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The User Experience Design for Learning (UXDL) Framework: The Undergraduate Student Perspective

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Abstract
The User Experience Design for Learning (UXDL) Honeycomb is an online learning design framework aimed at creating valuable online learning experiences, which some post-secondary institutions have started to use to guide the design of their online courses. While each of the principles are supported by psychological research, this framework has not been directly validated or corroborated by the student experience. The present study aims to address whether the UXDL framework aligns with students' preferences, beliefs, and behaviours in online learning in a post-secondary context. This research adds to the growing literature on students' preferences, beliefs, and experiences in online learning, focusing specifically on second-year Canadian undergraduate students at a mid-sized, research-intensive university. Using a three-pronged methodological approach, we explore not only students' implicit beliefs (via open-ended surveys, N = 805), but also their experiences (in-depth interviews, N = 36), and impressions and behaviours while working in an online course (two user experience sessions, N = 36). Our qualitative analyses of these data reveal 4 prominent themes in online design that students find particularly valuable: (a) Accessible: flexible; (b) Useful: modes of design and delivery, (c) Intuitive: usable and findable, and (d) Desirable: affective design and humanizing learning.

Le cadre de conception de l'expérience de l'utilisateur pour l'apprentissage Honeycomb est un cadre de conception d'apprentissage en ligne qui vise à créer des expériences d'apprentissage enrichissantes en ligne. Certains établissements d'enseignement post-secondaire ont commencé à l'utiliser pour guider la conception de leurs cours en ligne. Chacun des principes est supporté par la recherche psychologique, toutefois ce cadre n'a pas encore été directement validé ou corroboré par l'expérience des étudiants et des étudiantes. L'étude présente vise à déterminer si ce cadre de conception de l'expérience de l'utilisateur pour l'apprentissage s'aligne avec les préférences, les croyances et les comportements des étudiants et des étudiantes en ce qui a trait à l'apprentissage en ligne dans un contexte d'enseignement post-secondaire. Cette recherche s'ajoute à la documentation croissante sur les préférences, les croyances et les expériences des étudiants et des étudiantes concernant l'apprentissage en ligne et se concentre spécifiquement sur les étudiants et les étudiantes en deuxième année de premier cycle dans une université canadienne de taille moyenne axée sur la recherche. Nous avons utilisé une approche méthodologique en trois volets et avons exploré non seulement les croyances implicites des étudiants et des étudiantes (par le biais de sondages ouverts, N = 805), mais aussi leurs expériences (entrevues approfondies, N = 36), leurs impressions et leurs comportements alors qu'ils et elles suivaient un cours en ligne (deux séances sur l'expérience des utilisateurs, N = 36). Nos analyses qualitatives de ces données ont révélé 4 thèmes principaux sur la conception en ligne que les étudiants et les étudiantes ont trouvés particulièrement précieux : (a) accessible : souple, (b) utile : modes de conception et de livraison, (c) intuitif : utilisable et trouvable, et (d) désirable : conception affective et apprentissage humanisant.

Keywords
online learning, online course design, learner experience, qualitative; apprentissage en ligne, conception de cours en ligne, expérience des apprenants et des apprenantes, qualitatif

Cover Page Footnote
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The growth of online education over the past decade has been widespread with universities and colleges across North America steadily increasing the number of courses and degrees offered online (Martel, 2015), and growing numbers of institutions that have online learning as part of their strategic plan (Canadian Digital Learning Research Association [CDLRA], 2019). With this growth comes increased interest in creating more engaging online learning experiences that result in better student outcomes. There is a growing body of literature that highlights important features of online course design that impact student outcomes. This includes some well-established frameworks that help designers create assessments and community in online contexts (e.g., Garrison et al., 2000), thus alleviating the need for designers to scour the literature comprehensively on these topics. However, there are few overarching frameworks that address the instructional design of online content. One such framework that some post-secondary institutions have started to use is the User Experience Design for Learning (UXDL) Honeycomb (Zeni et al., 2017). While this framework is grounded in principles of psychology and learning research, there has been no work directly validating this framework or grounding it in the student experience. Below we introduce the UXDL Honeycomb, followed by an overview of what prior research tells us about the student perspective in online learning. Finally, we identify the ways in which the present study may serve not only to validate the UXDL Honeycomb, but further advance the literature on designing online courses in ways that students find valuable.

User Experience Design for Learning (UXDL)

User experience design (UXD) involves gathering and incorporating user input and behaviours to design experiences that they find valuable. The User Experience (UX) Honeycomb (Morville, 2007) is a widely-accepted framework that draws on UXD to create valuable user experiences. The framework suggests that for an online experience to be valuable, it should be useful, desirable, usable, findable, accessible, and credible. Taking the lead from UX experts who position UXD as “an approach to creating successful experiences for people in any medium” (Morville, 2007), instructional designers at the Centre for Extended Learning (CEL) at the University of Waterloo adapted Morville’s UX Honeycomb framework for a teaching and learning context, incorporating the work of a host of leading UX specialists and cognitive scientists. This framework is called the User Experience Design for Learning (UXDL) Honeycomb (Figure 1), which is openly available online through the Centre for Extended Learning UXDL Honeycomb website.

Figure 1
UXDL Honeycomb

Note. Adapted from Morville's (2007) UX Framework with permission by Zeni et al. (2017)

Creating Valuable Learning Experiences

The Useful cell of the UXDL Honeycomb draws from the cognitive psychology literature, specifically Mayer's (2009) cognitive theory of multimedia learning, to address the question, "How might we create useful online learning experiences?" As we know from cognitive models of learning, well-designed courses should take into account humans' cognitive limitations, such as the impact of cognitive load on working memory (Mayer, 2009; Sweller, 1999, 2003, 2005). Though working memory is not the locus of learning, it is responsible for information processing. Moreover, processing in working memory influences changes in long-term memory (i.e., retention of information; Schnotz & Kurschner, 2007) and, as Sweller et al. (1990) state, "if nothing has been altered in long-term memory, nothing has been learned" (p. 477). Useful design, therefore, aims to reduce unnecessary cognitive processing and cognitive load, freeing up resources for deeper learning. To encourage this deeper learning, Mayer outlines several instructional design principles that help students select relevant information, organize it into a coherent representation, and integrate it with prior knowledge held in long-term memory (Mayer, 2006, 2009).

