Article

The Praxis of User Experience (UX) in the Design of Undergraduate Online Classes: Framing the Perceptions of Engineering and Social Sciences Students

Orchida Fayez [1,*], Burhan Ozfidan [2] and Hala Ismail [1]

[1] Linguistics and Translation Department, College of Humanities and Sciences, Prince Sultan University, Riyadh 11586, Saudi Arabia
[2] College of Education, Florida Gulf Coast University, Fort Myers, FL 33965, USA
[*] Correspondence: ofayez@psu.edu.sa; Tel.: +966-555614660

Abstract: A sustainable educational design that derives from a user experience (UX) frame does not only represent the praxis of online class design(s), but also empowers students to take an active part in their educational journey. The purpose of the study is to promote user experience (UX) measurements for the design of online classes. An online survey based on the criteria of user experience, UX, derived from the literature is administered in two higher educational contexts in Saudi Arabia and the USA with 890 participants from both genders and diverse fields of study. User experience is identified within usability, educational context, and the emotional or hedonic aspects of the experience, which are measured from thirty-six items from the survey constituting the independent variables. Reframing of students' perceptions into UX offers a sustainable model of technology design that ensures a student-centered model by filling the gap between theoretical use of students' perceptions and the praxis of online class design. The findings reveal that a working educational model should be centered around human values in addition to usability. This model can be replicated in various educational online contexts, but it has to be an ongoing process accompanying online design where student satisfaction is the outcome from variable measurement.

Keywords: sustainable education; user experience UX; online design; students' perceptions

1. Introduction

Traditional students' perceptions reveal students' readiness to embrace the new digital transformation, while a user experience, UX, reflects the praxis of such transformation. UX approach is a challenge to the presumption that all students are equipped and ready for the online move. The measurement of UX fills a gap by grounding educational theories of online engagement by reflecting on the actual practice of online classes: i.e., praxis. Even though the very concept of UX originated in the fields of marketing and service sciences, it has grown into a rising trend in evaluating human-computer interaction [1] making it relevant for online classes. The basic principles of UX are complementary to a student-centered mindset that contributes to a better design of online courses [2].

An overview of the literature before and after the online transformation triggered by the coronavirus pandemic affirm the relevance of UX principles to account for computer interaction within the educational context but is missing the elements of praxis. UX is detected in early research evaluating students' readiness for online experiences as opposed to blended options [3]. Furthermore, UX is an approach where human needs and experiences become the basis of technology design [4]. The gap, thus, becomes measuring the practice of online classes from the point of view of users to evaluate students' acceptance of purely online experiences: the dependent variable. The main aspect of UX design is its measurability [5], informing the design process [6].

The study attempts at reframing the concept of reporting on students' perceptions into a user experience, UX, model that guides the design of online classes. The design of the survey derives from the main principles identified by the UX literature and is administered in a higher education context. The result offers a sustainable frame that can eliminate "the digital divide" resulting from the separation between designers of educational tools and students' actual needs and abilities. It aims at meeting the criteria of UX praxis that achieves advocacy of students' needs, human-centered sensitivity to such needs, and an inclusive representation of a diverse population [7].

2. Literature Review

2.1. Contextual Frame

Both the literature review and the formulation of the metrics of the UX survey for this project are characterized by two main features. First the fairly recent literature is studied since most discussion takes place in the aftermath of the COVID-19 digital transformation. Second, most of the references especially for creating the UX metrics derive from research tackling human/technology interaction and the business practice of technology design. The practice marks the evolution of waves or paradigms that include other disciplines exploring the interaction with technologies in educational research [8–10]. Even though good practices in technology design is transferable between sectors such as business and education, there has to be a sensitivity toward the differences arising from context or even individual preferences [11]. It is the researchers' strong belief that these are the elements of praxis that offer a unique edge to this study.

The starting point for the UX rationale derives from studies designed to test students' satisfaction or perceptions. Research covering students' perceptions was employed to bridge the gap between theory and practice by measuring the quality of interaction with online classes [12]. In a student perception context, most findings in terms of computer interaction stressed the functional aspect of technology, for example, recording students' dissatisfaction rates about the efficiency of technical services such as internet connectivity and availability of devices [13,14].

