of non-instrumental characteristics and iii) user emotional system response. Instrumental qualities involve the experienced level provided by the system, the ease-of-use attribute and the usefulness attribute concerning the practicality of the UX Model (Minge & Thüring, 2018). This category includes characteristics such as the effectiveness of system behaviour usability and functionality. Non-instrumental qualities include the system user's interface address, the system's appearance and its feel, which correspond to hedonic features in the UX model (Minge & Thüring, 2018). This category includes design characteristics such as visual aesthetics and tactile quality. According to a study, both perception and emotion are likely to influence the interaction process. Emotion can be described as a subjective experience

communicated through physiological responses and expressive behaviour (Yazid & Jantan, 2019). In the CUE model, the human interaction characteristic is represented by three factors: 1) system features such as functionality and interface design, 2) user characteristics such as knowledge or competence and 3) task/context. According to the author in (Minge & Thüring, 2018), the variable task/context includes the physical and social environment as well as the task which the user aims to accomplish.

2.3 Kansei Engineering (KE) for Design

"Kansei" is a Japanese philosophical term that refers to the psychological feelings and needs of humans (Redzuan et al., 2015). Kansei Engineering (KE) is a novel approach that offers a promising methodology for developing and constructing new appealing products and services with a strong focus on the human mind (Ismail & Lokman, 2020). According to (Afiza et al., 2021), KE was originally defined as the translation of consumer feelings with the product features and product image to some of the design aspects required to produce that product. The objective of KE is the development of new products in response to consumer feelings or emotions using the five human senses: vision, taste, smell, hearing and touch (Adnan & Redzuan, 2016). KE is a subset of artificial intelligence that is closely related to the design of systems and devices capable of recognising, interpreting and processing human emotions (Sandanayake & Madurapperuma, 2009). Although KE has been utilised in product development since the 1970s, the application of this methodology on education systems has arisen just recently, as seen in (Sandanayake & Madurapperuma, 2009), (Redzuan et al., 2015). For instance, in (Adnan & Redzuan, 2016), the semantic space for video-based e-learning materials for higher education will be used to drive the creation of video-based e-learning materials that incorporate targeted emotion. A model has been proposed based on student participation in e-learning, utilising KE to elicit design components associated with creating an emotionally engaging material to assist in encouraging pleasant learning experiences and fostering learning (Redzuan, Mohd. Lokman, et al., 2011). Thus, KE is one of the most effective ways for identifying emotion and correlating it with certain design elements in order to raise student interest in learning, motivating them to learn and enhance academic performance (Redzuan et al., 2015). Redzuan (Redzuan, Mohd. Lokman, et al., 2011) identified three components that influence pleasant emotional experiences in e-learning: interface design (UID), interaction design and content design. The design component of a chatbot can be applied as an artefact in our conceptual model using KE to enhance UX for e-learning. The KE methodology is typically conducted through a qualitative and quantitative approach using Semantic Differential (SD) to measure Kansei (Razali et al., 2020). In this context, SD is presented as Kansei Checklist (KC) to measure the relationship between e-learning chatbot and other component designs. KC is known as emotional descriptive words that consist of Kansei Word (KW). KW is related to user emotions and opinions represented as adjectives, nouns, verbs or sentences that are found in books, magazines and journals related to the domain (Ismail & Lokman, 2020). Thus, the KE methodology can identify emotions associated with a certain design in a chatbot, thereby the information can be used to improve user experience in e-learning.

3 PROPOSED MODEL

The purpose of this work is to present e-learning supporting tools design based on the CUE Model that we propose to integrate with Kansei Engineering to generate optimum user experience. We developed this model based on the extensive literature reviews discussed in the Section 2 to combine design influence and UX by taking emotion reaction into consideration. We employed the CUE model as a baseline model to construct a conceptual model that incorporates several different interaction property features, UX and system evaluations in the most significant components of human technology interaction. We design our study to implement KE as method to obtain emotion feedback toward the artefact that will be created in the next phase of our study. Our proposed conceptual model considers both teaching and learning aspects, as well as how e-learning supporting tools such as chatbots can enhance pedagogical transition processes in e-learning. Our proposed conceptual model is presented in Figure 1.