The Desirable cell addresses the question, "How might we create desirable online learning experiences?" by emphasizing the importance of leveraging positive affect for learning. We know from previous research that emotional design has considerable influence on learning outcomes because this type of design increases positive affect and motivation, as well as the learner's attention to relevant information (Park et al., 2015) and willingness to continue engaging with the material (Heidig et al., 2014). To ensure sustained, high levels of engagement, it is essential that the learner's attention is directed towards relevant information. Moreover, for students to have valuable learning experiences wherein they are making meaningful connections, they need to actively engage with the learning environment (Mayer, 2009; McKeachie et al., 1978; Young, 2005). One way to encourage this engagement is to make certain that the learning environment

(e.g., the design of the online course) is aligned with students' goals and needs, and that it is conducive to positive affective states and interest in course content. As Sansone and colleagues (2011) point out, "…motivation…is particularly critical when learning online, where whether students engage the material, how, and [for] how long, is entirely within their control" (p. 200) (see also Heidig et al., 2014; Mayer & Estrella, 2014; Norman, 2004; Park et al., 2015; Wang & Adescope, 2016).

In a similar vein, the Accessible, Usable, Findable, and Credible cells of the UXDL Honeycomb draw from the literature to provide evidence for good design in each of these areas. For instance, the Accessible cell promotes Universal Design for Learning guidelines which aim to meet the learning needs of individual learners by offering multiple approaches to learning (National Center On Universal Design For Learning [CAST], 2012). The Intuitive (Findable and Usable) cell draws on work by Norman (2004) and Goleman (1995) to create content that is easy to find and use and can be effortlessly navigated. The Credible cell emphasizes the impact of high-quality design on students' perception of instructor and course credibility (Nielsen, 2012; Peters, 2014).

Prior Research on Online Learning Design

Consistent with the growth of online education, there has been an increase in research exploring the impact of online learning design. Much of this research focuses on the impact of cognitive processes (e.g., Mayer, 2006, 2009; Schnotz, 2005) and, more recently, affective processes (e.g., Krathwohl, 2002; Leutner, 2014; Moreno, 2005) on learning outcomes. These studies offer important insights into how to design learning experiences that result in better outcomes for students. However, they often overlook the agency which students bring to their online learning experiences (Sansone et al., 2011). Understanding what students choose to focus on in online learning contexts and why they do so can help us to design online learning experiences that motivate and engage students, which can in turn lead to deep, significant learning.

Capturing Student Perspectives of Online Learning

Educational researchers who have investigated student perspectives of online learning have identified several course design features that both motivate and engage students in online contexts. Prevalent among these features is the importance of regular and meaningful peer-to-peer and instructor interaction (Blackmon & Major, 2012; Deng & Tavares, 2013; Dixson, 2010; Heale et al., 2010; and in a graduate context, Holzweiss et al., 2014). As Blackmon & Major (2012) affirm, it is incumbent on instructors "to establish presence in the absence of physical co-presence, work to build intellective relationships with students, and work to create a sense of community" (p. 83), if they wish to engage online students effectively. Deng and Tavares (2013) further discovered that student perceptions of usability, interface familiarity, and sense of ownership were strong motivators for participation in online discussions. Most important for students in their study, however, was the social presence of peers, who contributed to creating a sense of community, thereby increasing engagement. Heale et al.'s (2010) study corroborated these findings, reporting that a lack of familiarity with technical tools and access to technical support, as well as decreased instructor contact, delays in feedback, and feelings of isolation, resulted in student perceptions of impeded learning. Similarly, Okech et al., (2014) emphasized the importance of technology being friendly and accessible, as well as regular interaction with instructors and peers as conducive to a

positive learning experience. Flexibility also emerged as an important theme in this study, resounding with Braun's (2008) earlier study focusing on graduate students, in which he discovered that "issues of interaction can be overcome with quality content and the prevailing need from the student for independence and flexibility in completing coursework" (p. 85).

If the goal of educators and instructional designers is to create a learning environment that fosters interest, motivation, and positive emotions to boost learning outcomes, then these studies offer important insights by focusing on learners' perspectives (i.e., what they find pleasant and interesting, what motivates them, and what they attend to and interact with in the online learning environment). Many of these prior studies make use of student surveys and interviews, which provide insight into students' beliefs, but they overlook what students actually do—for example, how they navigate and use online learning materials, what they do when they are frustrated, how they respond when something is visually pleasing or invites interaction. In short, there has been little research that implements a user experience (UX) research approach to capture information about what successfully motivates and engages students. This approach provides another avenue by which to capture students' perspectives and experiences by directly observing how students behave and interact with their online courses.

Researching the UXDL Framework

The present study takes a three-pronged methodological approach to explore the primary research question: In what ways, if any, do the UXDL principles of online course design align with what students value in online learning? A second aim of this research was to corroborate prior research and advance the literature by providing additional insight into what design elements undergraduate students find valuable to their learning. To this end, we explored whether the UXDL framework was corroborated by students' implicit beliefs about online learning (open ended surveys), reported experiences in post-secondary online courses (directed interviews), and impressions and behaviours while working through an online course design using the UXDL framework (UX sessions).

