Learning to Innovate: A Case Study of Malawian Faculty Improving Food Systems with Human Centered Design

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** INTRODUCTION **

Transformative teaching and training practices for adult learners such as experiential learning (e.g., Kolb, 1984) and participatory designs (e.g., Fink, 2013) can lead to positive behavioral and mindset changes related to work, as both learner and trainer gain practical experience while co-designing and experimenting with new ways of being productive. International faculty development practices are no exception to the benefits of transformative education practices. However, because international contexts carry differences in knowing and learning as well as barriers to transformative education practices, such as national policies specifying the nature and number of exams (Merriam & Kim, 2008), western educators working in international contexts must consider ways in which learning opportunities are designed and implemented to ensure that both individual faculty and institutional leaders can make tangible personal learning gains.

In the application of human-centered design principles, as seen in *Design Thinking*, there is a potentially useful approach to transformative learning and facilitation. According to Tim Brown, design thinking is “a human-centered approach to innovation that draws from the designer’s toolkit to integrate the needs of people, the possibilities of technology, and the requirements for business success” (IDEO, 2017). Design thinking can be used as a model for transformative practices because it shares a common ground with learning processes and mindset change. At the same time, learning to use design thinking or any new approaches requires time and commitments from faculty and staff at universities and any facilitation teams helping with the process. This paper advances scholarship by exploring the training for and use of design thinking within a capacity development initiative in a Malawian higher education context - more specifically,
in the context of a USAID-supported project delivering an 18-month series of workshops in LUANAR. The workshops were focused on training LUANAR’s faculty and leaders to use human-centered design approaches (i.e., design thinking) for teaching, leadership, and research; LUANAR teams co-designed workshops with U.S.-based facilitators/trainers. To the best of our knowledge, this project is the first initiative to utilize a design thinking approach to target individual learning and institution-level gains while attending to national priorities for African Higher Education. Therefore, building upon principles of experiential education assessment (Heinrich, Habron, Johnson, & Goralnik, 2015; Heinrich & Rivera, 2016) and of changes in learner mindsets (Heinrich, 2017), this study has the goals of exploring approaches to assess how faculty learned and applied design thinking, how faculty were able to connect design thinking with innovation, and to facilitate cooperative practices related to evidencing faculty’s learning. Another goal was to augment the USAID model with details of an approach to assessing iterative agricultural innovation efforts.

LITERATURE REVIEW

Design Thinking

References to the bases of design thinking exist from around the 1950s to 1960s; the term became popularized in 1991 when IDEO was formed at the Stanford Design School (Szczepanska, 2017). The design thinking model posits iterative steps of Empathy, Definition, Ideation, Prototyping, and Testing as pivotal to design success. Essentially, it describes the process of deeply understanding a problem through empathy and exploring solutions through ideation, before prototyping and testing what seems to be the best solution - see Figure 1.

Figure 1: The design thinking model according to Stanford d.school (2017)

As pointed out by IDEO (2017), the Human-Centered Design (HCD) model is an essential component of design thinking; it explains a design methodology focused on ensuring that a final product will be usable and understandable, while user needs will be met. Another main component of design thinking is the Double-Diamond Diverge-Converge model of design (Norman, 2013), which describes a series of divergence and convergence steps in the two phases of the design process: when designers are trying to find the right problem, and when designers are trying to find the right solution - see Figure 2.

Figure 2: The Double-Diamond Diverge-Converge model of design according to Norman (2013, p. 220)

For the purpose of this article, we adopted the following definition of design thinking because it best represents our approach to problems; also, it posits design thinking as a mindset in addition to a set of tools:

Design thinking is a mindset. Design thinking is about having an intentional process in order to get new, relevant solutions that create positive impact. It’s human-centered. It’s collaborative. It’s optimistic. It’s experimental. (Horowitz, 2016, para. 2)

As mentioned above, design thinking is more than applying different design techniques - it is a mindset. Learning and growth mindsets can be powerful because of their ability to help an individual to see patterns and adapt practices. Thus, there is an argument that design thinking can be connected with different types of cognition (Wodtke, 2017). Distributed (or embodied) cognition understands human cognition as a systemic model where cognitive systems are intertwined with the impact caused by interactions between people and their environment (Hollan, Hutchins, & Kirsh, 2000). A key step in academic contexts of applying design thinking techniques is breaking down information into concise yet precise chunks of data ready to be manipulated, which facilitates the connections between ideas. Through sketching and visualizing solutions, designers model, organize, and turn abstract ideas into tangible objects, freeing neural processing power and making space for new kinds of information to
be perceived by the brain. Cognition is therefore improved, and more so because this process is experiential, building memory and affective associations with the experience. After all, another important facet of design thinking is that, with practice, it allows least-effort cognitive processing to happen when an individual is applying its techniques. In contrast, expertise thinking argues that effective problem solving depends on previous experience on solving similar problems and the amount of domain-specific knowledge one possesses (Taconis, Ferguson-Hessler, & Broekkamp, 2002). Thus, using design thinking techniques over and over improves expertise thinking while impacting cognition as knowledge is acquired through experience.

