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# Evaluating the Outcomes of Human-Centered Design in a Virtual Program Development Higher Education Course

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*Societal changes brought about by the COVID-19 pandemic have shown the importance of both intrapersonal and interpersonal skills in virtual environments. Two midwestern university instructors joint-taught their spring 2021 agricultural education and training program development courses, bringing students together in virtual teams during the pandemic. Course content included human-centered design (HCD) practices (a problem-solving approach focused on the end-user) applied to traditional models of education and program planning. Previous research from other fields has shown that HCD helps students become more empathetic, collaborate in more meaningful ways, and appreciate the need to adapt their points of view. Students in this training program development course completed a retrospective pre-posttest survey about their perceptions of skills associated with HCD. Overall, the course had a significant impact on skills associated with human-centered design. Further research should be conducted to explore human-centered practices applied to traditional education and training program planning models.*

*Keywords:* virtual teams, human-centered design, program development, experiential education, COVID-19, higher education

## **Introduction**

Employers believe college students need experience working to solve problems with people taking views different from their own (Hart Research Associates, 2015). However, only 37% of employers in a recent survey agreed that college graduates are well-prepared to work in team environments (Hart Research Associates, 2018). Additionally, the societal changes brought about by the COVID-19 pandemic have increased the need for teamwork skills in virtual environments as the presence of virtual environments has increased. One way to build virtual teamwork skills, including collaboration and leadership, is through simulated team projects in virtual settings (Pienaar et al., 2016).

Working in partnership, instructors from the University of Illinois in Urbana-Champaign and the University of Missouri developed an innovative approach to adding virtual teamwork within an agricultural education and training program development course taught during the pandemic. The

two universities' instructors joint-taught their spring 2021 courses, bringing students together in virtual teams to develop programs for clients. Not only did the joint venture provide students with an opportunity to work virtually with individuals outside of their home university, but it also included applied learning through real-world projects from client organizations in both states. Additionally, the course content was delivered using the framework of human-centered design (HCD) applied to traditional models of education and training program planning. This article focuses on the impact that using an HCD framework for program development in virtual teams has on students' perceived skill development.

### **Literature Review**

The value of integrating real-world experiences into the classroom has been well documented. Students given the opportunity to apply theories and concepts to practical problems are more likely to report higher academic motivation (Trolian & Jach, 2020). Actively engaging with course concepts leads students to greater mastery of the material (Maskiwicz et al., 2012) and higher-order thinking skills (Jensen & Lawson, 2011) compared to students less engaged in the learning process. In a study of problem-based learning, a technique that uses solving problems to learn course content, students over time demonstrated higher retention of course concepts compared to students in courses without problem-based learning processes (Dochy et al., 2003).

Human-centered design (HCD), or design thinking, is a term for the concept of innovating or designing with the end user in mind. HCD began in the fields of engineering and architecture and has recently become more mainstream. Principles of HCD are now infused into science, medical fields, K-16 education, and many other fields that include interactions with human beings (Goldman & Zeilezinski, 2016; Shebab et al., 2021). HCD principles complement the theories of teaching and learning that underlie program development in agricultural education and agricultural leadership and provide a framework for integrating real-world experiences into the post-secondary classroom.

While there are many definitions for HCD (Brown, 2009; Krippendorff, 2006), this project uses the definition and model developed for training and development (Boller & Fletcher, 2019). Using this definition, HCD is a problem-solving approach that involves working with the target audience to understand their needs and experiences, synthesizing this information, ideating around potential solutions, prototyping, and implementing. Using HCD principles, post-secondary students learn to shift their frame of reference to (a) be more empathetic, (b) collaborate in more meaningful ways, and (c) appreciate the need to adapt and change their point of view when gaining more information (Goldman & Zeilezinski, 2016). HCD processes and practices are related to individuals building skills in reducing cognitive bias, collaboration or working in teams, productive failure, creative confidence, problem-solving, and managing time (Aflatoony et al., 2018; Panke, 2019).

Post-secondary virtual learning opportunities have increased over the past few years, and many universities have implemented HCD principles in their synchronous and asynchronous courses to add opportunities to develop both empathy and problem-solving skills. As the COVID-19 pandemic upended traditional post-secondary education, Bozkurt and Sharma (2021) called for HCD practices to help move education from pre-pandemic teaching strategies to post-pandemic teaching strategies. Baran and AlZoubi (2020) included HCD methodology during the second half of the spring 2020 semester transition to remote teaching in a digital learning course offered to preservice teachers. Karakaya (2021) suggested using HCD in virtual classrooms to ease the transition from in-person instruction to virtual instruction but asked for more information on the models used by university professors.