Method

Ethics and Participant Recruitment

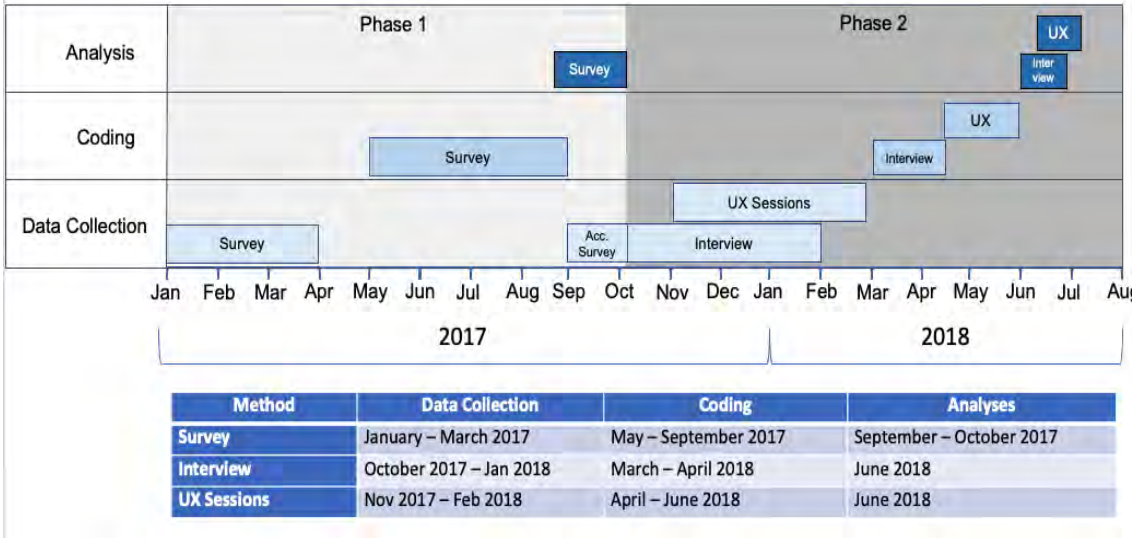
This research project received ethics clearance in Winter 2017, initiating the data collection process. All procedures in this study comply with the University of Waterloo's Research Ethics Board guidelines for preserving participant confidentiality and anonymity. The project consisted of two phases: survey, followed by interviews and UX sessions. All survey responses were anonymous except for those who opted-in to participate in phase 2 (by providing an email contact). Confidentiality was ensured throughout the interview and UX sessions by labeling all data files with anonymous ID numbers. Any personal information was removed from the contact files (e.g., name and email) upon completion of phase 2.

For the first phase of the study, which involved a survey administration process, we worked with the Office of Institutional Analysis and Planning at the University of Waterloo to gather email addresses for second-year undergraduate students. Students who completed the survey, indicated they had taken at least one post-secondary online course, and expressed interest in participating in

the interviews and UX sessions (opt in option) were invited to participate in phase 2 of the study (interviews and UX sessions). Figure 2 depicts the study timeline.

Figure 2

Study Timeline.



Method	Data Collection	Coding	Analyses
Survey	January – March 2017	May – September 2017	September – October 2017
Interview	October 2017 – Jan 2018	March – April 2018	June 2018
UX Sessions	Nov 2017 – Feb 2018	April – June 2018	June 2018

Note. Phase 1 included survey data collection, coding, and analyses. This informed the questions in phase 2 (interviews and UX sessions).

Survey

The research study involved a large-scale qualitative survey administered using Qualtrics™ survey software (see Appendix A for sample survey questions). The survey was designed to gain perspectives from a diverse sample of students from various programs of study, status (full-time, part-time, international, domestic), and age within the undergraduate community at the University of Waterloo. The survey was sent out via email to all second-year students (*N*=7,795) in the Winter 2017 term. Our response rate was 10.4% (*N*=805). To ensure that our sample included perspectives of students with accessibility needs the survey link was sent from the director of Accessibility services by email to all registered second-year students (*N*= 452) in Fall 2017. Our response rate was 5.3% (*N*=24). Survey participants were remunerated for their participation by opting into a draw to win one of five $75 University Retail gift cards.

Survey data were coded in an iterative fashion. To begin, four researchers coded a subset of data across the four qualitative survey questions. The four questions aimed to yield insight into the following: What the students liked, disliked, hoped for, and expected, all in relation to their online learning experiences. This initial analytic step was integral to: (a) building consensus on initial descriptive codes as a way of classifying the data, and (b) establishing a codebook that would be used and further developed in our survey coding process. Our qualitative codebook ultimately emerged as a combination of *emic* (from within; i.e., generated from the data itself) and *etic* (from outside; i.e., generated from the literature) codes.

The next stage of survey coding involved three researchers open coding data from 15 participants by hand to reach greater consensus on the labels that best described what particular codes signified. When this task was completed, we applied this same open coding process—generating descriptive codes and categories from appropriate segments of text—to an additional

100 surveys using QSR NVivo software. Two of the researchers then continued coding with NVivo™, completing three passes of the data. The first 400 participants were coded by both researchers. The codebook was largely established by the 200th survey, with few novel codes added and little disagreement between the two researchers' coding. Inter-rater reliability was calculated on the surveys 201-400, which showed agreement of 98% and precision (kappa) of 0.73. The final 400 surveys were coded separately (200 per researcher). The descriptive codes that emerged were clustered and collapsed into categories and themes as we uncovered interrelationships and moved towards developing more abstract, conceptual interpretations.

Once the survey coding was complete, we engaged in several post-coding activities, using focusing strategies, such as: (a) the "top ten" list, (b) the study's trinity, (c) codeweaving, and (d) the "touch test" (for detailed descriptions of these strategies, see Saldaña, 2009). Each of these strategies enabled us to focus on a select number of ideas that emerged from the study with the aim of reflecting on their essential meanings. This process further generated an in-depth conversation about the results and led to the curation of unique and common themes related to students' online learning experiences. This data gathered in phase 1 of the study provided us with a broad sketch of online student perspectives. In phase 2, we shifted from capturing student perspectives about online learning more broadly to a more specific line of questioning and observation. The purpose of phase 2 was to uncover more detail about student experiences and behaviours in online learning at a post-secondary Canadian institution (i.e., The University of Waterloo) and to observe student impressions and behaviours while interacting with online courses designed in accordance with the UXDL principles.

Interviews and User Experience

We accepted the first 36 participants (n=36) who indicated at the end of the survey their interest in completing phase 2 and who had at least one direct experience with online learning at the University of Waterloo. The interview and user experience phase of the study began in the Fall 2017 term and was completed in the Winter 2018 term. This phase consisted of three sessions (each approximately 60 minutes in length) that focused on the student's experiences and interactions with online content (see Appendix A for sample questions from this phase). Participants were remunerated for their time with a $20 gift University Retail card per session. The first session of phase 2 involved a qualitative interview and experience sampling to gain insight into the student's prior direct experience with online learning. The second and third sessions were UX sessions, which involved the observation of students as they interacted with a fully-online, asynchronous module from one of the following four topic areas: Chemistry (Chemistry for Engineers), Earth Sciences (Introductory Earth Sciences), English (Shakespeare), or Psychology (Introductory Psychology). These modules were designed with the UXDL principles in mind and were developed at the Centre for Extended Learning, The University of Waterloo. The modules were text-based, containing mixed-media (a variety of content presentation formats such as text, images, infographics, videos, and inline knowledge checks). An example of content from these modules is shown in Figures 3 and 4.