As early as 2015, discussions emerged identifying how challenges of educational technologies go beyond usability into user experience [15]. What Adam Wagner points out is how a user experience approach changes the dynamics of a top-down digital perspective into a two-way communication. At the onset of 2019, there were emerging reports confirming that embracing a UX design in education is the only option for educational institutions to keep up with the changing norms triggered by the post COVID-19 digital transformation. The business model of traditional universities is already being replaced by a more comprehensive educational UX design, otherwise it risks falling behind [16]. Moreover, a gap is identified between frames derived from the literature which is conceptual as opposed to focusing on a specific context [17].

2.2. Conceptual Frame

A UX perception revolves around an individual's impressions of the experiential or the affective aspect of an experience that marks the interaction between humans and computers. The definition (ISO [18] of user experience (UX) is "a person's perceptions and responses that result from the use or anticipated use of a product, system or service." In so doing this makes use of the pragmatics of use (functions), and the hedonic (related to emotions) [19]. It involves students' internal experience (e.g., motivation or mood), the characteristics of use (e.g., functionality), and the context of interaction [20] The educational context, on the other hand, is the aspect of creating innovative environments that can be a success factor for the design of UX undergraduate courses [21].

Evaluating students' perceptions from a UX point of view fills in a missing link between online design that is based on extrinsic motivation and what the education designer Dorian Peters identifies as intrinsic motivation [22]. In her view, extrinsic motivation is the direct result of a top-down educational hierarchy where the teachers and instructional

designers are the ones responsible for activity design. Thus, UX designs can contribute an intrinsic motivation to learning. Studies have confirmed the correlation between intrinsic motivation and students' investment, advancement, and willingness to return to tasks. It is a correlation that facilitates social involvement, goal setting, and self-monitoring [23] Other studies indicate that students' perceptions about usefulness, and ease of use are key factors in teachers' decision to use technology [24].

The UX evaluation originates from users' interaction that is rooted in combining usefulness (usability) and hedonic attributes. Stressing the hedonic aspect of the UX experience becomes the most evident aspect of measuring the quality of the technology interaction [25,26]. Further research broadens the relevance of UX to education since it covers user-centered design, learner experience (LX), and universal design (UX) for university teaching and learning [27]. The significance of Kraft's parsing of acronyms and the identification of the overlap between them is placing usefulness, usability, desirability, and accessibility at the core of the design [28]. Morville's design is validated in Troop, White, Wilson, and Zeni's study as they highlight the building blocks of the UX frame as crucial to the UX research [29].

However, the rising issue becomes the scarcity of measuring tools available in general and for educational purposes in particular. There is an obvious lack of academic theoretic frameworks and models both quantitative and qualitative [15,29–31]. There were various attempts at finding the core criteria of UX design, the most obvious of which was to adopt a questionnaire to measure UX. The main items included were an evaluation of "attractiveness" that branches into pragmatic qualities and hedonic qualities [32], especially with the recognition of a gap between measuring tools and theoretical foundations [33]. Similar terms become efficiency, effectiveness, and satisfaction [34]. Hedonic elements are determined according to the nature of the online design, for example where animation or multimedia is used, the questionnaire includes "fun, entertaining," while motivation increases [35].

Considering that those items are the variables affecting students' perceptions, the empirical results highlight the relation between the analysis of the questionnaire items and satisfaction. This conforms with established UX models where satisfaction constitutes the dependent variable [36,37]. Ease of use influences perceived usefulness and pleasure that in turn leads to acceptance of the online experience [38]. However, there has to be a distinction between purpose of usability, which is pragmatic, and UX, which is hedonic [39].

3. Methodology

3.1. Design and Participants

The study was approved by the Institutional Review Board, IRB. All participants, according to IRB protocol (#2020-03-0033), were completely informed regarding the procedures of the study. The researchers emailed the survey link to 3465 undergraduate and graduate students in all departments at the university.

The researchers used a survey instrument to investigate perceptions within the praxis of user experience (UX). The response rate was 25.6% and a total of 890 participants (Male = 452; Female = 438) completed the survey instrument. The demographic data highlighted that 70% of the participants were undergraduate students, and 30% of the participants were graduate students. The demographic data also indicated that the study has a diverse population consisting of one Saudi institution (482 participants) and a U.S. institution (408 participants). The majors of the participants covered all the offered programs in both social science institutions (83.5%) such as education, political science, sociology, business, psychology, and so on, and engineering institutions such as engineering, computer engineering, civil engineering, and so on. The purpose of having diverse participants from different areas was to meet the criteria of UX praxis that achieves advocacy of students' needs, human-centered sensitivity to such needs, and an inclusive representation of a diverse population.

