"I like these exercises; they break up the hard readings into a simpler form of learning": Student Outcomes from Experiential Learning Exercises for Online Introductory Textile Science Courses

Jennifer Harmon, Solaiman Bin Ali & MD Imranul Islam
University of Wyoming

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Introduction. Large class sizes are cost efficient and are able to accommodate increases in overall student enrollment (Benton & Pallett, 2013; Cash et al., 2017). However, students routinely report a preference for small class sizes, which are capable of implementing in depth experiential learning exercises in complex subjects (Koenig et al., 2015; Harmon, 2024). Although recent research questions the assumption that large classes lead to lower student learning through student grades, the study authors recognize instructors teaching classes of 40 students or more may be forced to abandon certain quality enhancing writing assignments or time intensive projects (Ake-Little et al., 2020). However, such projects are necessary for professional development and learning, especially when working with complex subjects (Burch et al., 2014; Craney et al., 2011; Fechheimer et al., 2010 & Harmon, 2024).

Literature Review. During the pandemic, most lab or field-based coursework was canceled (Hammerness et al., 2022). As a result, students expressed a loss of deep learning. Even though they received good grades, they felt their understanding was much more superficial (Hammerness et al., 2022). They believed that the online learning experience had made it harder for them to develop a solid understanding of foundational ideas in their classes and that their grades might mask the fragility of their understanding. (Hammerness et al., 2022). Experiential learning "…is a hands-on form of learning that begins with a concrete experience," in addition to reflecting on the process of the experience (Association for Experiential Education, 2019). In a typical textile science course, the instructor defines and explains the topic and directs the actions of the students (Farr et al., 2005). Experiential learning, while impactful for students, is difficult to deliver online. Especially in textile science, where student demands for autonomy are in contrast to complex scientific principles and standard material testing protocols which need to be learned. Other educators have found success implementing short but more intensive learning experiences and digital substitutes (Lashley & McCleery, 2020; Koivisto, 2017).

Experiential learning exercises (ELEs) of 4 or 7 were constructed and implemented in online and on campus courses, and then compared to a control online and an on campus course.

Methodology. *Course Structures.* The course ELEs were implemented in was a junior level, introductory textile science course. Between the years 2021 - 2023, six separate sections of the course were taught. These sections included two sections with 4 ELEs, one on campus and one online. Two sections without ELEs, one on campus and one online. Finally, two sections with 7 ELEs were both taught online. All sections of the course were taught by the same instructor, using the same lecture notes, exams and assignments. Both on campus sections met 3 days a week for a normal semester of 16 weeks. Online classes were largely asynchronous, with the section engaging in the 4 ELEs lasting a semester and the section without, half a semester. Online sections with 7 ELEs were taught over a half and full semester. *Experiential Learning Exercises.* Four exercises were constructed and expanded into seven to emphasize key topics in the course. The exercises included making cellulose fiber paper, investigating impurities in wool

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fiber, yarn spinning with a drop spindle, weaving, knitting, fabric dyeing and transfer printing. Activity kits were mailed to online students a week before class. 4 ELE kits cost approximately $18.87 per student and the kits with 7 ELEs, $31.63, with shipping. All sections participating in the exercises wrote reflections after activities. *Survey Measure.* The survey measure was distributed for extra credit. The survey measure consisted of learning objective questions and the Distance Education Learning Environments Survey (DELES) (Walker & Fraser, 2005). There was a total response rate of 71.1%, with 108 completed responses returned across the 6 course sections. Respondents who skipped more than 1 exercise were excluded. Bootstrap analysis results indicated the use of parametric statistics to test group differences was appropriate.

Results. *Learning Assessment.* 38 item learning assessment and online DELES scores are below.

On campus	Online ½ S	On Campus 4E	Online 4E	Online 7E, ½ S	Online 7E
M= 26.85	*M*= 23.06	*M*= 28.00	*M*= 25.64	*M*= 26.36	*M*= 25.75
—	*M*= 162.22	—-	*M*= 176.21	*M*= 185.79	*M*= 178.22

These averages indicate ELEs are improving learning gains and student experience for online textile science students, both in ½ semester and full semester sessions and that more progress is seen with a higher number of exercises. To test these differences, a .1 level of significance was chosen due to the small sample sizes and a higher level of variance between individual scores. At this level, a significant difference was observed in a two-sided t-test between the online ½ semester control course and the online 7 ELE ½ semester course ($t(30) = -1.81$, $p = .080$) and 7 ELE full semester course ($t(48) = -1.80$, $p = .078$), but not the 4 ELE online course or between the 2 on campus sections. *Student Experience.* Similar to the learning assessment, presence of ELEs improved DELES scores and scores improved more with a higher number of ELEs. While the difference between no ELEs ½ semester and 4 ELEs full semester was not significant, or 7 ELEs, in the half semester ($t(30) = -1.69$, $p = .10$) or full semester ($t(48) = -1.63$, $p = .11$). This indicates the presence of an increased number of ELEs improves the online student learning experience. *Reflections.* Student reflections from online 7 ELEs sections displayed 5 initial themes. Students revealed the ELES enhanced their understanding of course materials; “I like these…exercises; they break up the hard readings into a simpler form of learning.” Additionally, several students reported finding various ELEs fun; “Heck yeah I would do this again it was fun.” Students observed practical implications; “I think this was a great exercise because I could explore the weaving steps, from shedding to picking to beating up and taking. It helps to have a hands-on activity like this because I can fully process each step as opposed to watching a video…”. However, students also reported difficulty completing some of the ELEs, especially the yarn spinning exercise. One student reflected “I have never attempted spinning before. It always intrigued me but I never really had a reason to try it. It was much more difficult than I expected.” Finally, some students found select ELEs impractical, in that “...by the end my hands (were) cramping and I was very frustrated.”

Conclusion. Overall, ELE students reported a positive learning experience. With some of the more difficult exercises, students reported struggling. 7, instead of 4 ELEs proved necessary for observable impacts on learning gains and online student experience. In the future, incorporating more students, additional exercises or using a repeated measures design can be implemented.

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