Figure 3

Sample Content from the Introductory Psychology Module

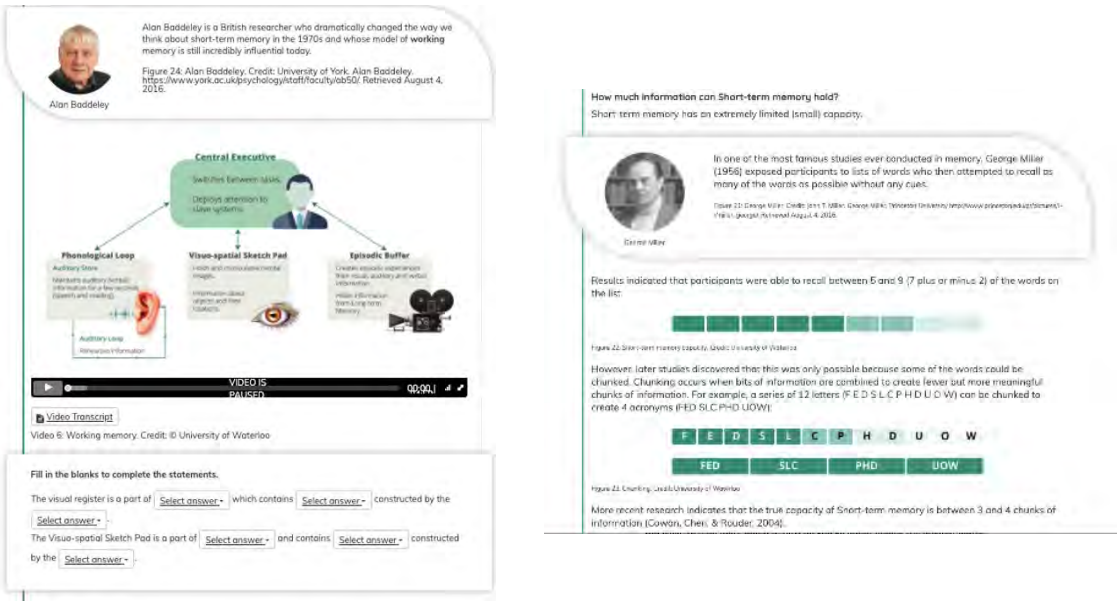
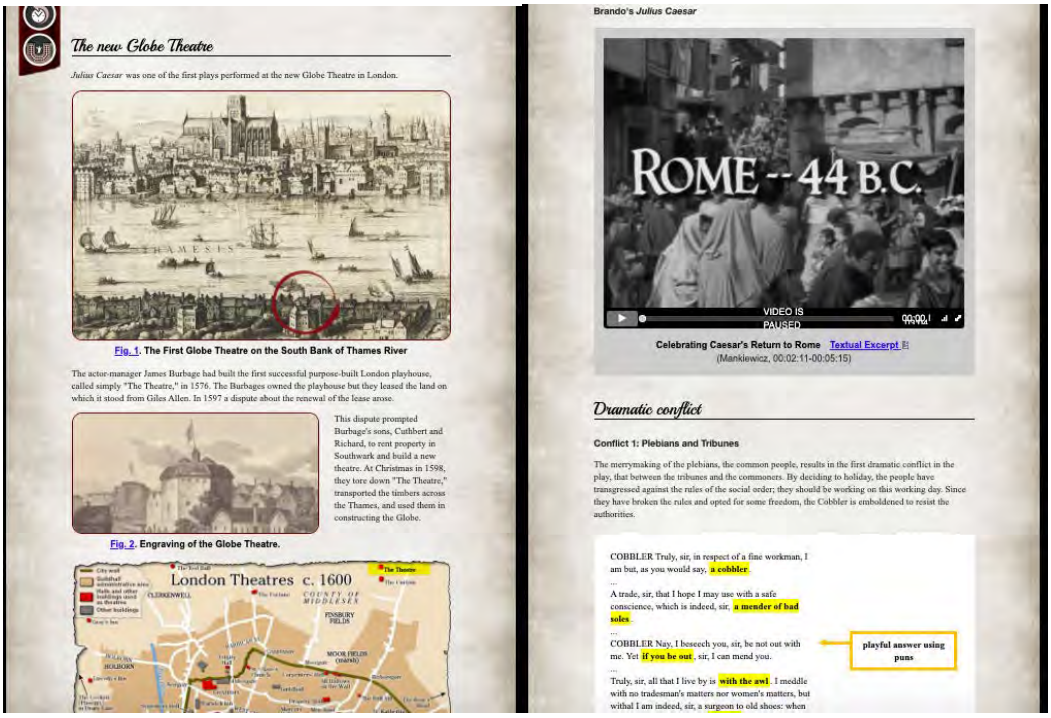


Figure 4

Sample Content from the Shakespeare Module



Participants were purposefully assigned to one of the modules to ensure that the sample was representative of the students that would typically enroll in these courses (e.g., participants assigned to the Chemistry module had a STEM background). Whereas session 2 aimed to capture participants' initial perspectives of a module, session 3 focused on asking learners to interact with

the same module to find specific information (this approach was used to target the Intuitive cell of the honeycomb - findability and usability). In both sessions 2 and 3, a think-aloud method (Charters, 2003; Nielsen, 2012) was applied to capture clear, vivid descriptions of the participants' learning process as they engaged in, and navigated through, a sequence of authentic tasks. These sessions began with an orientation script that was read aloud by one of the researchers assigned to the case, briefly explaining the rationale and the process involved for each participant (Charters, 2003). Prompting during the session itself was only used to encourage participants to share their thoughts aloud if they had been reading silently for a prolonged period of time. Participants were observed by two researchers during the user experience sessions and field notes were taken throughout. The researchers developed an observation protocol that was followed throughout each session (see Appendix B). Researchers remained in the room after the session to debrief with one another about their observations and field notes. Field notes were integrated with transcripts to provide behavioural context to the audio and text. These sessions were 45 minutes to 1 hour in length and were audio recorded using a digital recorder (as well as a laptop in case of digital recorder failure) for subsequent transcription. As students were interacting with the same module in sessions 2 and 3, these two sessions occurred no more than 2 weeks apart.