3.2. Instrument

The literature employed for the instrument development is derived from the industry of UX design. The steps form a cycle starting with learning about the audience (in an educational context it becomes students) and conducting a task analysis by observing learners' experience, resulting in an informed plan to improve the online experience based on feedback. The steps are already identified as essential to design a learner-centered experience [40]. This process is already established in UX research where metrics are derived from existing questionnaires or user reviews [41].

Traditional metrics of student perceptions can be a good place to start when devising UX metrics. Inserting measures of UX quality can leverage the surveys [42]. The first step is to identify users, identify measures of success (related to the institution's KPIs), and identify areas of improvement. Similar guidelines are presented by the designers such as Kayode Osinusi and Muditha Batagoda as they both identify users, and the goals of the users while adding context and "satisfaction" as key components of UX metrics. In their elaboration, satisfaction is a view that goes beyond functionality and ease of use into the "aesthetically pleasing and delightful" [43,44]. Further studies emphasize the importance of metrics of aesthetics as well as the emotions arising from usage [17].

In contemplating how context is relevant to the formulation of our metrics, it became clear that it is the educational context that differentiates educational UX metrics from commercial design. Thus, in some ground-breaking research, it was relevant to link the "emotions" as the hedonic conditioner contributing to the "cognitive processes" [45]. In our case, it became hedonic satisfaction within the context of achieving the educational goal/outcome.

The survey began with demographic questions to identify the background information of the participants, and it continued with five-point Likert-type scale questions "strongly disagree = 1; disagree = 2; neutral = 3; agree = 4; strongly agree = 5". Thirty-six items highlighted the general perspective of the UX of online classes divided into usability, educational context, and hedonic. All items on the instrument were generated from the literature review.

3.3. Validity and Reliability

Validity and reliability of a study were accomplished through a confidential, extended, and trusting relationship between informants and the investigator, instead of through the establishment of "the psychometric properties of the research instruments" [46] (p. 117). The researchers piloted the instrument with 79 participants, randomly selected among 890 participants of the current study, to evaluate the feasibility of the study. These results were presented with the research plan to the IRB committee that approved administering the study. They found Cronbach's alpha of the study to analyze the reliability of the scale. The average Cronbach's alpha score of 19 items was $\alpha = 0.88$. Nunnally stated that "a minimum value of 0.70 for Cronbach's alpha is considered acceptable" (p. 55). Therefore, the results of Cronbach's alpha score showed that the scale is reliable. The validity results of the study were found statistically significant.

3.4. Data Collection

The survey instrument was prepared in the Qualtrics program and sent out to participants. To collect the data, the researchers contacted the department heads of three different universities. The prepared survey link was emailed to the department heads, and they shared the link to the instructors in their departments. Afterward, each instructor emailed the prepared survey link to all of their students before starting the class. Each instructor allowed their students to complete the survey during an online class period. Each participant had to accept the consent form on the first page of the survey before filling out the survey. The time specified to complete the survey ranged from 10 to 15 min. In the first phase of the study, the researchers used exploratory factor analysis (EFA) to highlight the instrument's suitability. In the second phase of the study, the researchers used descriptive

statistics to analyze each factor that came from the EFA results. SPSS was used the analyze all the data.