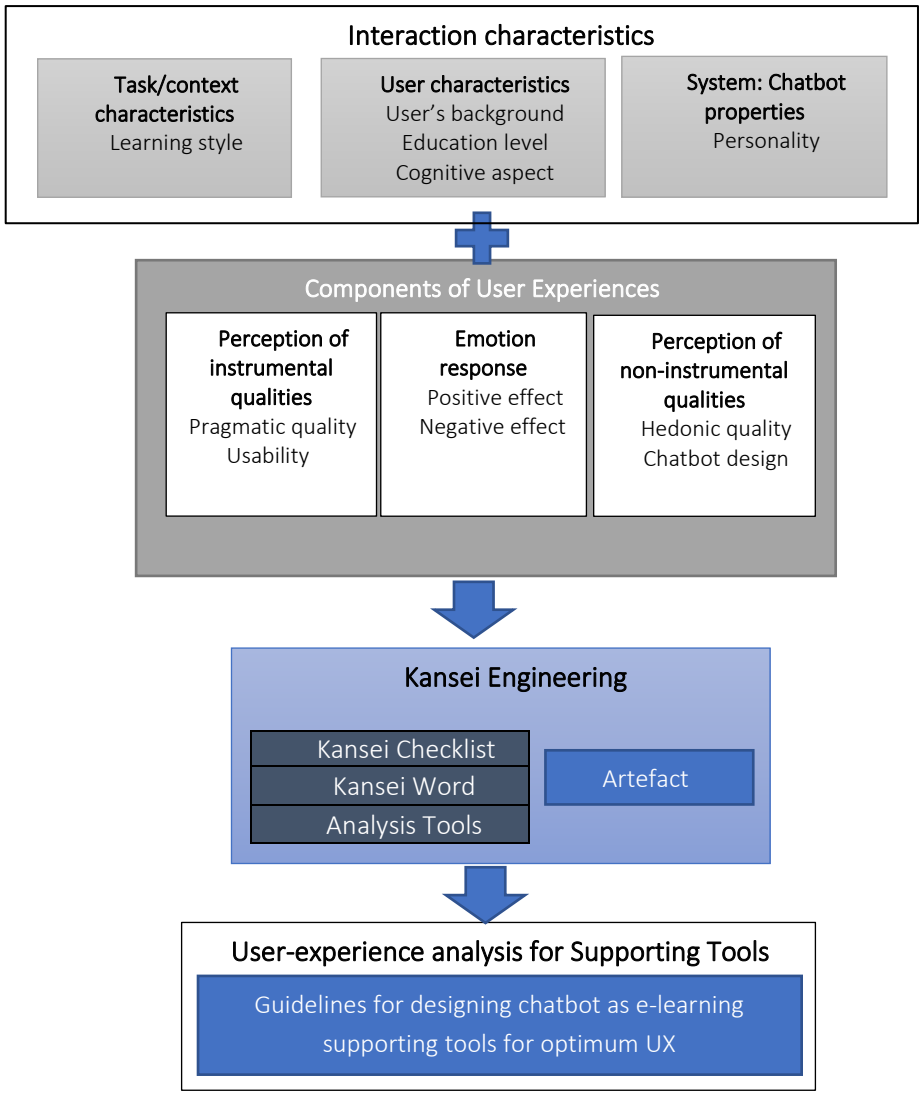

Figure 1: E-learning supporting Tools (Chatbots as scope) Design based on the CUE Model Integrated with Kansei Engineering for Optimum User Experience

The selection of variables for the model was guided by a review of models from the Human-Computer Interaction (HCI) literature, Hassenzahl's UX model and the KE approach for interpreting users' emotional responses and predicting UX outcomes such as system appraisal and intention to use (Minge & Thüring, 2018). Similar to the CUE model, our proposed model set variables into three categories: (a) interaction characteristic which has the task/context variables, user characteristic and chatbot characteristic; (b) component of UX that consist of perception of instrumental and non-instrumental qualities and KE approach for emotional response measurement; and (c) UX outcomes. Our proposed model will develop the early-stage process in designing e-learning that utilise chatbot and assess how UX influences positive emotions of users.