Once the interview and user experience data were collected, the recordings were transcribed by independent transcribers. The field notes were then inserted into the transcripts by the researchers who had taken the notes to provide further context within the transcripts (describing participant actions and behaviours). The research team then completed conceptual coding using QSR NVivo, building on the codebook developed from the surveys, followed by thematic organization of the data and a categorization process. This final stage involved the synthesis of data by way of searching, linking, reorganizing, reflecting, and categorizing (Weitzman, 2000).

Results

Demographic Data

The majority of participants fell within the typical age range for 2nd year undergraduate students (i.e., 18-20) (Statistics Canada, 2013) and were primarily full-time students. Approximately half of the participants were affiliated with one of the STEM faculties (Engineering, Mathematics, or Science - 57.9%). The remaining 42.1% of participants were affiliated with Arts (25%), Environment (23.9%), Applied Health Sciences (AHS; 6.4%), or a special school/program (e.g., Optometry or Pharmacy; 2.3%).

Thematic Analysis

Our qualitative analysis of the surveys, interviews, and user experience data revealed several themes that figure prominently in students' experiences of online learning. These themes emerged strongly across all formats of data collection and thus the results are presented together. We have selected a handful of representative quotes from each theme, from each of the different study formats (labeled by participant identifier and session code): the broad open-ended survey, the in-depth interviews, and the hands-on UX sessions. The four prominent themes that emerged—(a) flexibile, (b) modes of design and delivery, (c) usable and findable, and (d) affective design and humanizing learning—are aligned with four of the cells in the UXDL Honeycomb: Accessible, Useful, Intuitive, and Desirable (see Table 1). Within these themes are important insights into

students' experiences, desires, motivations, behaviours, and expectations, as they relate to UXDL principles in the design of online courses.

Table 1

Prominent Themes that Emerged from the Surveys, Interviews, and UX Sessions and How They Align with the UXDL Honeycomb Principles

Prominent Themes	UXDL Principle
Flexible	Accessible
Modes of design and delivery	Useful
Usable and findable	Intuitive
Affective design and humanizing learning	Desirable

Accessible: Flexible

Flexibility was a prominent theme in the data and aligns with the Accessible cell in the UXDL Honeycomb. The Accessible cell recognizes individuality and emphasizes inclusivity and universal design and giving students more control over their learning. In this vein, several students indicated that they enjoyed the freedom of working through the course at their own pace, rather than being tied to the pace set by the professor or other students. For example, the online nature of the course allowed students to pause and rewind or re-read material, move through it slowly or work ahead, and more easily make up missed weeks, as dictated by their personal circumstances:

> [...] if I could listen to it at 1.5 speed or 2 times speed even...I'd probably be more willing to watch the videos because it goes by so much faster and I can still take in the content at that speed. Or, if I find I'm having kind of a rough concentration day, I could slow it down if I need to. (D5, Session 3 User Experience – session type simplified after this instance to "UXS3")

> I just really like the flexibility and also having the chance to go back to parts of the course that I didn't really understand as opposed to having to go to office hours and schedule out a good time to talk to the professor. (K2, Session 1 Interview - session type simplified after this instance to "I")

Many students also expressed enthusiasm for the autonomy and sense of ownership that they had over their own learning in online contexts. For them, autonomy meant that they could learn when and where they wanted to learn, rather than being tied to a scheduled class and location. Students noted, "I feel like because I am not forced to learn at a certain time, I can choose a time when I am alert and ready to learn" (502, Survey - survey simplified after this instance to "S") and "There is no need to wait for the professor or other students in order to progress" (519, S).

Online learning can have a motivational advantage over face-to-face learning since students can choose to learn when they are ready to learn, making the experience less stressful:

> With online learning, the whole syllabus is there for you, the course content is usually there for you, so you can do whatever you want whenever you want. And that relieves my stress later on when midterms are coming, because I do most of the work in the beginning of the semester. (D2A, I)

Students also welcomed flexibility with respect to assessments, including strategies such as soft and hard deadlines, and a window of availability for assignments. One student noted, "One of the classes I had had soft deadlines and hard deadlines - I really liked these because they gave me more room to complete my activities especially with other courses happening" (691, S) and another said, "… soft deadlines [...] gave you a date to aim for but it didn't incur academic penalties if you missed the soft deadline" (2, S).

The flexibility that students enjoyed so much online, however, sometimes worked against productivity, making it easier to procrastinate and decreasing motivation to stay on task. Students said the following: "I often forgot that I was even taking an online course because it was not something that had a specific time slot in my day/week" (153, S), "It's really easy to get lazy since the course is very much independent" (520, S), and " [I dislike] feeling entirely unprepared at the end of term when you've got a cumulative final exam looming and half a course to teach yourself" (405, S). The majority of students liked the flexibility and convenience that online learning experiences afforded them despite the associated challenges that came with increased autonomy and self-directed learning.

Useful: Modes of Design and Delivery

Several students highlighted the value of aspects of the Useful cell, such as the segmenting, modality, signaling, Renkl's principle, and multimedia principles, as effective means of engaging attention. For instance, they liked having lectures divided into shorter chunks (segmenting principle). When asked about the mix of media, a student replied, "I think it keeps attention, keeps engagement because, at least that's how I work. If it's just one thing it's a little bit too monotonous: too much reading, too much video, that's when my mind starts wandering" (D12, UXS2).
Students also struggled with maintaining attention when videos were too long:

> [...] my attention is more drawn to the time bar and how long this video actually is. [...] I'm honestly really zoned out right now. I'm not sure what he's talking about anymore, nor am I even trying to pay attention anymore. (D8, UXS2)

In addition to segmented content, online students liked having important information pointed out in text-based, mixed-media modules (signaling principle); this is important in the absence of a physical instructor who orients their attention to key content: "I enjoyed the bolded words, because that emphasized which vocabulary terms you'd need to know" (D2A, UXS2).

