User Engagement Using an Etextbook
A Descriptive Study

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Engagement is an integral pedagogical component underpinning effective educational activities and is of importance for educators using online platforms. Carefully designed, technology-enabled learning resources can increase student engagement. We developed an open educational resource etextbook on vital sign measurement using an interactive and multimodal platform to facilitate student learning. The etextbook design was informed by experiential teaching-learning theory. Students progressed through the etextbook at their own pace, following pedagogy informed by the iterative process of read, observe, practice, and test, commonly used in nursing education. The etextbook was introduced as a required reading in a first-year health assessment course at one university and two colleges. In this project, we explored the level of engagement experienced by users of the etextbook. We conducted a descriptive study using the User Engagement Scale to measure students' degree of engagement using the etextbook. Results from participants (N = 455) who used the etextbook in the study indicated a high level of engagement. The responses to an open-ended item on the survey provided context to the results and shed light on effective design practices. Several recommendations for best practices in developing etextbooks are identified for educators to consider.

KEY WORDS: Engagement, Etextbook, Nursing education, Open educational resources

There has been an increase in the use of open educational resources (OERs) across North American postsecondary institutions. As opposed to copyright licensing, OERs are materials that are published in the public domain under an open license, which means they can be freely used, modified, and remixed by faculty or students and can be modified to meet learning needs.[1,2] With the rise of creative forms of technology, advances in OERs are being enhanced with multimedia and interactive experiences to augment user engagement.[3] Another important advantage is their availability at no cost to students, decreasing the financial burden for students. With advances in technology, there are more options to provide interactive and multimedia content to engage the user in the OER.

We created an open etextbook on the topic of vital sign measurement and included technology-enabled activities designed to enhance user engagement and learning. In the development stage, a pilot study was conducted using focus group interviews to learn more about students' experiences with the etextbook. Students from several healthcare programs, including massage therapy, occupational therapist assistant and physiotherapy assistant, and practical nursing, participated. Findings indicated that the participants found the etextbook to be an engaging and well-designed resource for novice learners.[4] The etextbook's interactive learning activities were valued by the participants, who recommended that more etextbooks of similar design be developed.[4] A similar study with baccalaureate nursing students found the design features increased accessibility for users and the etextbook provided a trusted online resource for learning the content (O. St-Amant, M. Verkuyl, J. Lapum, W. Garcia, S. Callahan, N. Savicevic, unpublished data, September 2020). To further explore our findings, this study was designed to measure the level of engagement experienced by users of the etextbook and to identify the various components that contributed to learner engagement in order to incorporate these features into future etextbook design.

BACKGROUND

Student engagement is a critical component in the teaching-learning process. Experienced teachers recognize that engaging the learner is the first step in the learning process. Student engagement is a topic that has been formally studied since at least the 1950s and its conceptualization has evolved continuously since that time. Astin equates engagement with involvement, theorizing that engagement was the product of two factors: input (student variables) and environment (resources and interactions).[5] Engaging

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the learner is a particularly important issue for the teacher who uses online resources.[6]

While interest in engagement has continued to grow over the decades, the topic really came under scrutiny when educational institutions began to recognize that engagement was a key component in most educationally effective practices and it was closely tied to major student outcomes such as satisfaction and grades.[7] Every year, a growing number of educational institutions evaluate student levels of engagement through tools such as the National Survey of Student Engagement.[8] While there is still no consensus on a definition for student engagement, there is general agreement that it is a multidimensional construct and should be assessed as such.[9]

In the context of human-computer interaction, O'Brien et al[9] define user engagement as "A quality of user experience characterized by the depth of an actor's investment when interacting with a digital system."(p28) O'Brien and McLean[10] identified six attributes of engagement: esthetic appeal, novelty, focused attention, felt involvement, perceived usability, and endurability or the willingness to use an application again or recommend it to others. A consideration for educators designing online learning activities in the digital environment is how to sustain engagement from beginning to end, as sustained engagement differs from one-time use.[9]