We assume that the interaction between a system and its users can be interpreted as qualities for interaction. There are two components in our model: interaction characteristic and user experiences that can be tested using Kansei Engineering. In our proposal, the interaction characteristics include task/context-related variables, user attributes and the system that can be tailored into personality. We propose that the level of learning adoption is diverse with a distinct demographic component, education level and cognitive aspect. These are included as the measuring variables encompassing the features of e-learning users. Our approach is based on the prediction that more efficient, effective and compelling educational materials can be designed and developed by taking learner characteristics into consideration. This model embraces personality to be implemented and in our conceptual model.

In this study, we are aiming to apply chatbot designs as an artefact to improve the educational experience because chatbots are used in numerous industries, such as in e-commerce, healthcare, service providers and business (Mamani et al., 2019), (Pricilla et al., 2018), (Chung et al., 2020). A chatbot constantly being defined as a virtual assistant that provides a group of questions and answers much quicker than a human representative would in a phone queue or an email exchange (Zumstein & Hundertmark, 2018). The designs serve as a teaching support for an instructor or as an automated teaching assistant capable of handling student doubts related to e-learning modules. A chatbot enables an interactive learning experience similar to the one-on-one interaction with the teacher, allowing enjoyable exchanges between users and virtual assistants via private messaging platforms and the use of chatbots is becoming increasingly popular among e-learners. In this proposed model, we emphasize the criticality to establish the bot's personality before the designing process of the chatbot started. We take into consideration that creating the appropriate personality for chatbot can improve the UX interaction between users and bots while communicating the demands of users (Ruane et al., 2021). Our proposal is based on the study that proven that utilising personality provides several advantages such as improving user understanding, delivering design requirements at an early stage and efficiently focusing on user goals, traits and requirements (Zumstein & Hundertmark, 2018). This is also based on the findings that personality has emphasised voice-based agents and making use of visual clues such as animated facial expressions or body language (Ruane et al., 2021). Interactive design has received significant attention (Nielsen et al., 2015), followed by user preference, age and gender. We apply these features in chatbot conversations to express personality on the side

of the agent, as well as in our conceptual model to enhance the e-learning experience. We are focusing on chatbot as the measurement variable for the chatbot's properties and attributes. The component of interaction includes the consideration that learning styles are flexible due to underlying characteristics, cognitive structures, personality types, learning preferences, techniques and learning orientations. The emotional response in the model is also characterised into multiple components.

Based on the theory of the CUE model, the perception of instrumental qualities is related to pragmatic attributes to define the value of knowledge according to a tool's usefulness when users interact with a chatbot. In our proposed model, we define usability states according to five attributes: i) simple to learn, ii) efficient to use, iii) easy to remember, iv) few errors and v) pleasant to use as per the study in (Fan, 2020). Better e-learning environments stimulate learners to accomplish tasks enjoyably and efficiently. The approach known as non-instrumental qualities is related to hedonic attributes to fulfil the emotional and pleasure-related psychological demands of a user. Thus, in this research, we propose the chatbot design as a vital component to ensure the pleasure of entertainment that users will acquire to influence the behavioural intention of user application.