Boller and Fletcher (2019) developed the Learning Experience Design Framework as a tool to infuse HCD principles into traditional program development processes. This version is adapted from traditional HCD frameworks by starting with a problem request instead of a problem with the customer experience and ending with the actual implementation of the final project. It follows traditional frameworks by (a) focusing on customer perspectives, or empathy, to define the problem request, (b) cycling through ideating program solutions and prototyping those solutions, and (c) testing and piloting to refine the program before final implementation (Boller & Fletcher, 2019). Boller and Fletcher's framework offers similar steps to general HCD frameworks and practices outlined for post-secondary education (Panke, 2019; Shebab et al., 2021).

### **Course Description**

The agricultural education and training program development courses at the University of Illinois at Urbana-Champaign and the University of Missouri included the following learning objectives:

1. Demonstrate the educational and training program development process, including identifying needs, targeting program participants, and strengthening client connections.
2. Identify, design, and utilize appropriate methods, techniques, and materials for communicating and facilitating educational and training programs in various contexts.
3. Select and develop appropriate evaluation procedures and instruments.
4. Design a plan to promote, seek funding, and market education and training program development opportunities.
5. Work as a member of a team to design, facilitate, communicate, and assess the effectiveness of an educational and training program development in a real-world setting.

In addition to these learning objectives, instructors of the agricultural education and training program development courses desired to (a) connect students with peers through virtual,

collaborative experiences with a neighboring institution, (b) expand the traditional vision of a classroom to include client projects with real-world application, and (c) expand the frameworks for program planning and development to incorporate human-centered design.

### **Human-Centered Design Components**

During the semester courses, HCD principles were introduced to students and practiced while students completed client projects from organization partners. Student teams met with client partners and received an overview of the program the partner wanted to be developed. Students followed the HCD program development framework outlined by Boller and Fletcher (2019) to design and develop the program for their client partners.

Following the process of HCD, the course required student teams to meet with members of the client's target audience before designing a program outline. For example, the student team developing an agricultural education program for grade school youth met with a focus group of fifth grade students about their preferred way of learning and preconceptions about agriculture. Using another tool from HCD, the information from the target audience was analyzed using empathy maps (Boller & Fletcher, 2019). Teams used the information from their client discussions, target audience interviews, and empathy map analysis to define the problem their program would address and determine the overall learning goals for the program before beginning development.

With a clear definition of the program, teams used mind mapping to expand their thoughts and ideas about the program opportunities. Mind mapping is another technique common in HCD to expand the possibilities outside the expected, leading to more creative solutions and programs (Boller & Fletcher, 2019). Teams developed outlines for their programs and pilot-tested designs with their target audience before the final development of the programs were submitted to their clients.

### **Client Projects**

Before the courses began in 2021, instructors identified stakeholder organizations or clients interested in providing university students an opportunity to develop a training/educational program for the client's organization. Using partner organizations and real-world training needs allows students to develop a more complete picture of program design and a chance to interact with professionals in various career paths (Cooke & Williams, 2004). Clients from three midwestern states provided seven project opportunities focusing on projects ranging from elementary and middle school agricultural education, customer service, public speaking, food sanitation, and mentoring.

To form mixed-university virtual teams, students ranked their top three choices for projects. Instructors developed teams based on these choices as well as equal distribution of students

between projects and of universities between teams. The final teams included either six or seven members. Teams were tasked to set up virtual meetings with their clients to gain more information about the project and schedule times to meet virtually as a team.

Over the course of the semester, students met with their own university class during regular class hours. The two universities met together in virtual, bi-weekly meetings on Zoom to connect as an entire group and allow students scheduled time to meet in their virtual teams. The joint time was used for team building to assist in group formation, content learning related to aspects of the team projects, and problem-solving for team-related issues. The instructors also met individually with each team to discuss their challenges and questions.

At the end of the semester, teams virtually presented their programs and program resources to their clients. A grant from the Association of Public and Land-Grant Universities allowed teams to purchase supplies to assist with the program implementation. For instance, the food sanitation training purchased gloves, wrappers, and hamburger food models to practice wrapping hamburgers using food-safe practices. The team creating an agricultural education program for middle school students purchased a subscription to an online course learning management system to house their program materials for the client. Table 1 describes the components of the team-based client projects utilized in the course design.

**Table 1. Description of Client Project Components**

<b>Component</b>	<b>Description of Component</b>
Regularly scheduled course meetings	Due to Covid regulations, University of Illinois students met for class once each week virtually and once each week face-to-face. University of Missouri students met face-to-face for class three times per week and practiced social distancing.
Bi-weekly combined university virtual course meetings	Students and instructors from both universities met via Zoom for an hour-long evening meeting to touch base and address questions and concerns. Project teams met in break-out rooms during this time to participate in team-building activities.
Client introduction to virtual meetings	Once students were assigned to their project team, each team set up a virtual meeting with their clients to obtain the necessary information to begin the project.
Project team virtual meetings	Students were responsible for setting up virtual meetings to work together and delegating responsibilities to complete client deliverables.
Project team virtual presentation practice	Project teams were required to practice and record their virtual client presentation together on Zoom.
Team virtual presentations to clients	Project teams met with their clients via Zoom and presented their deliverables.
Team-created deliverables for clients	Project teams were required to include the following deliverables: empathy mapping, mind mapping, logic model, training/educational program outline, lesson plan, assessment of the lesson, and program evaluation plan.