Building on the importance of resources in engagement, several authors have suggested that engagement can be enhanced by effective design and use of learning resources, particularly in the world of online learning.[11,12] Claxton[13] observed that, in order to be engaging, learning resources need to meet certain criteria. For example, resources need to be relevant, give the learner a sense of responsibility or control over their learning, and offer realistic tasks. Claxton[13] also suggested that technology can be a useful tool to achieve such criteria. Other authors subsequently reported that technology can increase student engagement.[14,15]

PROJECT DESCRIPTION

We designed and created an OER etextbook, on vital sign measurement, in which the design was underpinned by experiential teaching-learning theory. Students proceed at their own pace through a progressive pedagogy of reading, observing, practicing, and self-testing.[3] We used an interactive and multimodal platform to facilitate students' learning and ability to practice these skills. This platform was important as it provides an opportunity for students to attend to the nuances of techniques through continual observation and demonstration offered through the open etextbook.[3] The platform combines textual information, visual images, and video clips that facilitate visual, auditory, and kinesthetic learning regarding temperature, pulse, respiration, oxygen saturation, and blood pressure. In addition, there are interactive quizzes including multiple choice and select all that apply questions, as well as documentation practice based on case studies. The OER etextbook has been integrated into the curriculum of many health professional programs across multiple institutions. The etextbook is licensed through Ryerson University (Toronto, Ontario, Canada) under a Creative Commons Attribution 4.0 International License and can be accessed free of charge by visiting the Ryerson University Pressbooks site at pressbooks.library.ryerson.ca/vitalsign/.

The etextbook is a required resource for a first-year health assessment course at one university and two colleges that share a Bachelor of Science in Nursing (BScN) program. A link is included in the course weekly outline and the weekly PowerPoint slides. Instructors briefly introduce the etextbook the week prior to the class so that students are aware of what to expect in terms of online access and its interactive features. Students are expected to review the etextbook chapters before attending lecture. Textual content, images, and videos from the etextbook are also embedded in the lecture PowerPoint presentation. In the lab component of the course, instructors redirect students to the etextbook when practicing the skills.

METHODS

A descriptive study was conducted using survey methods to further evaluate students' degree of engagement using the etextbook. We used the User Engagement Scale (UES), which has undergone considerable development and testing.[9] We selected this survey tool because it evaluated online engagement beyond routine measurements such as the number of "visits" to an online course and the amount of time spent on a site. Rather, the tool helped provide a more nuanced understanding of the nature of engagement by seeking insight into variables that influence the learner experience. O'Brien and Toms[16] developed a multidimensional scale to assess user engagement with software applications based on several attributes: esthetic and sensory appeal, feedback, novelty, interactivity, perceived control and time, awareness, motivation, interest, and affect. The UES has been used in more than 40 studies since it was published in 2010 and has subsequently been modified.[9] Following a factor analysis, the UES was reduced from six to four dimensions to compose a short form of the UES, including focused attention, perceived usability, esthetic appeal, and reward factor.[9]

In our study, we used the 12-item short form version for practical reasons related to time and clarity. We modified three negatively worded items to make them positive statements, as the team has previously found students became confused with negative-worded items, and the literature supports this modification.[17] We modified the wording of one item, "The application X was aesthetically appealing" to "I

liked the look of the application X" as there were concerns that our student population, which has a substantial number of learners who have English as an added language, would have difficulty with the original wording. All remaining items were unchanged. We also used the five-point Likert scale recommended by the tool developers. The Cronbach's α for the 12-item scale was .85, providing evidence for item reliability. We added a Likert-type summative item for our own evaluation purposes, "I would recommend the vital signs textbook to my friends" and two open-ended items where students were asked to identify what made the etextbook engaging and what recommendations they had to enhance the etextbook's ability to engage the learner.

A hard copy of the survey and open-ended questions were administered to students in class or lab after they used the etextbook as their required reading over 2 weeks. Descriptive statistics were calculated for the UES. Responses from the open-ended questions were reviewed independently by each of the five researchers, following which the team met to categorize them. Once the categories were identified, we met again to review the data to validate the themes identified. This iterative process enhanced the rigor of our analysis and decision making.

ETHICS

Ethics approval was obtained from the three Research Ethics Boards. All students in the BScN program at the three institutions who used the etextbook were invited to participate in the study and the students gave informed consent.