At the same time, design thinking is connected with other knowledges, skills, and dispositions. For example, it can improve skills related with iterative world modeling (Wodtke, 2017). By applying, for example, the Double-Diamond Diverge-Converge model of design, designers ideate solutions which will be later prototyped and tested; such exercise of modeling the world while trying to envision how specific solutions can impact it allows designers to perceive the world as a complex, systemic, and constantly changing environment. Additionally, design thinking usually deals with solving “wicked problems” (Rittel & Webber, 1973), so learning is inherently a major component of this process. However, design thinkers need to plan enough time to gain insights from each one of the steps of design thinking; in other words, designers need to learn to plan to learn over time. After all, “to think like a designer is to see the world as it is and find a path forward to what it could be.” (Christina Wodtke, 2017, para. 38). Thus, because there is evidence of design thinking sharing a common ground with learning processes and changing mindsets, we argue that design thinking can be used as a model for learning.

Scholarship on design thinking as well as popular discourse (Johansson-Sköldberg, Woodilla, & Çetinkaya, 2013) evidences a broad range of application of design thinking including organizational management (Carlgren, Rauth, & Elmqquist, 2016), government and public policy work (Kimbell, 2011), and business and social innovation (Brown & Wyatt, 2007; Acklin, 2013). The broad diversity of application and adoption of design thinking engendered the exploration of design thinking into yet another new context for the project at hand: faculty and leadership development in African higher education through the Innovation Scholars Program (ISP).

**The Innovation Scholars Program**

The Innovation Scholars Program (ISP) at LUANAR in Malawi, East Africa, aimed to engage faculty and university leaders in an 18-month transformative pedagogy that leveraged design thinking as a means to developing local, innovative food systems solutions (Romme, 2003). Operating from the standpoint that innovative mindsets can be learned, and these mindsets enable behavioral/systems change, Michigan State University (MSU) researchers and staff from the Global Center for Food Systems Innovation (GCFSI) at MSU created a participatory, experiential, and flexible program. GCFSI is a member of the United States Agency for International Development (USAID)’s Higher Education Solutions Network, a multidisciplinary research and development initiative pioneered by seven universities whose teams design, evaluate, and scale innovations in development.

The implementation team for the ISP was composed of the research team, LUANAR faculty and university leaders, and regional content experts from different African universities. By including both faculty and university leaders from LUANAR, the program created the opportunity for the mindset of design thinking (the intervention) to be applied individually by faculty and collectively by university leaders to nurture an organizational culture of innovation (Tierney, 1988; Morgan, 2006). Simultaneously, regional content experts participated in co-design and co-delivery of workshops for the purpose of local systems impact (USAID, 2011, appendix C). Figure 3 provides a visualization of the teams in the ISP and this study.

![Figure 3: Visualization of teams in the ISP Program and this study](image-url)

In the ISP, the learning of design thinking was embedded within participatory, inclusive international capacity development policies and practices. Such policies and practices emerged through global conversations in the recent decade, such as the Paris Declaration (2005), and were reaffirmed in global compacts adopted in Accra (2008) and Busan (2011). The ISP was grounded on evidence-based practices for capacity development within local systems (USAID, 2014). Collaboration, capacity building, mutual co-design, and inclusive development were actively encouraged and demonstrated in the ISP efforts. Systems thinking was engaged when individuals recognized the existence and prevalence of systems, tapped into local knowledge, designed holistically, and monitored and evaluated for sustainability. Following the...
logic of the local systems framework (USAID, 2014), the implementation team planned for a series of interactions (see Table 1, appendix A), each of which included a public-facing activity with representatives from government agencies and local industries involved in each of six workshops. This added a layer of visibility and accountability and served to increase the relevance of the ISP project for the participants and facilitators (USAID, 2014).

The use of experiential learning theory guided the research team’s implementation and assessment plans. Experiential learning plans (Kolb, 2014) engage learners in a cycle of Concrete Experiences, Reflective Observations, Abstract Conceptualizations, and Application. In these four steps, participants continually considered the ways in which each phase of design thinking impacts elements of their immediate funded research project. The repetition of the cycles over six workshops created space and time for consideration of design thinking applied to teaching, mentoring, as well as other university roles and areas of their lives. Ongoing and iterative considerations of previous experiences have great potential to help learners retain and embody mindsets of design thinking (Gass, Garvey, & Sugerman, 2003). In the use of design thinking as a training framework, the implementation team identified a model that could be executed and practiced together with participants. Throughout the program, iterative learning in the co-planning process was practiced. Specifically, the research team encouraged LUANAR partners to provide critical and corrective feedback. Throughout the project, partners engaged in various ways. In response, the research team regrouped to adjust patterns of practice and engage partners differently to ensure the relevance of outcomes. Such iterative efforts allowed for responsive approaches to faculty attempting to create sustained impact upon their own local systems (Ramalingam, 2013).

An important goal for the implementation team was to learn through formative feedback throughout the project. Design thinking created formative learning opportunities from a series of structured interactions, which in turn, informed approaches to individual research projects and leadership practice. The implementation team implemented monitoring and assessment during and after each of six workshops to inform and provide feedback to participants through continual communication.

