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Using Human-Centered Design to Develop an Innovative Teen Pregnancy Prevention Program: Lessons Learned from a Case Study

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Abstract

While teen birth rates are at an all-time low for the United States, teen pregnancy remains a public health concern as significant disparities remain among demographic groups and geographical regions. There are 40+ evidence-based programs (EBPs) available, yet few exist for rural populations. This article describes how through a community-academic partnership, a community-based organization (CBO) in a rural town of North Carolina developed an innovative teen pregnancy prevention, game-based learning program for youth, *Using The Connect* (*UTC*) through a human-centered design (HCD) approach. The final program entailed a set of educational games focused on: adolescent growth and development, communication, decision-making, facilitating safe connections between youth and adults in their community, and accessing information. This manuscript describes the program development process, explains how youth voice was incorporated through HCD strategies, describes results from usability testing of the prototypes, and lessons learned for program development.

Keywords

Program Development, Sexuality Education, Human-Centered Design, Innovation

1. Introduction

Disparities for Teen Birth in Rural Communities

Teen birth rates have hit an all-time low for the United States as a country (Guttmacher Institute, 2016), yet disparities remain as demographic groups and geographic regions have teen birth rates that far exceed the national rate (Centers for Disease Control and Prevention (CDC), 2019; Martin et al., 2018; Hamilton et al., 2017, 2016; Sedlak & Bruce, 2010). Specifically, rural communities experience higher rates of teen pregnancy and birth (31 births per 1000 females (ages 15 - 19) compared to urban communities with 19 births per 1000 females) (Hamilton et al., 2016; Hamilton et al., 2017; Wuerch et al., 2019; Zaban et al., 2018). Such disparities are not surprising as many current evidence-based prevention programs target larger populations to produce a larger impact. To date, only one evidence-based program (EBP) exists for rural communities.

Current State of EBPs

Evidence suggests less than half of rural youth learn about sexual health topics, such as birth control, through formal health education (Lindberg et al., 2016), and EBPs for smaller and rural communities are nearly nonexistent (i.e., one in 40+ programs was developed for rural populations) (U.S. Department of Health and Human Services, Office of the Assistant Secretary for Health, & Office of Population Affairs, 2017). Additionally, current EBPs lack engaging methodologies and transferability to other communities (Barbee et al., 2016; Bull et al., 2016; Demby et al., 2014; Lindberg et al., 2016; Piotrowski & Hedeker, 2016; Wilson et al., 2017). These EBPs utilize a traditional curriculum format, with a rigid structure ranging from two to 25 sessions (U.S. Department of Health and Human Services, Office of the Assistant Secretary for Health, & Office of Population Affairs, 2017) using didactic lectures centering on a sexual health topic (e.g., puberty, contraception, boundaries, etc.), followed by youth role-play, group activity or an activity sheet based on the topic. Other limiting, traditional curriculum formats utilized by EBPs include: technology use, activities engaging parents/caregivers, and service learning projects (U.S. Department of Health and Human Services, Office of the Assistant Secretary for Health, & Office of Population Affairs, 2017). Though these approaches fill some content gaps and incorporate new activities or modalities, research indicates such programs still have a traditional design and approach with similar limitations to previous EBPs (Barbee et al., 2016; Bull et al., 2016; Piotrowski & Hedeker, 2016; Wilson et al., 2017). Furthermore, implementing EBPs requires extensive facilitator training and administration costs, which increases the organizational capacity required for financial, time, and personnel burdens (Demby et al., 2014).

While established EBPs are grounded in individual-level behavioral and health theories (e.g., theory of reasoned action, health belief model, social learning theory), they lack insights from education and learning. Programs centered in educational theories, such as game-based learning, have been shown to be more effective at impacting knowledge and skill development (Blunt, 2006; Haruna, Hu, & Wah Chu, 2018). Thus, there is a strong need to develop innovative sexuality education program for rural populations to fit the context of their community and offer engaging learning techniques.

Game-Based Learning (GBL)

One way developers have updated their approach to program design in an effort to make programs more engaging is by using games and game-based learning (GBL). Games have the potential to be both engaging and educational (Abt, 1970; de Freitas, 2006). While traditional games aim to entertain the user, GBL aims to educate the user through game play (Noemí & Máximo, 2014). Researchers and developers support the use of GBL because it is an effective teaching strategy that is highly attractive and motivating for participants (Abt, 1970; Garris et al., 2002; Haruna, Hu, Chu et al., 2018; Noemí & Máximo, 2014). When designed appropriately, the user of GBL is motivated, focused, and engaged to the point of repeatedly playing or returning to the game over time (Garris et al., 2002). Research shows GBL cultivates critical thinking, motivates youth to apply knowledge and skills, and increases confidence levels (Cicchino, 2015; Harrold & Fuller, 2015; Haruna, Hu, & Wah Chu, 2018). Ultimately, GBL is an effective strategy enabling students to develop, apply, and practice critical thinking skills more efficiently than traditional teaching methods (Blunt, 2006; Haruna, Hu, & Wah Chu, 2018).

Furthermore, the theoretical underpinnings of GBL suggest that games can be a source of education and skill development in communities with limited resources or social norms that do not support discussing taboo topics, such as sexual health (Haruna, Hu, Chu et al., 2018). This concept is especially applicable for small, rural communities who lack options or access to traditional resources for health education. Moreover, games developed collaboratively with community stakeholders can incorporate aspects of socio-cultural norms that may go unaddressed in traditional programming approaches (Haruna, Hu, Chu et al., 2018).