RESULTS

Out of a potential sample of 583 students, 455 (78%) completed the UES. The majority of participants (405; 89.2%) were female. The mean (SD) age was 19.4 (3.7) years and ages ranged from 17 to 48 years. Most students (408; 89.9%) had not completed a previous degree. Three hundred eleven students (68.7%) indicated that they had previously used an etextbook. Four hundred fourteen (90.9%) indicated that they would use this particular vital signs etextbook again. Three hundred sixty-four (81%) said they would recommend the etextbook to their friends; 14 (3.3%) would not, and 68 (15.2%) were neutral.

The maximum possible score on the 12-item survey using the five-point response scale was 60. The mean score for the UES was 45.1/60 (or 75.1%). Scores ranged from 17 to 60/60, or 28% to 100%. The percentage of users who scored 80 to 100 was 36.2%. Twenty-two (4.8%) scored lower than 60. There was no statistically significant relationship between age ($P = .054$) or previous etextbook use ($P = .81$) and the total score on the UES. The subscale means indicate that one strength of the etextbook was its perceived usability; participants found it easy to use and to navigate. Another strength was the participants' perceptions of its reward factor; they found it rewarding and worthwhile to use. The esthetic appeal subscale scores also received a relatively high score, while the focused attention subscale score was low (Table 1).

All individual survey items received a mean score of 3.5/5 or 70/100 or higher, with the exception of the items "I lost myself in the vital signs e-textbook experience" and "The time I spent using the vital signs e-textbook just slipped away," which received scores of 2.4/5 or 48/100 and 2.7/5 or 54/100, respectively (Table 2).

There was a high response to the open-ended items: 399 (88%) of the participants responded. Responses to the open-ended questions highlighted what made the etextbook engaging and participants' recommendations to make it more engaging. We discuss the responses according to four categories, including content, format and layout, multimedia, and interactive activities. The responses and categories are considered in the context of the UES dimensions of focused attention, perceived usability, esthetic appeal, and reward factor.

Content

It was clear that most participants found the etextbook engaging. One participant explained, "It is engaging because it contains significant information. It is also very detailed but not in a way that it is overwhelming. The e-textbook helped to understand the key concepts of vital signs and deepened the engagement of interest for learning." This statement highlights the reward component of the UES, particularly in terms of the resource's endurability and future engagement. Other participants indicated that in terms of content, it was engaging because it was "relevant" and "applicable" to what they were learning and provided "step-by-step procedures." Additionally, one participant elaborated by noting: "What made the vital signs etextbook engaging for me was that it was informative and beneficial in my learning," and as a student, "it is important for me to have resources that are educational and interesting."

In terms of recommendations to make the etextbook more engaging, some participants merely noted having "more detail" and "more examples so it's even easier to understand." They found that examples allowed them to apply the information, and thus, this level of engagement

Table 1. UES Subscale Means, Standard Deviations, and Percentages

Subscale	Mean (SD)	%
Focused attention (FA)	8.6 (1.9)	57
Perceived usability (PU)	12.8 (2.2)	85.3
Esthetic appeal (AE)	11.4 (2.3)	76
Reward factor (RW)	12.1 (2.1)	80.6

Table 2. Mean (SD) Scores for the User Engagement Scale (Short Form)

Item	Mean (SD)
I lost myself in the vital signs e-textbook experience	2.4 (0.95)
The time I spent using the vital sign se-textbook just slipped away	2.7 (0.98)
I was absorbed in this experience	3.6 (0.85)
Using the vital signs e-textbook went smoothly	4.2 (0.82)
I found the vital signs e-textbook easy to use	4.3 (0.79)
I found the vital signs e-textbook easy to follow.	4.4 (0.77)
The vital signs e-textbook was attractive	3.7 (0.92)
I liked the look of the vital signs e-textbook	3.8 (0.92)
The vital signs e-textbook appealed to my senses (vision and hearing)	3.9 (0.84)
Using the vital signs e-textbook was worthwhile	4.2 (0.78)
My experience with vital signs e-textbook was rewarding	4.0 (0.84)
I felt interested in the vital signs e-textbook	4.0 (0.84)

challenges them on the depth of their cognitive investment when interacting with the content. In other recommendations to enhance engagement, users suggested a "glossary of terms" or "key term definitions."