Design thinking serves to add guides for individual behavior and mindsets applied to system elements. Conceptually, the implementation team’s work aligns with the holistic Human and Institutional Capacity Development (HICD) model posited by Gill, Jones, and Hammet (2016), which positions a nested arrangement of Enabling environments, Organizations, and Individuals to describe the HICD space. USAID’s HICD model posits that humans and their institutions are approached as a system (Gill, Jones, & Hammet, 2016):

[USAID’s] holistic approach emphasizes identification of institutional and national needs, support for individual training to address those needs, and the building of long-term connections between US and developing country institutions. (Gill, Jones, & Hammet, 2016, p. 405).

Design thinking serves to add guides for individual behavior and mindsets applied to system elements. Specifically, we adapted USAID’s (2011) HICD model by adding space for iterative implementation and feedback cycles (Figure 4). This approach, combined with formative, summative, and reflective assessment (Figure 1, appendix 3), aims to foster a mindset of design thinking among project participants.

![Figure 4: Adaptation of USAID’s (2011, p.8) HICD model focusing on adding iterative implementation and feedback cycles](image-url)
The HICD framework (USAID, 2011) identifies a process for capacity development but does not specify which practices work in certain contexts, or how to match evaluative efforts and policy implications. At the same time, by using experiential learning—which yields cognitive, behavioural, and dispositional tasks—and associated assessment methods, the research team posits that it is possible to identify the ways design thinking mindsets emerge for learners as key project gains. This conceptual model leads to the following research question:

**RQ:** What does it mean to learn and apply a design thinking model for faculty learners in the context of international training/development?

**METHODS**

Beginning in April 2017, the research team began to analyze individual learner experiences for evidence of understanding and application of design thinking principles. A multidisciplinary research team provided a variety of thinking and approaches to the analyses of learning. Analysts included four members of the program implementation team. Two team members also served as scholars’ coaches; one team member was the project evaluation coordinator, one was the project leader. Other team members included a program staff person and a research assistant with some distance from the participants. The program staff person and research assistant in the research team interrogated the use of undocumented observations and intuition and helped the analysis focus on documented learning contained in artifacts, interviews, and self-reports by program participants. Using multiple sources of data and consciously bringing multiple disciplinary perspectives to bear throughout analysis, the team utilized an iterative process of research to inform outcomes.

**Participants**

Although ten scholars began the program, complete data was collected for seven participants, who were all African scholars taking part in the ISP between September 2016 and March 2017. All seven scholars were purposely sampled to participate through an application process based on their teaching and research background, as well as their interest in adopting and integrating design thinking principles into their work. Their training and scholarship ranged across the agricultural sciences.

**Methodology**

In order to learn more about how individuals understood and applied design thinking, the current study was grounded in a constructivist research paradigm that included an inductive exploratory design aiming to examine individual thinking and research activity (Miles & Huberman, 1994). Investigating thinking and actions relied on both deductive and inductive approaches to theories and sources of data (Denzin & Lincoln, 2005; Glesne, 2006). The research team chose qualitative, semi-structured, individual interviews (appendix B) to explore multiple influences on participants’ thinking and action. Interview protocols were piloted with both education and agriculture experts to determine best approaches to semi-structured interview prompts (Merriam, 1988). Because assessments of learning design thinking have not been undertaken prior to this study, an inductive approach to known concepts of design thinking was necessary. Interviews were useful for gaining a deeper understanding of individuals’ influences, approaches to, motivations for, and application of assessment practices (Creswell, 2008). Intentional efforts were taken to acknowledge the African-Western positionality of the research and implementation teams. These included seeking the leadership of LUANAR on both the implementation and research teams; emphasizing regional expertise; and surfacing and testing assumptions throughout the program.

**Data trustworthiness and credibility**

Trustworthiness was maintained during data collection, analysis, and interpretation through the use of detailed field notes, post-interview memos, verbatim transcriptions, and organization of artifacts (Patton, 2002). The research team engaged in deliberate consideration, discussion, and interrogation of all artifacts in order to make careful analyses and conclusions. The research team analyzed transcripts from interviews with scholars, scholars’ workbooks, coaching documents, and field notes. The research team also compared individual interviews with field observations made by the implementation team; artifacts from design-based workbooks used in each one of four in-person workshops prior to interviews; and monitoring and evaluation worksheets submitted by participants throughout the experience. These approaches allowed the research team to explore the role of expected influences on design thinking and unexpected application thereof (Creswell, 2008; Merriam, 1988).

This exploratory research design sought to inform the agriculture development field about understanding the application of design thinking in a university context. Findings from this study are not directly generalizable though may transfer to similar settings. Causality should not be inferred from the relationships described. The participating individuals represented a small cross-section of current perspectives on using design thinking.

Four rounds of analysis were applied to establish analytical trustworthiness, described as follow:

**Round 1. Develop and Refine Estimates of Individual Learning Gains**

The first round of analysis occurred in April and May 2017. Prior to coding, analysts developed preliminary
estimations of how participants learned design thinking. The research team worked together coding interviews to identify evidence of the five stages of Stanford’s design thinking model, using a deductive approach. Then interviews were coded again in a second round of analysis using an open thematic analysis to code participant artifacts (Lichtman, 2012). The second round of coding yielded the ways in which each participant demonstrated two constructs: Concept and Application. Concept was defined as the scholar’s ability to demonstrate a theoretical understanding of design thinking. Application was defined as the scholar’s ability to demonstrate meaningful integration of design thinking processes in projects both inside and outside the ISP. The research team then created an estimation matrix encompassing each participant’s relative learning gains between preliminary estimates and estimates after two rounds of coding and analysis. These preliminary and refined estimates are shown in Figure 5; preliminary data points are represented by circles and refined data points are represented by squares.