Students also appreciated having activities integrated at regular intervals throughout content pages (Renkl's principle), as it increased and maintained engagement and focus, and provided valuable feedback on learning. One student said, "Sometimes when there are interactive elements where there's a video and then a quiz built in, I find those help to keep my interest in the course" (K2, I). Another noted,

> […] I was crunching all these modules in, I'm like 'this is so boring', and I just want it to be over, and then a little quiz popped up, and I'm like 'oh my gosh, I need to pay attention.' That was a really pleasant surprise. (D9, I)

Students expressed clear preferences related to format and presentation of content. For instance, they wanted a mixed-media approach (multimedia principle) in their online courses and expected that courses were explicitly designed for the online context, with more interaction and the use of a greater range of media and technologies than on-campus courses typically offer. One student said, "[I hope to] have a more interactive learning experience than I would taking courses in class" (511, S). Another student said,

> [I prefer a] combination of everything. I like to have multiple options online. (K7, I)

> I really enjoyed how there was a variation. [...] there was text, and then they'd take breaks by having some kind of image that would sum up what was presented in that text above, or there were videos where it can aid in my learning and … provide examples that I can engage in as well. (D8, UXS2)

Intuitive: Usable and Findable

Usability and findability were also important for participants and relate to the Intuitive cell of the UXDL Honeycomb, which emphasizes intuitive navigation and ease of use as a critical way of removing barriers to learning online. Online students liked information to be well-organized and easy to find and navigate, especially assessment and course schedule information. Students said, "I liked that all the assignments were well organized in a clean section that was easy to find with their respective units and dates listed, so I didn't have to write that down myself" (494, S) and "I really hated when I had to search and hunt for information" (131, S). They alluded to the negative impact that poor course structure, organization, and navigation can have: "It is a bit confusing in the first few weeks to figure out exactly where everything is. This leads to losing marks due to being unfamiliar to using the website" (303, S).

Participants pointed to the use of headers and visuals as landmarks that help them find information, highlighting the importance of these design features for navigation. One student said, "If it's something I've already gone through, then usually you'd have some recollection of what you're looking at and where things are. So headers would be a good trigger to remember where the information is" (K10, UXS3). Another student said,

> I was just recently trying to find something [...] and I'm like, I know it was at the bottom right paragraph [...] I feel like I have, create a memory of just sort of where, where chunks are located […] the illustrations, you know, pinpoint where to start looking. (D12, S3)

Yet another student remarked, "[I disliked] having to scroll down the screen for a really long time if the subheading is long (hard to find content for studying later on)" (782, S).

Several learners expressed a preference for text-based content because of the ease with which text can be searched to locate specific information (i.e., by using keyword search, control+F/command+F function). One student said,

> ... [T]he transcripts ended up being super helpful because I could skim through them and then when I was working on stuff I could go back and Control-F what I was looking for and find the information I needed, and be like "okay, that's how I do this," and then go back to the assignment. So having a transcript is one of the secret helpful things. (D1A, I))

Some students opted to search for information outside of the course if content was difficult to find. This tendency to search elsewhere emphasizes the importance of making it as easy as possible to find key information to encourage learners to engage with course content: "I was able to use the content within the course for the most part, but if there was anything that wasn't easy to find, I would immediately go and look elsewhere. [...]I'd Google something" (K1A, I).

Many students reported feelings of frustration and annoyance when poor usability got in the way of their learning experience and specifically mentioned usability issues with videos in particular:

> Honestly, for me, the annoying part of a video is really just that I really have to listen through all the content in order to find a bit of content. And especially that I can't go through it at my own pace. I have to go through it at the video's pace. So, honestly, I'm not sure how you could fix that and still have it be a video. So, the transcript is really good, though. (D14, UXS3)

Desirable: Affective Design and Humanizing Learning

Students reported that good design and strong instructor and peer presence enhanced their online learning experience, which is aligned with the Desirable cell of the UXDL Honeycomb. This cell highlights the important role that good visual (visceral) design, functional (behavioural) design, and reflective design can have on positive affective states, which are conducive to learning. Good visual and information design can impact positive affective states such as motivation, interest, and curiosity. One student said, "I liked the visual representation. I liked the stark colours and that they had tabs. So it was a nice way of making it look like there wasn't as much writing as there was" (D9, UXS2). Another noted,

> So when I went through the module, because of the images and how engaging it was, and how attractive it was, [...] and how the information was presented, it made me want to actually take the course [and] stay engaged and stay attentive. (K7, UXS2)

Another student also reported experiencing positive affect resulting from reflective design (i.e., design which captures the pedagogical design vision of the course author and creates an immersive experience):

> [W]hoever made this [course]… focused on all the different elements. […] it's giving you a sense of okay, here I am back in 1599, watching this play, and it's like "oh, this is how they would have experienced it." And having the movie clips and all that kind of stuff just really reinforces that, so I think it was really interesting. (K2A, UXS2)

Positive learning experiences and increased motivation also resulted from feeling connected to and supported by instructors in the online space (humanizing learning):

> The professor extended some grace when I missed something on a deadline. After that it felt like, okay, yeah, I don't want to screw up on the guy again. I'm going to try and do well… because [the instructor] is engaged and enthusiastic about it, and I actually am interested. (D11, I)

Conversely, several students reported that a lack of instructor and peer presence online created a sense of frustration and emotional disengagement: "I have tried to use discussion boards, it's always really annoying when the TA and the prof doesn't reply in a long time" (D7, I); "[I dislike the] lack of connection between peers - empathy, shared suffering, help with courses" (407, S); and "I expect [online learning] to be a bad experience. I expect all the work to be on my shoulders and not the profs that I am paying thousands of dollars to have 'teach me' (230, S).

Some students pointed to the discussion forum as a means to promote interactivity and connection with their professors and peers, and to deepen their learning: "I think for an online course it's important to have an active discussion board of just things you don't understand or just a place to ask a question and have peers respond, or TAs or your prof respond" (K10, I) and "I think some interaction is good because you always learn from dealing with other people — not just dealing with other people, but content, just if they see it differently or have different questions than you do" (K8, I).