Format and Layout

Overall, participants found the online format and layout of the etextbook engaging based on ease of usability. They indicated that the "layout was organized" and the "table of content was easy to follow," and it was "accessible…and the overall format and user interface was good" with "no noticeable bugs or issues." Another participant noted that the "formatting of the textbook allowed for easy navigation," and as such, you were "engaged in the content rather than figuring out how it works." Specifically, they found that it was "visually appealing" and "visually well organized" with "good font size," which highlighted the esthetic appeal of the interface in terms of user engagement. In terms of the format, one participant remarked that the "etextbook was engaging due to the straightforward descriptions, clear headings, large pictures, and easy to use platform," while another participant "like[d] the simplicity of the design and how it is broken into chunks." They found that these "short pages/wasn't daunting to go through/did not feel overwhelmed." One participant emphasized how they found it engaging because they "had more control over the etextbook," which highlights the perceived usability of user engagement.

Recommendations were made in terms of how to make the etexbook more engaging related to format and layout. Some of these recommendations were a matter of preference. For example, many participants appreciated the organization of the etextbook; however, some requested having "all sections for a particular topic in one page so that I could just scroll down through the entire document." Additionally, comments were made related to perceived usability; one participant commented that it would be helpful to have "the next page button…more visible," while another participant recommended some sort of indicator that reflected "how far a long you are in the chapter…how much you have left." In terms of esthetic appeal, some participants found it "plain and boring" in terms of layout and recommended "more colour to make it more appealing." There were a few comments related to audio features, such as a "read text out loud mode." An audio format would address the concerns of two participants who said "it's useful" but using the online format "hurts my eyes after reading for a couple hours."

Multimedia

The etextbook's multimedia components (eg, videos and images) were overwhelmingly viewed as positive and found to be "very engaging," with a "mix of visual, auditory, and words," which helped "to practice my skills." The etextbook included several videos including a full demonstration of vital signs acquisition skills like taking a blood pressure. One participant remarked that the videos "give you a visual understanding to help you efficiently perform the action." This was reinforced by many others, as another participant said, "the videos and practice simulations, like what is incorrect about XYZ, were really engaging to enhance my understanding." Another participant specifically noted that the multimedia components were "engaging…because it was appealing to my eyes and helped me learn a lot better and understand a lot more about vital signs." These comments highlight the esthetic appeal dimension of the UES. Other comments highlighted the reward factor in terms of durability of the UES, as participants emphasized how the multimedia components "kept me interested" and "kept me engaged."

In terms of recommendations to make it a more engaging etextbook, many said: "it was okay the way it was," whereas others noted wanting more "animations," "visual components," and "videos to enhance learning." Specifically, one participant remarked, "to make the e-book more engaging. I think more pictures and diagrams could be incorporated directly after instructions/explanation." It was clear that the visual and interactive appeal of the multimedia components engaged them and focused their attention in ways that text alone does not.

Interactive Activities

The interactive activities (such as quizzes, interactive images, flashcards) allowed for participants to apply acquired information. Participants commented on the usability, noting that

the "interactive questions were engaging because it allows us to test out knowledge and apply what we have read" as opposed to "just passively reading." Another participant said, "[it] assured you had an understanding of the content" and "helped further my understanding and solidified my knowledge." It was consistently noted that the interactive quizzes facilitated students' capacity to "focus my learning and apply it" and that the "self-tests…helped me absorb knowledge better." Additionally, not only was it "very engaging," but the interaction also "kept me engaged," which highlights the endurability of the interactive activities.

Recommendations to make the interactive activities more engaging were largely related to increasing the number of them, as one participant said, "I wish there were more practice questions to reinforce my learning." Another participant stated: "the inclusion of more case studies and situational problems associated with taking vital signs would enhance my knowledge." Related to this, participants recommended having "more complex test questions," "more application questions," and always including "rationales" for the answers.