Following the estimation of learning gains, team members serving as individual coaches for particular scholars offered their analysis, based on their interactions with scholars in the ISP. Then, participants’ artifacts were analyzed in a group effort to refine descriptions of learning (Concept and Application), using additional coaching material and artifacts. This round of analysis resulted in richer descriptions of our initial estimates, without adjusting them. However, the research team wanted to see more precise descriptions of learning gains; the estimations grid seemed to be too gross of an approximation of learning. For example, it was difficult to differentiate between some individuals (e.g., Baako and Gebre were plotted in the same data point). A more accurate indexing was needed to display nuances of individual learning.

**Round 2. Artifact Analysis on more discrete concepts**

In the next round of coding (May 2017 and June 2017) the research team focused on the transcripts of interviews completed during the field site visit to Nairobi in April 2017. Analysts coded the interviews to highlight evidence of six constructs: Empathize, Define, Ideate, Prototype, Test, and Vision. The first five constructs were derived from Stanford’s d.school design thinking model (Empathy, Definition, Ideation, Prototyping, and Testing), and scholars demonstrated their application of these five design thinking categories within their ISP projects. The sixth construct (Vision) captured a broad category of other uses of design thinking (i.e. in other academic work as well as in personal life). Then, the six constructs were grouped as either Concept or Application. Concept was used to summarize the work of Empathize, Define, and Ideate, while Application was used to summarize Prototype, Test, and Vision. Identifying these six unique constructs allowed the use of numerical estimates of performance/learning across six categories.

**Round 3. Transformation from text-based estimates to numerical estimates**

In the third round of analysis, the research team indexed each participant on each of six constructs. Using a 0-10 scale of estimated competence, the research team re-coded notes and artifacts with numerical values. The numerical indexing required an additional discussion of codes and shared understanding among the research team and the implementation team. The transformation from text-based estimates to numerical estimates provided a succinct visualization of how different learners might score similarly but display different strengths.

**Round 4. Final visualizations (group and individual)**

In the final round of analyses, the research team created two types of visualizations to display participants on the numerical index. First, the team created individual visualizations with the 0-10 scoring on each of six
constructs to provide a more precise view of each participant's current competency (Figures 6 to 12). Second, the team created a matrix plot, aggregating participants' outcomes on the conceptualization and application axes (Figure 16). Numerical indexing is represented in both visualizations. The aggregate display collapses individual scores found in the dispersion graphs into two major categories (Concept/ Application) on a single matrix. Visuals are presented in the findings section below and used for analysis of comparative individual progress.

FINDINGS

To answer the research question, each participant's experience was described both individually and in relationship to other participants. Evidence of learning was displayed in three ways. First, participant's learning was assumed to be grounded in both current experiences and substantively informed by each individual's mental model of professional practice (Johnson-Laird, 1983). Table 1 describes key roles held by each participant, as well as their project status at the beginning of the ISP. Roles and work type might influence the ways people learn design thinking. Second, the evidence of learning was analyzed at the individual level which yielded a representation of how each participant learned and applied design thinking. Third, by displaying learning gains of participants, authors could then identify similarities and differences among scholars' outcomes. Authors aimed to visualize patterns of learning among participants by viewing the dispersion graphs together and by viewing the refined matrix (Figure 6) to represent more precise estimates of learning gains.

Key roles and contexts

Training and disciplinary socialization, environmental and cultural socialization, and incentives and accountability each served to influence the ways faculty learned and adopted new mindsets (Heinrich, 2017). Understanding the influences, incentives, and constraints, guided conclusions about learning new mindsets.

The influences of environmental and cultural socialization, and incentives and accountability each contributed to the quality of scholar participation. Participating in the ISP meant that scholars had access to some project-related funding, and were associated with a project that was supported, both tactically and materially, by the campus leader, the Deputy Vice Chancellor.

Additionally, project status at the beginning of the program, number of workshops attended, and number of available artifacts might have affected learning and shifting mindsets. Table 1 below describes the participants in ways that could have possibly influenced them:

Finding 1. Individual participant learning gains

This section presents the seven participants' individual gains. In visualizations known as dispersion graphs, each vector represents a construct of analyses and the overall coverage gives a visual indicator of learning gains that reflects a holistic view of design thinking.

Overall, learning gains ranged across participants. While dispersion graphs showed quality of learning gains (Figures 6-12), the learning gains matrix showed an aggregate view of all participants and their relative gains, suggesting patterns among learners (Figure 16 on next subsection). To further illustrate participants' differentiation, sample quotes from interviews and other artifacts were provided.