## Purpose

The purposes of this course evaluation were to describe how post-secondary students in agricultural education and training program development courses using virtual teamwork and real-world projects (a) perceived learning HCD-related skills and (b) would use HCD techniques in the future. The data reported in this article is one component of a more comprehensive course evaluation that we conducted in 2021.

## Methods

### Study Design

In the evaluation research reported here, we utilized a retrospective pretest and posttest survey to determine how the HCD framework for program development impacted students' perceived skill development. Students from both universities enrolled in the program development course at their respective universities were included in the sample.

The objective that guided the quantitative component of this evaluation was to examine the extent to which students identified learning skill outcomes associated with HCD principles in the program development course.

### Data Collection

Students who were enrolled in the course from both universities were sent an email invitation to complete a retrospective pre-posttest survey about their experiences in the course. Of the 40 students enrolled, 19 students (47.5%) completed the survey. The survey was administered through the Qualtrics XM online experience management operating system.

### Instrumentation and Data Analysis

The course survey included an HCD outcomes scale in which students rated their skills in concepts linked to HCD experiences in previous research. The survey included skills related to critical thinking, collaboration, and time management, among others. The scale used a seven-point Likert scale from 1 = *Strongly Disagree* to 7 = *Strongly Agree*. Students were asked to report their use of the skills both before and after the course.

The survey items came from a University of Illinois, Siebel Center for Design scale of HCD-related outcomes created by combining questions related to reflective thinking in HCD (Hong & Choi, 2015) and the design thinking mindset (Dosi et al., 2018). In our sample, Cronbach's alpha for the eleven-item pretest and posttest were .86 and .92, respectively, which is similar to the results of the original survey samples. The results listed in Table 2 also include the question language used in the survey.

In addition, the survey asked students to report how likely they were to use HCD principles in their future careers and if they were interested in taking other courses utilizing HCD principles. These questions were on a five-point Likert scale from 1 = *Very Unlikely/Uninterested* to 5 = *Very Likely/Interested*. Quantitative data were analyzed using SPSS statistical software. The research was approved by the Institutional Review Boards of both universities.

## Findings

### Human-Centered Design Skill Outcomes

To evaluate the extent to which students identify learning skill outcomes associated with HCD principles during the program development course, the retrospective survey pretest and posttest answers were compared using a paired sample *t*-test. Students reported a significant increase in their HCD outcomes between the retrospective survey pretest ( $M = 66.94$ ,  $SD = 9.93$ ) and the posttest answers ( $M = 72.56$ ,  $SD = 8.64$ ),  $t(17) = 3.30$ ,  $p < .01$ .

While the pre-posttest indicated an increase in skill development associated with HCD for student participants, this result does not provide specific evidence usable for formative evaluation of specific course content and design. Therefore, instructors completed paired sample *t*-tests between the retrospective pretest and posttest individual items to indicate which HCD outcomes students were more likely to report from their class experience. Students reported a significant perceived impact on time management, critical thinking, comfort with the unknown, using new approaches to problem-solving, making mistakes, and reflecting on thoughts and actions. The other outcomes associated with HCD experiences were not significant in the sample.

Table 2 compares the mean answers from the retrospective pretest and posttest for each item on the HCD outcomes scale.

**Table 2. Paired Sample *t*-tests Comparing Human-Centered Design Skill Outcomes from Retrospective Pretest and Posttest**

Item	Retro. Pretest		Posttest		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
I manage time effectively. ( $n = 19$ )	5.58	1.07	5.95	.97	2.69	.02
I think critically about problems and solutions. ( $n = 19$ )	5.11	1.24	5.95	.97	3.62	.00
I am comfortable with what is unknown. ( $n = 19$ )	4.74	1.28	5.53	1.02	3.17	.01
I am comfortable dealing with problems for which I cannot predict if they will be successfully solved. ( $n=19$ )	4.79	1.36	5.37	1.30	2.00	.06