DISCUSSION

The purpose of our study was to measure the level of engagement that users experienced with using an etextbook and to identify those components that contributed to learner engagement with a view to guiding future etextbook design. This is important as several authors have noted a lack of attention to learning engagement when it comes to the creation of OER systems.[18,19]

The mean score for the UES was 75%, which suggests that most students had an engaging experience. A close look at the individual survey item means shows that two items pulled the total mean score down. These were "I lost myself in the vital signs e-textbook experience" and "The time I spent using the vital signs e-textbook just slipped away." O'Brien et al[9] developed the UES to evaluate a diverse range of activities, including video games, educational products, and social networking systems. Although the survey items had been carefully validated by the team when planning the study, in retrospect, those two items were not a good fit for measuring engagement in the context of an etextbook. Expecting students to become "lost" in an etextbook or to report that "time slipped away" was an unrealistic expectation. By and large, the participants' open-ended responses supported the survey results and confirmed the utility of capturing different attributes of student engagement.

The range of total scores was very wide: 28% to 100%. The vast majority of students were engaged and over one-third indicated that they were highly engaged. This finding was also explained in the open-ended item responses. Students reported that the content, format layout, multimedia design, and interactive activities were the essential components that made the etextbook engaging. The foundation for student engagement rested on relevant content, content that was clearly related to learning outcomes and where a balance between detail and essentials had been achieved. The finding that content needs to be relevant and realistic has been reported elsewhere.[13] A very small number of students reported a very low engagement score. The low score was explained by student responses to the open-ended items. Not everyone liked using an online resource and some students found it challenging to read online.

Engagement is also influenced by online layout design, making it essential for resources to be formatted in a way that promotes engagement instead of just simply replicating information found in the hardcopy textbook.[7] Carefully designing interactive etextbooks that are esthetically pleasing and encourage frequent, continuous student participation supports student engagement.[7,20] The read, observe, practice, and test pedagogy using various multimedia activities that we systematically applied throughout the etextbook reinforced student knowledge and skill development. Giving students the opportunity to observe skills before performing the skill facilitated student immersion into the content, thereby enhancing engagement and skill achievement.[21,22] Furthermore, these multimedia and interactive activities motivated students to engage in the etextbook. Sullivan and Puntambekar[23] found that student's usage and uptake are enhanced when faculty navigate through and demonstrate sections of the etextbook prior to use. Enhancing uptake is important since students who are motivated to interact with the etextbook and value the quality of the material provided within the resource have better academic performance.[24]

When we created our etextbooks, we followed David and Glore's[25] recommendation to include instructional designers on the team to provide expertise on design, accessibility, and esthetics. This decision was supported in our study findings, which indicated that design features and esthetics increased user engagement and immersion in the etextbook. These findings support the work of earlier researchers who have highlighted the importance of effective navigation of digital content, organization, and esthetics in promoting learning and user engagement[4,25,26] and which may have a positive impact on performance.[27,28] Our participants recommended improving the etextbook navigation by providing more search options and bookmarking items clearly to be able to easily find specific content items such as multimedia videos. Some students recommended enhancing the color to increase user attention; however, we were constrained by requirement to meet accessibility standards related to color and contrast.[29]

One strength of our current study is that it was conducted with nursing students at three sites: a university and two colleges. Another strength is the relatively large sample size and excellent survey response rate. A limitation of the study is that students from one profession were surveyed. Ongoing assessment is crucial as OER evolve and expand. More research is needed to increase educators' understanding of students' engagement with online resources. This is increasingly important in nursing as educators move to adopt more online resources such as etextbooks. Further research is needed regarding the link between engagement and learning styles and the achievement of learning outcomes. Lastly, research is needed to determine how different technology-enabled learning activities meet specific learning needs.

CONCLUSION

With increased adoption of OERs comes faculty responsibility to design resources that meet learning needs while engaging the individual student and the collective group. A high level of engagement can be experienced by nursing students when etextbooks include a number of specific features to enhance attention and usability, have esthetic appeal, and include reward factors. Our findings provide direction to etextbook developers regarding specific design features that enhance engagement for nursing students using etextbooks and to educators who are considering adopting these resources. As etextbook use expands in nursing education, further studies are needed to assess learning outcomes based on pedagogical designs.

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