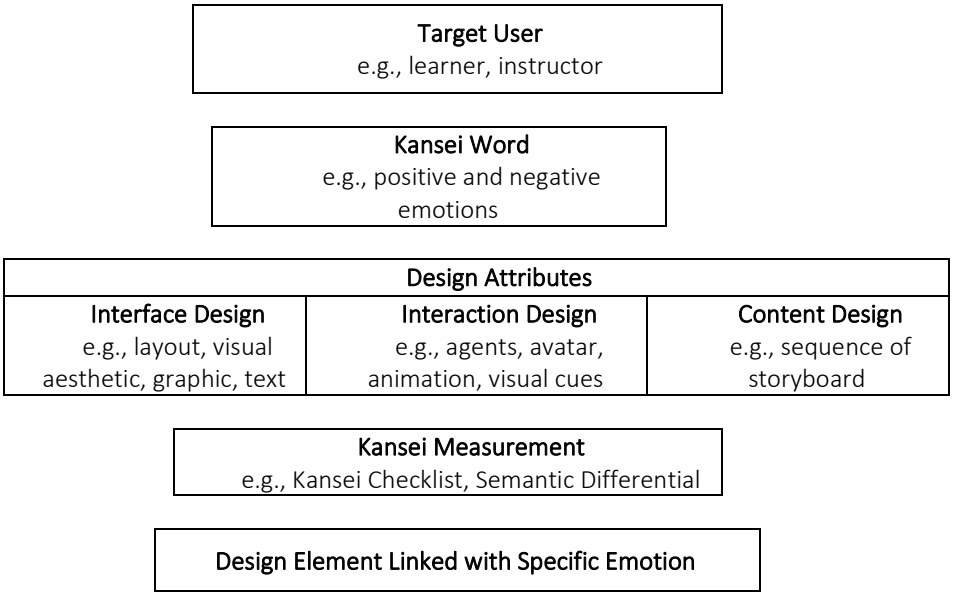

Figure 2: Research design to extract the combination of features by implementing KE approach via Kansei Checklist, Kansei Word and Analysis Tools

The model is further extended with the KE approach to extract the combination of features that emphasise the components of UX while utilising chatbot, exhibiting the effect of emotional experience in e-learning environments. KE is a recognised technique for extracting design features in numerous research areas. Figure 2 illustrates the research design of extracting the combination of features by implementing the KE approach via Kansei Checklist, Kansei Word and Analysis Tools. The output for this approach will set specific design elements linked to particular feelings or emotions. This will provide valuable information for developing chatbot based on the

approach and predicting e-learning experience outcomes that include chatbot use intention, satisfaction and goodness.

4 CONCLUSION AND FUTURE WORKS

In conclusion, e-learning is electronic learning that involves the interaction between teachers and students that can be enhanced for better student learning experience using supporting tools including chatbots that we chose as our scope for this study. The use of chatbots proven to give several advantages in education due to the ability in promoting continuous learning, increases student motivation, improves student learning and listening abilities. Chatbots can be better utilized in giving better user experience in educating students on new concepts, facilitate self-guided learning and spark student interests in particular fields if the chatbot being design by taking various consideration during the design phase. Previous studies have stated that user feelings and e-learning have a significant relationship with positive learning experience. Most previous studies have claimed that emotion manipulation can enhance e-learning, making it more attractive to learners. Thus, this study discusses the important of designing the chatbot to better support the e-learning by taking emotion into our consideration.

The purpose of this study is to elicit emotional engagement in e-learning systems when the chatbots application are being used. We discuss how the CUE model and KE technique can be utilised as a potential baseline and mechanism to capture user emotions by enhancing UX. Designing and implementing e-learning supporting tools such as chatbots, however, is not as straightforward as it seems. Chatbot technology is evolving at breakneck pace, with several enhancements and new functionalities being launched on a regular basis. The development of chatbots as e-learning supporting tools should be carefully planned. Selecting the suitable platform tools is critical as it can contribute to the chatbot's efficacy and efficiency. Thus, this study proposes a conceptual model to support the enhancement of user e-learning experience based on CUE Model and Kansei Engineering that will serve as a guideline for developing the design of e-learning supporting tools such as chatbots. In the conceptual model, we integrate CUE Model with Kansei Engineering as the methodology with aim to optimize the user experience by embedding the emotional aspect during the interaction. This paper reports the fundamental of our on-going study that will be further extended to obtained the result by performing activities that were explained in our research design. We intended to further explore chatbot design techniques and quantify the relationship its posses with e-learning approaches.

Future works are as follows: (1) conduct a study to evaluate and validate the conceptual model by experts, (2) develop instruments and artefacts for data collection and (3) analyse the collected data to understand the effectiveness of the proposed conceptual model. This study will contribute to a comprehensive analysis for e-learning supporting tools that focusing on chatbot interaction as our research scope. Based on the finding, we will develop functional and useful chatbots that will increase student engagement and UX.

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