However, other students felt that online discussion spaces were not meaningful. These students pointed to instances in which the interactions did not feel genuine or authentic: "[There is] next to no interaction with other students except occasional forced and insincere interactions on mandatory discussion boards" (113, S) and "[Professors] will use discussions to try and establish community. This doesn't work. Nobody wants to challenge each other" (143, S).

Discussion

Designing courses that foster interest, motivation, and positive emotions is an important instructional goal. This is especially true in online environments where the agency that students bring to their online learning experiences, and the increased self-regulation required to succeed, makes engagement particularly important. Participants in our study identified several design factors that they value and that help keep them engaged in their online courses, which align with the UXDL Honeycomb framework: Accessible: flexible, Useful: modes of design and delivery, Intuitive: usable and findable, and Desirable: affective design and humanizing learning.

Our research corroborates previous findings as outlined in the introduction of this paper, demonstrating that students value flexibility in how and when they learn, a clear organizational and navigational structure that renders content and assessment information easy to find, tools that are easy to use, present and engaged instructors, and an active community of peers. Our investigation reveals that students also value a mixture of media (text, visuals, infographics, videos) with regular interactive activities interpolated throughout content. Further, good visual and information design matters to them and impacts their attention and motivation. Courses that do not employ these design principles may be contributing to the concerns or anxiety about taking online courses expressed by some students.

Instructional designers in post-secondary education should consider these findings when designing blended and online learning experiences and may find the UXDL Honeycomb helpful as a guide. By using a multi-pronged approach: investigating students' perspectives and inherent beliefs about online learning (open-ended surveys), listening to students share their experiences in

online post-secondary courses (interviews), and observing students as they interact with online course modules, we have enhanced our understanding of what undergraduate students find valuable in online learning courses and how these values align with the UXDL Honeycomb. We better understand, for example, what motivates and interests online students, and what they find meaningful for learning. These include: (a) flexible and intuitive design that renders course components easy to use and find (Accessible and Intuitive cells); (b) a mix of media that offers variety and opportunities for regular interactions with content, instructors, and peers (Useful and Desirable cells); and (c) good visual and reflective design that taps into learner affect (Desirable cell). This deeper understanding of online students' experience has helped us to validate the UXDL design principles to enhance student engagement in online learning.

Recommendations and Conclusions

This research project emphasizes the importance of highlighting and incorporating students' perspectives in the process of validating an evidence-informed framework. As the UXDL framework is used by instructional designers, faculty, and developers to make informed decisions in the context of online course design, it is crucial to ensure that we are truly creating valuable learning experiences for our students. Our study validated the UXDL principles and highlighted the importance of particular cells in the framework.

Our study also revealed areas that require further exploration to enhance the existing framework. For example, several themes emerged from the data that are not currently part of the framework, including humanizing learning in online contexts. Also, this study focused mostly on the design of online courses, whereas future studies could look more closely at the intersections of design and facilitation in the online learning and teaching environment. Subsequent study offers the opportunity to conduct user experience sessions that engage students not only with the content, but also explore the relationships and interactions that emerge through learner-learner interaction and learner-to-facilitator interactions.

One of the limitations of this study is the sample rate, which was about 10% of the student subpopulation (2nd-year undergraduates). We cannot be sure whether a larger sample or looking at a different sub-population (e.g., students in their final year) may have produced different results; however, the high degree of consistency in the four key themes, across data collection methods (survey, interview, and UX sessions), use cases (Chemistry, Psychology, Earth Sciences, and English) and student abilities (we ensured the sample included students registered with Accessibility Services) does provide confidence in the reliability of these results.

We close with a caveat: the UXDL honeycomb framework is a good starting place for those interested in creating quality online course content intentionally designed to engage and motivate students. However, it is also just a starting place. Students' needs and desires change over time; technology changes over time. As such, it is important for instructional designers and others involved in online learning to continue to connect directly with students about what they find valuable. Otherwise, we are simply designing our courses for ourselves.

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Appendix A

Sample Survey Questions

Thinking about the online courses that you have taken, what design features did you like? (if you haven't taken any online courses please write N/A)

Thinking about the online courses that you have taken, what design features did you dislike? (if you haven't taken any online courses please write N/A)

Based on your experiences as an online learner, what do you *hope* to experience when taking an online course?

Based on your experiences as an online learner, what do you *expect* to experience when taking an online course?

Sample Interview Questions

If you could design your ideal online course, what would it look like?

A. What formats would the content be in?
B. How much and what types of interaction with the instructor/TA would it include? How much and what types of interaction with other students?
C. What kinds of assessments would you like to have in online courses? How frequent? Why?

Think about a recent online course that you've completed at the University of Waterloo We'd like to know about what you did in this course and what your experience with the course was.

When you were looking for specific content, how did you find it?
How was content presented in the course? (What formats was it offered in?; e.g., video, text, audio)
Did you find this/these formats useful? Why?

Tell me about an experience in one of your online courses that you would consider the best. The worst? You can choose from any of the online courses that you've taken. The best and worst don't have to be from the same course.

What made them best/worst?

Follow-up probes:

What about them was helpful/not helpful?
What about them motivated you/failed to motivate you?

Sample UX Questions

Session 2

We're going to ask you questions about your experience. These questions will focus on the way the content is presented; in other words the format, as opposed to the content itself.

Is anything about the way the content is presented distracting you from learning?

What part(s)?
Why?

Would you prefer to see one format used exclusively in your online course, or would you prefer to see a mix of formats (like the example you just experienced)?

If one format, which one?
Why?
If a mix, a mix of which formats?
Why?

Did the way the content was presented impact your motivation to engage with the material?

Why or why not?

Session 3

I would like you to imagine that you're a student registered in this online course, and that you're trying to locate specific information. Please do what you'd normally do as a student registered in an online course, and say your thoughts out loud.

[Chemistry for Engineers] You remember that this module discusses the movement of electrons. When does one atom give electrons to another atom? How do you find the term for this?

[Introductory Earth Sciences] You remember seeing some content in the course that addresses the importance of water through time. You need to find out the location of the world's oldest flowing water. How would you seek out this information?

[Shakespeare] Last time you looked at this module, you recall seeing a reference to a primary source document that describes a 16th century theatre-goer's description of his experience at the newly-built Globe Theatre. You'd like to read the original document. How do you go about finding the reference?