4. Results

4.1. Exploratory Factor Analysis (EFA)

Kaiser–Meyer–Olkin (KMO) is used to highlight the instrument's suitability for factor analysis. KMO is "an assumption that must be met in determining the appropriateness of using factor analysis. values can range between 0 and 1" [47] (p.176). Jolliffe [48] affirmed that "the KMO test can be used to determine the overall sampling adequacy of the sample or to measure each individual variable" (p. 96). The Encyclopedia of Phycological Assessment [49] highlighted that a "value of 0 shows the sum of partial correlations is large relative to the sum of correlations, which indicate diffusion in the correlations pattern; therefore, factor analysis is probably inappropriate" (p. 143). He also stated, "if the value is close to 1, patterns of correlations are quite compact and factor analysis indicates different and reliable factors" (p. 143). Kaiser [50] stated that a value higher than 0.5 is acceptable. Anderson and Gerbing [51] highlighted that "values between 0.5 and 0.7 should be considered mediocre, values between 0.7 and 0.8 should be considered good, values between 0.8 and 0.9 should be considered great, and values of more than 0.9 should be considered superb" (pp. 135–136). The KMO results for the current study indicated that the Kaiser value was 91, which fell into the range of superb. Thus, the researchers highlighted that the data are appropriate for factor analysis (see Table 1).

Table 1. KMO and Bartlett's Test.

KMO Measure of Sampling Adequacy	0.907
df	6943.916
Sig.	0.000

Using principal component analysis (PCA) with Varimax (orthogonal) rotation, nineteen items linking to reasons for framing students' perceptions within principles of user experience (UX) were analyzed., The findings for the entire set of variables generated three factors describing a total of 55.451% of the variance. The first factor was labeled "Educational Context/evaluation" and explained 14.543% of the variance. The second factor was labeled "Hedonic" and explained 17.450% of the variance. The third factor was labeled "Usability" and explained 23.458% of the variance (see Table 2). These three factors are independent of each other, and they were not correlated. Each factor measured different perceptions within principles of user experience.

The exploratory factor analysis results indicated that the items in the survey, respectively, 3, 6, 7, 10 and 13, displayed unsatisfactory loading tendencies towards other implicit variables. Thus, the researchers removed these items from the scale. The communality results on the extraction assumption emphasized the common variance in the data structure. The communality scores' average is greater than 0.6, and communality scores after extractions are greater than 0.7 as well. The average of the community scores is 0.65 after adding all of them up.

4.2. Descriptive Results

The items of the questionnaire offer validation of the overall desirability and effectiveness that impact decisions of "learner efficacy" to the original trio of feasibility, viability, and desirability, being crucial to the success or failure of any educational product [52].

The table below illustrates the first factor, which is educational context/evaluation. Table 3 indicated that participants of the study clearly connect important course goals and understand course topics under educational context. Table 3 also highlighted that technology-based courses increase academic success and discipline.

Table 2. Pattern Matrix.

Items	Factor 1	Factor 2	Factor 3	Communality
Clearly connect important course goals	0.791			0.639
Understanding course topics	0.722			0.621
Academic success	0.730			0.599
Discipline	0.731			0.661
Quality of feedback on students' satisfaction		0.712		0.532
Effects of Teacher Roles on Student Satisfaction		0.704		0.516
Comfortable		0.702		0.577
Motivation		0.689		0.642
Social Interaction		0.670		0.612
Flexibility		0.678		0.595
Interaction among students		0.659		0.544
Clearly link course topics			0.780	0.576
Clearly link the learning activities			0.776	0.551
Clearly provide course learning activities			0.744	0.576
Interactive learning environment			0.728	0.645
Cost-effective (Cost of learning)			0.715	0.612
Accessibility of resources			0.711	0.621
Time-management skills			0.696	0.654
Interaction between student and instructor			0.652	0.578
Eigenvalues	3.732	3.176	2.913	
% of variance	14.543	17.450	23.458	
Total Variance			55.451	

Table 3. Educational Context/evaluation.

Items	Mean	SD	Strongly Disagree- Disagree (%)	Neutral	Agree- Strongly Agree (%)	N
Clearly connect important course goals	4.01	1.01	11.95	8.76	79.29	890
Understanding course topics	4.21	1.11	12.06	9.43	78.51	889
Academic success	4.54	1.06	12.21	8.98	78.81	889
Discipline	4.12	1.02	11.88	11.43	76.69	890

Note: "1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree".

The table below highlights the second factor, which is hedonic. Table 4 shows that participants of the study were satisfied with the quality of feedback and the teacher's role under the technology integrated courses and/or online learning. The participants also highlighted that online learning or technology integrated courses are more comfortable and flexible for students, and that the students have great interaction with each other.

Table 4. Hedonic.