Ayo's individual gains

Ayo did not demonstrate evidence of learning gains across constructs on the dispersion framework (Figure 6). Overall, Ayo seemed to understand how design thinking principles are connected with innovation, as noted in this quote:

“If I still use the same principles of design thinking, we can get to what we're calling innovation in health and agriculture... I think the thing I've learned is you can teach how to innovate and this is what this process is trying to do.”

Also, Ayo did not claim to embody this learning nor did he demonstrate evidence of richly understanding and/or integrating design thinking techniques in or outside his ISP research project; for example, although Ayo mentioned empathy in both workbooks and interviews as important, he did not indicate how farmers and technicians were being consulted in his ISP project. Instead, other stakeholders were only mentioned when Ayo demonstrated understanding of problem definition (i.e., designing for their needs). Moreover, Ayo did not provide a complete working definition of design thinking, instead making a connection between design thinking and innovation. In summary, Ayo demonstrated understanding but did not show evidence of applying design thinking.

Ayo

Figure 6. Dispersion graph for Ayo
Baako showed a high understanding of most design thinking principles according to the research framework (Figure 7). Workbooks showed strong evidence that Baako was interested in experiential learning, a theme that together with problem definition was consistent throughout interviews (i.e., Baako mentioned working with stakeholders to define problems and find solutions in their current research project). Baako’s interview responses indicate a clear understanding and application of empathy and ideation:

“We are now taking the students, getting them to work with one of the stakeholders [e.g., farmers] so that they can get to understand what the problems are, other than just reading about them but actually experience it and for them….you can go here and experiment and come up with problems that are actually being experienced by these people and work with them to come up with a solution.”

Moreover, Baako gave a working definition for design thinking that was focused on the human-centered approach: “[Design thinking] puts the person you are trying to design for or the person you are trying to create a solution for at the center of each [model]”. Finally, Baako provided evidence of applying design thinking principles outside the ISP project when teaching about microfinance projects. Regarding teaching with design thinking, Baako
mentioned that “it was also a trial which I’m looking forward to doing it again so I can perfect it”. This statement is an example of Baako understanding the importance of prototyping and testing for future iterations of their efforts.

**Figure 7. Dispersion graph for Baako**

**Cayman’s individual gains**

Cayman’s learning gains were focused on applied design thinking principles (Figure 8). Notes from the ISP coaches described this participant as very engaged during workshops (i.e., asking questions and taking notes) and such interest was demonstrated in most workbooks. In interviews, however, Cayman was very reserved. Overall, there was evidence that this participant understood design thinking as a set of techniques that can be used in a disaggregated way when they align to a step in a given project. For example, Cayman valued prototyping more than other design thinking principles. When asked about his use of design thinking, he responded: “Prototype is more important.” This response may be because his ISP project was already in prototyping and testing phases. Another example is Cayman’s claim of use of empathy in teaching because it was needed to improve the course: “I empathize with how the student perceive, how the student understands what I do”. It was unclear why Cayman decided that design thinking should be used in these ways.

**Figure 8. Dispersion graph for Cayman**

**Dubaku’s individual gains**

Dubaku showed learning gains on only some design thinking principles (Figure 9). Interviews and workbooks provided evidence that Dubaku believes design thinking is a way of helping the local community and promoting change, especially through the use of prototyping: “With design thinking, people are able to localize things and maybe prototype things and do things that they think can help people locally. … [Through] Design thinking we should [be able to] change the approach to things and probably using our local experts or local materials, improve the way we do things.”.

Dubaku also made a connection between design thinking and innovation: “Design thinking drives innovation, you cannot separate them.” However, this participant seemed to be putting himself in the center of the design thinking process instead of acknowledging how users think and incorporating their feedback into the design thinking process. For example, Dubaku claimed to be doing observations with local fishermen and ideating on those observations. At the same time Dubaku claimed to design prototypes for them, instead of collecting information, ideation, and prototyping with them. While subtle, this description is evidence that Dubaku sees the benefits of working with stakeholders but has not yet de-centered a research driven approach to finding solutions as prescribed in human-centered approaches.

**Figure 9. Dispersion graph for Dubaku**

**Ekene’s individual gains**

Ekene’s learning gains were also mostly focused on applied design thinking principles (Figure 10). All Ekene’s artifacts provided evidence that, throughout the ISP, this participant had become more conscious of the importance of design thinking and how it could be used to promote change and improve effectiveness. Ekene claimed to use empathy in the ISP project with teammates: “While they’re putting it together, they gave me feedback”. Similarly, in teaching work outside the ISP project, Ekene noted a similar engagement with empathy: “Getting a little
feedback from the students, whether if a test was too much of what kind of questions they prefer”.

Moreover, there was evidence that prototyping was important for Ekene, likely resulting from the phase of their ISP project. Ekene also noted that design thinking is related to innovation: “If you are trying to set up a certain process or design something, you might come up with something you hadn’t thought about.” Overall, Ekene demonstrated some design thinking principles and was trying to apply them outside the ISP project, although there is no evidence that Ekene fully understood the entire design thinking process and the connection amongst design principles when creating a solution.

**Folami’s individual gains**

There was not much evidence of learning gains for Folami (Figure 11). Folami seemed to understand the main components of the design thinking process:

“It has given me an insight on how I can define a problem and come up with ideas on how I can solve that problem and then how I can maybe come up with a certain prototype or design and test it”.