Item	Retro. Pretest		Posttest		<i>t</i>	<i>p</i>
	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
I respect other peoples' perspectives. ( <i>n</i> = 19)	6.42	.96	6.68	.67	2.04	.06
I accept the group's decision even if I have a different opinion. ( <i>n</i> = 19)	6.05	1.03	6.26	1.20	0.70	.49
I share my knowledge with my teammates. ( <i>n</i> = 19)	6.00	1.25	6.42	0.90	1.29	.22
I am comfortable collaborating with people with different backgrounds. ( <i>n</i> = 18)	6.00	1.09	6.33	0.91	1.56	.14
I am comfortable trying new approaches to solve problems. ( <i>n</i> = 18)	5.56	1.25	6.06	0.80	2.47	.02
I am comfortable with making mistakes and learning from them. ( <i>n</i> = 18)	5.17	1.51	5.83	0.92	2.75	.01
I am comfortable reflecting on my own thoughts and actions. ( <i>n</i> = 18)	5.72	1.07	6.11	0.96	2.12	.05

### Human-Centered Design Future Use

Students answered how likely they were to use HCD principles in their future careers. Of those that answered the survey, 88.9% reported they were likely or very likely to use HCD principles in their future careers. In addition, 50% reported they were interested in taking another course that incorporates HCD principles.

### Discussion/Conclusion

Our findings suggest that, in general, participation in this course led to an increase in HCD-related skills, as reported by the students. However, when the student responses to individual HCD-related skills were reviewed, not all mean responses showed a significant increase in students' perceptions of their skills before and after the course.

Specifically, the sample did not show a significant increase in skills related to respecting other people's perspectives, dealing with problems without a predictable solution, accepting the group's decision even if they had a different opinion, sharing their knowledge with their teammates, and feeling comfortable collaborating with people of different backgrounds. Previous research suggests that by using HCD principles, students learn to shift their frame of reference to (a) be more empathetic, (b) collaborate in more meaningful ways, and (c) appreciate the need to adapt and change their point of view (Goldman & Zeilezinski, 2016). Our sample did not fully support these findings. It may be that the virtual nature of this project impacted survey results and perspectives of dealing with other team members or that the instruction about HCD principles by the instructors was not clear and effective.

Virtual interaction may have also had an impact on the fact that only 50% of students desired to take another course incorporating the principles of HCD in the future. It is interesting to note, however, that almost 90% of the students felt they would use HCD principles in their future careers. This speaks to the importance of providing students with experiences in problem-solving, collaboration, and perspective-taking in post-secondary classrooms.

All collaboration between the two universities happened in a virtual setting, with all connections between teams and clients occurring on Zoom. Serhan (2020) found that university students using Zoom through COVID felt that the experience did not have a positive impact on their motivation or ability to learn. A review article on Zoom utilization in higher education settings included many attempts to determine the impact of Zoom use but determined many factors influence the impact of Zoom utilization on learning, which was compounded by individual experiences coloring student opinions on the effectiveness of Zoom use (Krome, 2021). The specific experiences of university students in navigating coursework and life in the spring of 2021 will most likely never be replicated. Therefore, future use of Zoom for collaboration without the individual factors faced during the pandemic, including aspects of their setting, support systems, and motivation to learn (Tan, 2020), may yield different results.

The results of this study are limited by the single iteration of the course plan and the pandemic-related factors that underlie the course delivery. However, virtual learning is most likely here to stay (Ghilay, 2017). University students will be faced with opportunities to collaborate in virtual spaces in their future careers. This research answers Karakaya's (2021) call for more information on human-centered teaching strategies used virtually during the pandemic. It leads to more questions as to the differences between course delivery during pandemic times and as a "new normal" of face-to-face and virtual course delivery develops in the next few years.

### **Implications**

While it is important to value an end product that learners create, it is also critical for instructors to prioritize the process used to help students develop the product. Instructors should continually consider how to design learning experiences to help students improve empathy, collaboration, and the ability to understand others' perspectives. Results from this evaluation indicate that students believe they will use skills associated with HCD in their future careers. We, as educators, need to identify best practices to equip post-secondary students with these skills that employers value.

This project suggests undergraduate students may not intuitively see the opportunities to increase empathy, collaboration, and perspective-taking when working on team projects. Just because students work in teams does not mean that they perceive they are improving teamwork-related skills. Instructors may need to be more direct with their attempts to include these concepts associated with HCD instead of assuming team projects and skill practice equal skill attainment.

Alternatively, an outside observer may feel that students have increased their skills while students do not see the change. More research should be conducted to explore this phenomenon.

A small sample size ( $n = 19$ ) means this study cannot be generalized to a larger population; results are limited to the sample on which it was based. Conclusions should be restricted to this sample. However, instructors may be able to apply lessons learned from our course if they are considering using HCD, virtual teams, or client projects in their own courses.

Finally, this project described how we incorporated HCD skills into an agricultural education program development undergraduate course. We suggest that courses in other fields focusing on problem-solving and teamwork may also benefit from an HCD approach. Students in all fields have the need for problem-solving and team skill formation, and human-centered design offers a unique way to teach skills in these areas.

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