Items	Mean	SD	Strongly Disagree- Disagree (%)	Neutral	Agree- Strongly Agree (%)	N
Quality of feedback on students' satisfaction	3.91	1.09	13.32	8.90	77.78	890
Effects of Teacher Roles on Student Satisfaction	4.04	1.02	10.98	8.03	80.99	890
Comfortable	4.10	1.04	11.23	8.71	80.06	888
Motivation	3.88	1.10	14.98	9.09	75.93	890
Social Interaction	4.21	1.06	10.42	7.89	81.69	890
Flexibility	4.12	1.11	10.98	7.01	82.01	889
Interaction among students	4.43	1.01	9.34	8.30	82.36	889

Note: "1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree".

The Table 5 below highlights the third factor, which is usability. The participants indicated that online learning clearly links course topics and the learning activities and provide course learning activities. The participants also emphasized that online learning provides an interactive learning environment and accessibility of resources for the students. They also highlighted that the cost of learning is cheaper and time management is more flexible for students.

Table 5. Usability.

Items	Mean	SD	Strongly Disagree-Disagree (%)	Neutral	Agree- Strongly Agree (%)	N
Clearly link course topics	4.08	1.10	10.99	9.37	79.64	890
Clearly link the learning activities	4.11	1.16	12.01	8.67	79.32	890
Clearly provide course learning activities	3.80	1.02	13.27	10.09	76.64	890
Interactive learning environment	4.23	1.09	10.29	8.79	80.92	889
Cost-effective (Cost of learning)	4.01	1.11	11.56	10.26	78.18	890
Accessibility of resources	4.21	1.27	10.11	9.87	80.02	890
Time-management skills	4.13	1.09	12.37	9.38	78.25	887
Interaction between student and instructor	4.00	1.04	13.08	10.59	76.33	890

Note: "1 = Strongly Disagree, 2 = Disagree, 3 = Neutral, 4 = Agree, and 5 = Strongly Agree".

5. Discussion

The findings pertaining to students' feedback in a UX context aims at creating a sustainable model of a student-cantered direction. The study makes use of the online transformation initiated by COVID-19 among a sample from in both Saudi and US universities. The correlation between the specified domains of the survey guided by the UX frame is an initial dataset that validates theory through practice, i.e., praxis of online class design. When applying a UX context, the findings show a user perspective based on "persona" rather than "role" [53] (p. 376), as it reflects the individual subjective opinions about online classes. The numbers reflect the three factors for each of the core perceptions of user experience in independence of each other: educational context, hedonic elements, and usability. Moreover, it agrees with global research that adopt UX tools starting from the users' answers to structured questionnaires [54,55].

The educational context is represented in students' evaluation of course goals, course topics, academic success, and discipline. The significance of the numbers is that they reveal a high level of students' awareness of evaluating online classes. On the spectrum of the Likert evaluation, course goals revealed a strong agreement ratio, as opposed to disagreement. An understanding of course topics scored very closely with academic success, making the three items interrelated in students' perception. The item pertaining to discipline scores similar percentages of agreement while disagreement falls within the fair percentage. For all items, the undecided rate stands at an average that does not affect the overall responses. Thus, course context fits within the students' perception of their study plan while grasping the various topics that highlight the correlation between technology-based environments and academic success.

The hedonic rate of the feedback stood out together with the emotional aspect linking both usability and educational context. They appeared to meet students' needs and offered the frame for future online design. These items were motivating students to accomplish, communicating effectively, meeting students' needs, providing access to a wide range of content, providing a well-organized course structure, providing numerous sources, providing explanatory feedback, and facilitating meaningful discussions. In an online classroom, these items may enhance connections between the instructor, the students, and the course content. It agrees with the literature indicating that adding hedonic factors provide a more holistic evaluation of UX [56,57].

The hedonic factor is represented in students' evaluation of their satisfaction with comfort, motivation, social interaction (among teachers and fellow students), and flex-

ibility [25,58]. The results indicated that the students acknowledged the importance of interaction to improve their learning and enhance their knowledge of the course content. The importance of interaction to the students revealed a strong agreement rate as opposed to disagreement rates which conforms with similar studies of UX [25]. Another factor that represents the hedonic factor is the flexibility of online courses as students could plan their studies and work at their convenience. The results revealed that the students indicated the importance of flexibility in online courses while a similar factor related to convenience is comfort. The students perceived online classes as more comfortable as opposed to the traditional classroom. They indicated that comfort is an important element of their satisfaction with online classes.