However, there was no mention by Folami toward applying design thinking to the ISP project or beyond. Interview responses were superficial and other artifacts did not provide more information about either understanding or application constructs.

**Gebre’s individual gains**

Gebre demonstrated learning gains in most design thinking principles (Figure 12). In interviews, this participant demonstrated a clear understanding of the importance of empathy and ideation in different instances (such as teaching) and projects (inside and outside the ISP).

“Design thinking helped [me] to empathize [with] and appreciate the role of different expertise and working with stakeholders. We need to now take different ideas... so I’ve learned now that I even have to listen to [my students]. We have to work with different expertise, we have to learn to understand each other’s objectives.”

Moreover, there was evidence that Gebre clearly understood the connection between design thinking and innovation from a systemic point of view:

“Innovation includes not only the implementation process but even the way you are handling the whole systems, the people, the culture that you are cultivating. So, innovation should not be seen as just the feasible outcome that comes out at the end, but innovation should be seen as even the way you do the process... So innovation and design thinking cannot be separated. They are one.”

Additionally, Gebre noted the systemic influence of introducing design thinking practices during the ISP project. Gebre indicated it was possible to promote change in a horticultural framework perpetuated in the past twenty years. These sentiments were consistent throughout other artifacts as well. Overall, this participant seemed to have embodied design thinking practices and applied them in early stages of their projects. There was evidence that Gebre was anticipating how design thinking principles (prototyping and testing) will be applied to the next phases of the current project and to future projects.
Finding 2. Patterns Among Learners

Design Thinking, Innovation, and Effectiveness

Responses to the question “Do you feel that you’re more or less effective in your work since you have worked with Design Thinking?” showed that 87.5% of participants perceived themselves as more effective. No participant perceived a decrease in effectiveness due to the use of design thinking in their projects, while one participant believed their effectiveness was the same. Responses to the question “How would you describe or characterize the relationship between design thinking and innovation?” were unanimous in terms of both concepts being related. Some participants were more thorough on their answers and enacted the human-centered approach of design thinking when giving their answers (e.g., see Gebre’s quote above), while others were more reserved simply stating the connectedness of the concepts.

Groups of Learning

After analyzing participant’s individual learning gains and their dispersion graphs, it was observed that participants’ outcomes grouped in three different ways:

- **Group 1.** Understood and applied (or planned to apply) design thinking
- **Group 2.** Applied design thinking but experienced some disconnect between concept to application
- **Group 3.** Understood fewer concepts of design thinking

Dispersion graphs were re-organized and are displayed below based on these groups (Figures 13-15). Table 2 shows the average scores for design thinking categories across groups (ranging from 0 to 10) and the total average score across groups (ranging from 0 to 60).
**Table 2**: Average scores for design thinking categories across groups

<table>
<thead>
<tr>
<th>Design Thinking Categories</th>
<th>Total</th>
</tr>
</thead>
<tbody>
<tr>
<td>Empathy</td>
<td>Define</td>
</tr>
<tr>
<td>Group 1</td>
<td>9</td>
</tr>
<tr>
<td>Group 2</td>
<td>2</td>
</tr>
<tr>
<td>Group 3</td>
<td>0.5</td>
</tr>
</tbody>
</table>

The matrix below (Figure 16) is an index of learning on understanding concepts and application thereof. This index is not normed to any external standard and aims to illustrate differential learning gains in one view. These groups are drawn from the same raw scores of learning data presented in the dispersion graphs (above). Scores from the seven dispersion graphs are aggregated by person in two groups, concept and application, and graphed on a biaxial plane.

![Figure 16](image)

**SIMILARITIES AMONG FACULTY**

Despite learning differentiation, each and every faculty participant identified how design thinking was connected to innovation and almost all of them stated that design thinking can make them more effective in their work. Most noted how the support of campus-level leadership made easier their participation in this project (Deputy Vice Chancellor). Both of these statements point to the nature of the environment as an influence on learning. The second layer of similarities existed in the ways participants described the campus support for their work in this project. Contextually, one key element in the overall program is that the faculty participants learned design thinking side by side with university leaders and department level decision makers (i.e., deans, directors). Each faculty participant proposed a food-systems research project related to their work as an agricultural university faculty member. Funding faculty research is not a new idea, doing so within an environment of overt institutional support gave research faculty space to leverage their newly acquired design thinking skills in an experimental (read: risky) approach to research.

The distribution and differences among ISP project participants in learning design thinking were detectable with these assessment methods. Findings across the seven participants indicated a differentiation of learning gains as a result of working with design thinking concepts and opportunities to apply concepts to real research projects. By observing different levels and qualities of learning, future faculty development projects may benefit from the following reflections.

**DISCUSSION**

The findings of this inquiry pointed to key insights about the research question:

**RQ**: What does it mean to learn and apply a design thinking model for faculty learners in the context of international training/development?

First, individual learning and assessment of design thinking can be achieved in a series of workshops aimed at transformative learning. Second, extending international development pathways with human-centered design frameworks was an effective approach to individual capacity development. Building on practices and theories of transformative adult learning, this research demonstrated how highly trained and well educated scholars learned new and updated knowledge, skills, and abilities. Learning concepts and applying them often serve to inform individuals’ mindsets (Fink, 2013). This research also demonstrated a method to assess how learning happened for individuals in international higher education development contexts and (Heinrich, 2017; USAID, 2011).