[Introductory Psychology] You have an assignment coming up on types of memory. Find information about this topic in this module. How does Short-term Memory differ from Working Memory?

Appendix B

Observation & Field Notes Guide

During the session, the second researcher should take field notes, and create a summary of the session. Notes should be reviewed and fleshed out/written up in full as soon as possible after the session.

What to look for when doing observations

1. Physical setting.
2. Activities.
3. Human, social environment.
4. Formal interactions.
   - The way in which human beings interact within the environment. This includes patterns of interactions, frequency of interactions, direction of communication patterns, decision-making patterns.
5. Informal interactions and unplanned activities.
6. Nonverbal communication.
7. Observing what does not happen.

How to document observations

Use the template provided. Guidelines for use follow:

Q/T	Description	Reflection
Indicate **Task** or **Question** item (Q1, Task)	· Capture a word-picture of the setting, actions and conversations; · **Describe the setting**. Take a photo (before the participant arrives); · **Reproduce the sequence of actions & behaviours**; · **Describe the people** who took part in the activities and their roles; · **Describe meaning** of what was observed from perspective of participants; · **Record exact quotes** or close approximations of comments that relate to the observation activity; [log the time] · **Describe any impact** you may have had on the situation you observed; · Should be accurate and detailed, but not "cluttered with irrelevant trivia"; · Use descriptive words rather than interpretive words ("the participant smiled" vs "the participant was happy").	· Record thoughts, ideas, insights, questions and concerns based on the observations and interviews; · Include sentences that are subjective; e.g., a more personal description of what you observed; · Include hunches, impressions, insights and speculation about what you're observing; · Include unanswered questions arising from reflecting on the observation data; · Clarify points and correct mistakes in other parts of field notes;

Prior to the session:

1. Set up urls for participants to access course content.
2. Assign an identifier code to each participant. You have a responsibility to protect participants' privacy. Avoid using identifying information during the session.

3. Prepare/print out materials for the session:
    - Orientation script (to be read aloud to participant)
    - Copies of consent form
    - Copy of interview questions
    - Recording device

Just before the session:

1. Arrive at the test site 15- 20 minutes before the session begins to ensure the room is ready for the session.
2. Ensure that there is a monitor and back-up computer that the participant can use that:
    a. is on,
    b. is connected to the Internet, and
    c. has at least one web browser installed.

(in case the participant doesn't bring one.)

3. Set up the audio recording device/software.
4. Ensure that the room has a chair for the participant and chairs for the researchers that are situated in front of the computer they will use.
5. Check url(s) to ensure that they are functional.

During the session:

1. Welcome participants, and guide them into the room where the session will take place.
2. Give the gift certificate to the participant.
3. Read the orientation script. As part of the script, the participant has the option of reading (or listening to) the information letter again, and of reading (or listening to) and signing the consent form. Give participants the opportunity to ask questions.
4. Read the task to the participant.
5. Provide the url to participants.
6. Remind participants to *think out loud* as they are completing their tasks/navigating the site. If at any point you are wondering what they are thinking, do not hesitate to remind them to think out loud. E.g., you may want to ask the following:

When This Happens	Say This:
You're not absolutely sure you know what the participant is thinking or feeling.	"What are you thinking?"/ "How do you feel about what you're doing right now?" "What are you looking at?" "What are you doing now?"
Something happens that seems to surprise them. For instance, they click on a link and say "oh" or "hmmm" when the new page appears.	"Is that what you expected to happen?"
The participant is trying to get you to give him/her a clue. ("Should I use the ____?")	"What would you do if you were at home?" (Wait for an answer.) "Then why don't you go ahead and try that?" "What would you do if I wasn't here?" "I'd like you to do whatever you'd normally do."
The participant makes a comment, and you're not sure what triggered it.	"Was there something in particular that made you think that?"
The participant suggests concern that s/he's not giving you what you need.	"No, this is very helpful." "This is exactly what we need."
The participant asks you to explain how something works or is supposed to work (e.g., "Do support requests get answered overnight?")	"How do you think it would work?" "I can't answer that right now, because we need to know what you would do when you don't have somebody around to answer questions for you. But if you still want to know when we're done, I'll be glad to answer it then."
The participant seems to have wandered away from the task.	"What are you trying to do now?"

(Source: Krug, S. (2010). *Rocket Surgery Made Easy: The Do-It-Yourself Guide to Finding and Fixing Usability Problems*. Berkeley: New Riders. pp. 83-4.)

7. The guiding principle for you as the observer is neutrality. You need to avoid inadvertently influencing the participants, either positively or negatively. Be aware of your biases (Do you particularly like how something is designed? Dislike it?). Steer clear of communicating these likes and dislikes. As Krug (2010) states:
   "Maintain a poker face. No frowning or smiling and no laughing unless the participant says something clearly meant to be funny. And, above all, no sighing." (p. 101)

   "Don't coach or help the participant in any way. No nodding or grinning when they do something right, for instance." (p. 101)

9. During the session, observers can only help participants by clarifying task instructions, not helping them complete their tasks. This is analogous to how a student writing an exam can ask for clarification on what they are asked to do, but cannot get help with the answer. Most of the time, you will answer their questions with the question: "What do you think?"

10. The participant has the right to withdraw from participation and leave at any time (ensure that the gift voucher is given before the participant leaves.)

11. **FOR ACCESSIBILITY SESSIONS:** Participants should only use the AccessAbility lab computers (and the software on these machines) if that's what they'd normally do. Ideally, they should use the screen reader they would normally use to access their online courses.

12. The session is not to exceed 60 minutes. If the participant has not completed their tasks after 40 minutes, stop the session and proceed to the Interview Questions.

13. The participant is not to keep the paper handouts. Collect all materials at the end of the session.

14. Give participants the study feedback form (i.e., information about what the study goals are, the anticipated completion date, and how to contact the research team if they have any questions).

15. At the end of the session, both researchers should write down the three most important observations you witnessed in the session. (Note: We will be keeping field notes throughout so this is simply an exercise in synthesizing the main three points afterwards.)

16. During the session, the second researcher should create a summary of the session. Refer to the Observer Guide for what things to take note of.