Social interaction was another aspect of hedonic factors that indicated a positive impact on the effectiveness of online learning. In the presence of social distancing rules and guidelines, socializing online became the only form of socializing that the students were able to obtain and therefore was a valued aspect of online learning. The significance of social interaction and the role of teachers is a significant role in guiding and supporting students in their online experience. The feedback that the students receive from online learning is also an important component of the hedonic factor. Feedback allows the students to assess their knowledge of the course content and determine the areas that they need to improve. Therefore, the students indicated the importance of feedback with a high rate of strong agreement. Motivation was also perceived as an important element. This is related to the fact that online learning requires from learners a high level of independence and self-regulation, more than the traditional classroom [23].

Usability included the importance of an interactive learning environment and the availability of learning resources to the students overall learning experience. The students highlighted their importance to their online experience. The ability to interact and collaborate with their classmates gave the students the opportunity to engage with each other in an interactive meaningful environment. The students expressed the importance of an interactive learning environment with a high percentage of strong agreement as opposed to neutral or disagreement. Another important element of the usability factor is the accessibility of resources. Accessibility of tools, features and functional aspects of the online class is important to the overall learner experience. Next is the clarity of linking course topics and the learning activities which is related to usability. Moreover, the availability of supplemental material and a well-organized course content affected the usability of online classes. This was indicated by strong agreement from the participants.

Time management is one of the challenges of online classes that is related to usability as well. There is evidence that online classes helped students stay on top of their assignments and their deadlines compared to the traditional classroom. Cost efficiency is another important feature of usability since online classes can be significantly more cost-effective compared to traditional classes. In terms of clarity of course learning activities, students indicated that their online courses provide them with clear learning activities. This points out that offering many learning activities to the learners in their online classes enhances their overall learning experience. Moreover, student-teacher interaction is a valued and necessary aspect of the online learning environment as it provides the students with opportunities to enhance and improve their learning. The participants acknowledged the importance of student-teacher interaction at a fair rate which offers a room for further enhancement.

6. Limitations and Future Research

The sample of the study is representative of the population of university students since it includes participants from a variety of disciplines, as well as females and males from different higher education institutions in two countries (the US and Saudi Arabia). However, the study's results might be limited because it was conducted during the online transformation which took place as a result of the COVID-19 pandemic. Therefore, future research may replicate the study with participants who opt for online education. Moreover,

students from other disciplines or contexts can be investigated especially using the literature indicating the influence of studies on students' ethical and moral perceptions.

Future research may use the current study's findings to develop and improve online platforms and online classes in a way that satisfies the needs of the students. Future studies may also investigate how the students' user experience affects their learning performances and academic achievements in online classes. Additionally, future research may investigate the students' user experience during online exams, an essential aspect of the students' overall experience that needs to be examined separately from the students' experience in online classes.

7. Conclusions

The areas of educational context, usability, and the hedonic contribute to the domains of students' experience from a UX point of view. The implication here is that the adoption of online classes entails an adoption of the UX considerations that are necessary for technological design. In the discussions distinguishing UX from any other means of measurement of a product, UX combines usability with satisfaction about the product in question. Thus, the domains of educational research that tackles student satisfaction can be well framed within a UX model. The findings show that students' perceptions of online classes that combine usability and hedonic considerations present a holistic model. The interrelation between the items specified by UX contributes to student satisfaction and improves the overall experience of online learning.

The shift in the analysis of students' experience gives a deeper insight into the online classes that derive from user experience. The aim of UX research is to inform a better user experience, thus, the findings have to be directly geared towards the design of the online class. The second point about this study is that it brings praxis into the educational landscape. It derives from the actual experience of students in an online environment to inform the online educational experience, thus bridging the gap between theoretical conceptualization and practice [17]. It should be noted that the UX model in this study can be replicated in other educational institutions as long as the three criteria of usability, educational context, and hedonic are applied. However, this is a process that has to be continuously accompanying a digital online experience. It is an ongoing data collection and monitoring process to collect perceptions that inform satisfaction with the design. This model mainly achieves a ground-up type of design instead of the long-established hierarchy of educational design as a top-down realm.

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