Using design thinking served to enhance individual learner expertise through seriated programming moments, and yielded evidence of individual learning through seriated assessment moments. The assessment methods detected a range of learning gains among different individuals. The range of different outcomes would be expected in a given adult learning context, establishing a level of trustworthiness in the assessment approach.
In the ISP, the test project for research faculty was research. Using research was both practically and politically important for recruiting research faculty as participants. Upon entry to the program, faculty participants made intentional choices about the scale of research projects to which they would apply design thinking principles. While implementation teams coached faculty participants on the scope of their research project, choices were left to the faculty. Several faculty chose modest research projects while others chose to focus on one element of larger existing research agendas. A third group chose ambitious new projects.

**Group 1.** These faculties understood and applied (or planned to apply) design thinking. This group embodied design thinking practices and applied them in ISP project. The projects of these faculty were a new modest project and a new ambitious project.

**Group 2.** These faculties applied design thinking but experienced some disconnect between concept and application. It was unclear though if the choice of only using certain concepts of design thinking is due to lack of self-reflection or a misunderstanding of the design thinking process as a whole. These learners were working on research projects with high needs for prototypes including an animal cage, a biology learning game/app, and a cold storage mechanism. Two faculty focused on a prototype element of their research while one used design thinking to re-evaluate their approach (the game app).

The individuals in group 2 might have re-considered their research to reflect design thinking principles. In this group, only the faculty participant who was designing the game app actively re-imagined the intended benefactor of their project from themselves as a researcher to students as better learners.

**Group 3.** These faculty understood fewer concepts of design thinking and demonstrated little application to projects. Sufficient understanding may or may not have impacted these individuals’ willingness to integrate design thinking principles in their ISP project. The projects in this group were an ambitious new project and a modest new project. Early artifacts for these participants indicated similar progress to participants who demonstrated greater learning, but after two workshops, these participants demonstrated less activity outside of the site visits by the implementation team. A key insight for this group is the ways in which coaching and accountability structures might have played a role in pushing projects forward, although, administrative records indicate similar coaching and communication patterns among all participants. Early hypotheses indicated higher learning gains for these participants. Further investigation might determine if individuals articulated clearly early but did not demonstrate their work in the project.

Some faculty used existing larger projects, which were not flexible enough to make significant changes to research design or personnel, making some of the obvious lessons of design thinking unavailable in their projects. Consistent with theories of social and experiential learning that posit that gains take place in iterations (Fink, 2013; Kolb, 2014), individuals might have learned the concepts, decided such iterations would not work for their project, and remained polite participants for the duration. The same participants reported design thinking connections to innovation without demonstrating competence in the process of design thinking.

**Future Research**

A key insight from this work was the team approach to planning, training, and assessment. Many training and development projects rely on one or two faculty members teaching or training some number of participants or learners. On this project, the implementation team was interested in establishing an evidence-driven approach to individual capacity development. The research team helped to establish an assessment pattern that demonstrated how design thinking, as an approach to capacity development, was learned. The teams utilized the skills of nine different professionals at different times during the implementation. These planning processes were time intensive but yielded continuous implementation improvement over the course of 18 months and a consistently high level of engagement from participants. A future approach to research and evaluation might explore how teams like this communicate and collaborate to leverage changes and improvement, including the capacity of teams.

As the teams reflected between each workshop, some members noticed emerging indicators for attending to and assessing resistance to design thinking. Future research might address evidence of program effectiveness in light of resistant individuals. By treating resistance as a formative moment for both participants and implementers, new information in capacity development might emerge in a compact amount of time. With this kind of insight, teams might reproduce effective programming in different contexts.

**LIMITATIONS**

One limitation in the proposed framework is that it uses a simplified model that captures some (but not all) participants’ idiosyncrasies. Although participants’ learning gains are displayed through different visualizations, the proposed framework does not intend to compare individual learning as if all individuals were the same, or to compare learning gains through a standardized learning outcome lens. Instead, the goal is to identify and describe possible learning patterns and mindsets emerging from the intervention. Additionally, this
analysis explores how unique mindsets were intertwined with participants’ previous experiences and backgrounds. In other words, individual training and work experiences matter in the context of this study. Another limitation is that this study is based on available artifacts for each participant. Artifacts were analyzed through a lens of observable learning gains. It is possible that participants' actual level of understanding design thinking concepts is different from what was demonstrated in their artifacts due to several reasons (e.g., introversion, lack of self-confidence, different learning styles, lower workshop attendance). Participants were invited (rather than required) to engage in learning activities and demonstrate their learning during workshops. This approach had the potential to create an authentic learning and assessment environment, but created some distance between actual and observable participant gains.

Design thinking focuses on the end user in the food system (i.e. grower, consumer). For some researchers, the value proposition of their involvement in the project appeared more focused on research and publications (individual productivity) in juxtaposition to solving a real life problem of food systems. By attempting to refocus efforts from publication to end user, the implementation may have been interpreted as a threat to productivity, or to the relative influence of researchers as authorities. Perceived threats like these would likely lead to resistance to change (Schein, 2009).

Finally, a pre-test related with the understanding of design thinking concepts prior to the intervention was not performed. Pre-post measurements are valuable in terms of assessing individual’s growth against a baseline. However, this approach is exploratory, focusing on emerging mindsets, leading to the interpretive epistemology and not aligned with traditional pre-post measurements.

CONCLUSION

In this USAID sponsored project, the implementation team adopted the HICD model (USAID, 2011) and adapted it to help locate an intervention for their work. When design thinking was identified as a possible approach, the implementation team also saw opportunities for design practices to emerge in spaces between the system practices outlined by USAID (Hervy & Gilboy, 2014; USAID, 2014). Following USAID local systems framework for supporting sustainable development, this program makes the assumption that design thinking is nested in regional and local systems approaches to solve local problems (USAID, 2014). This approach gives a design thinking mindset an opportunity to flourish throughout a system.

USAID’s (2011) model does not name a specific approach to HICD, and many models of HICD intervention exist. Yet in design thinking the implementation team saw a way to move to a mindset approach, rather than replicate and adapt a non-contextual tool or model. The design thinking mindset approach had potential to deeply engage local university and community stakeholders through an experiential, professionally mentored, training and development program. Specifically, the implementation team chose to use the Stanford d.school approach to design thinking (Hasso Plattner Institute of Design, 2017), and this choice reflected the team’s desire for this program to fulfill the need for integrated human and institutional capacity.

This program is a case where facilitators intentionally embedded self-learning and teaching throughout the program, engaging the same adaptivity advocated by the design thinking process. By leveraging the principles and ideas of design thinking as model, the implementation and research teams were able to engage an exploratory study of our work. Through the process of assessing a complex learning experience at multiple data collection points, a pattern of learning and innovative design behaviours was observed by the implementation and research teams. By attending to the data collection points throughout the 18-month workshop series, authors were able to articulate a thorough understanding of individual learning gains about design thinking. By considering multiple points of collection, types of data, and multiple perspectives on data analyses, the research team identified learning outcomes and behavior patterns that indicated conceptual understanding of and contextually applied design thinking. The teams watched closely how individuals first understood concepts of design thinking, later how they adjusted practices, and finally, how some individuals engaged repeated measures of implementing design thinking principles.

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APPENDICES

Appendix A: INNOVATION SCHOLARS PROGRAM PROJECT SCHEDULE AND PLANNING PROCESSES

The project schedule describes the major activity, assessment, and coaching processes that collectively formed the Innovation Scholars Program at LUANAR (Table 1).

Table 1: Description of workshops, schedules, assessment, and adjacent planning processes.

<table>
<thead>
<tr>
<th>Timeline</th>
<th>Project Intervention</th>
<th>Activities</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dec 2015</td>
<td>Co-Creative Program Development Meeting</td>
<td>Series of meetings with LUANAR faculty and leadership to determine goals and interests of program</td>
</tr>
<tr>
<td>June 2016</td>
<td>&quot;Crash course&quot; workshop introducing design thinking</td>
<td>Experiential activities introducing design thinking process</td>
</tr>
<tr>
<td>September 27-29, 2016</td>
<td>Community Engagement for Innovation in African Food Systems,</td>
<td>Series of activities guided by regional facilitator, including public forum to discuss local community engagement</td>
</tr>
<tr>
<td>Dec 2016</td>
<td>Teaching and Learning for Innovation in African Food Systems</td>
<td>Series of activities guided by regional facilitator, including public forum to discuss teaching and learning practices</td>
</tr>
<tr>
<td>March 2017</td>
<td>Nairobi Kenya Excursion</td>
<td># Planning sessions focusing on local innovation models for teaching, learning, and research. Development of interview questions</td>
</tr>
<tr>
<td>June 2017</td>
<td>Leadership Development for Innovation in African Food Systems</td>
<td>Series of activities guided by regional facilitator to discuss leadership development</td>
</tr>
<tr>
<td>Aug 2017</td>
<td>Communication for Innovation in African Food System</td>
<td>Series of activities guided by regional facilitator, including public forum to discuss local communications between public and academia</td>
</tr>
<tr>
<td>Oct 2017</td>
<td>RUFORUM Design Facilitation Session</td>
<td>Program graduates led session on design thinking for regional leadership in African higher education</td>
</tr>
</tbody>
</table>
Appendix B: INTERVIEW QUESTIONS FROM NAIROBI EXCURSION

Table 2. Interview questions about design thinking asked during Nairobi Excursion.

Nairobi Excursion Design Thinking Interview Questions: March 19-23, 2017

1. Please tell me a story about how you used design thinking in your ISP (research or leadership) project.
2. Where else in your work or community (or family life) are you applying principles or concepts of Design Thinking?
3. Given what you just described above, what is your working definition of Design Thinking?
4. Do you feel that you’re more or less effective in your work since you have worked with Design Thinking?
5. How would you describe or characterize the relationship between design thinking and innovation?

Appendix C: LOGIC MODEL BASED ON USAID’s HICD model

Figure 1: Logic model including assessment layers