Human-Centered Design (HCD) Approach

Developing innovative programs and GBL programs requires thoughtful strategy and techniques. One approach to innovation is human-centered design (HCD) (Bevan Jones et al., 2018; Brown & Wyatt, 2010; Collopy, 2019; Cottrell et al., 2009; Garney et al., 2019; Hendricks et al., 2018; Kasper & Clohesy, 2008; Vechakul et al., 2015; Wilson et al., 2017). HCD is a collaborative, rapid-cycle process to co-create meaningful intervention prototypes *with* stakeholders, rather than just *for* stakeholders (Brown & Wyatt, 2010; Vechakul et al., 2015). Rooted in empathy, HCD helps professionals develop a deep understanding of their target populations' needs and the underlying problems that need to be addressed (Kasper & Clohesy, 2008; Vechakul et al., 2015). HCD often involves techniques similar to ethnographic research including, but not limited to, observations, interviews, contextual inquiry, and immersion (DeVoe et al., 2014; Thorne et al., 2019; Vechakul et al., 2015). Through such practices, the experiences of the end-user provides, and are treated as, invaluable expertise on the core problem researchers or developers may not otherwise extract (Blomqvist et al., 2010; Elsbach & Stigliani, 2018).

Upon understanding the problem at hand, stakeholders and program developers then engage in converging and diverging strategies to iteratively brainstorm, develop, and refine ideas, incorporating user feedback along the way (Brown & Wyatt, 2010; Kasper & Clohesy, 2008). This process continues in a rapid cycle to maintain momentum for developing a new program or service in a timely manner (Brown & Wyatt, 2010; Ferguson, 2018). As potentially promising ideas are further developed, they are presented to end-users for feedback. This feedback allows developers to refine the innovation while still at the "drawing board," rather than reconstructing a fully developed program, service, or product. While still a relatively new concept to social services, HCD is increasingly being used in health promotion and health education to further meet the needs of society through innovative programs and practices (Bazzano et al., 2017).

Purpose/Objectives

This article discusses the use of HCD to create a GBL program called *Using The Connect* (UTC), a sexuality education program comprised of four games and one take-home activity for youth in grades 6-8, which was developed through an academic-community partnership between Texas A&M University (TAMU) and Michael's Angels Girls Club, Inc. (MAGC), a rural youth-serving community-based organization in Tarboro, NC. This partnership developed after MAGC participated in an HCD "bootcamp", facilitated by the TAMU project team, that was hosted by Rural Opportunity Institute (ROI) in Tarboro, NC for local organizations, such as MAGC. This manuscript is a result of the partnership and work accomplished through it, revealing important lessons learned regarding program development.

The purpose of this article is to discuss the development of an innovative, GBL program called *Using The Connect* (*UTC*) using a human-centered design approach with a community-based organization in rural North Carolina.

2. Methods

In December 2017, ROI, a social innovation lab in rural Eastern North Carolina, applied to be and was selected as the host site for an HCD bootcamp led by the TAMU. After the selected host site, ROI recruited local community members and organizations to participate in the HCD bootcamp. The HCD bootcamp was aimed to develop organizational capacity for innovation in adolescent health. Fourteen stakeholders [officially] representing four organizations attended; of those, three attendees were community stakeholders not employed by the organization they represented/participated with. Participating organizations comprised: one preparatory school, one social services agency, and two after-school program-type organizations. To arrive at a program idea that could be further explored and developed beyond the one-week bootcamp, participants worked with people from their organization and/or community stakeholders in groups of two to four people. During the four-day bootcamp, stake-

holders collaboratively participated in HCD strategies—which included intensive activities to assess its community's concerns, assets, resources, and deficits—and brainstormed ideas for innovative teen pregnancy prevention programs for their community.

At the end of the bootcamp, Michael's Angels Girls Club, Inc. (MAGC) was one organization that received support and funding to proceed with further developing their program idea. Although the team ended the bootcamp with a program idea, which resembled The Amazing Race, they did not have a developed program and therefore needed to continue using design activities to explore and iterate the idea. Due to low program development capacity of this small two-person organization, MAGC partnered with facilitators from the TAMU team to conduct a design sprint. The TAMU design facilitation team traveled to Tarboro once a month for four months to work with the MAGC design team in one- and two-day design sprint workshops. The MAGC design team comprised the two MAGC staff and three additional community members convened to be on the team: one was a local young person, one from the Edgecombe County 4-H program, and one from a local social service agency who worked primarily with local adolescents.

Design Sprint Workshops

The design sprint workshops were guided by a pre-developed tentative schedule following LUMA Institute's iterative HCD process of looking, understanding, and making. Design workshops occurred during workdays at the MAGC facility in downtown Tarboro, NC, and focused on identifying the core challenge and leverage points in the system, understanding the needs of the youth, brainstorming and iterating program ideas, developing prototypes, and soliciting user feedback (see Table 1).

Prior to the design sprint workshops, the TAMU team traveled to Tarboro, NC to meet with the lead contact of MAGC to discuss planning and preparation steps to complete before the workshops. The first workshop focused on setting the stage for developing a program by creating a systems map for the Tarboro, NC community. The systems map allowed the design team to identify leverage points for having an impact on the community, and develop guiding "how might we…" statements to guide the design process. In the second workshop the design team examined components of games local youth identified as "favorites". This allowed them to identify key features and components of the games to apply in brainstorming and creating educational games for sexual health. The third workshop centered around game development and iteration. During this workshop the design team narrowed their focus to the specificity of each game including its purpose (content and/or skill), components, and functionality—testing early ideas among the team for early critiques and revisions to reach near-final prototypes. The fourth workshop entailed finalizing game prototypes and preparing for and conducting user-testing with local youth. This was an important step as the youth provided feedback on the most formal and finalized games. Feedback from the youth was then used to modify games before presenting

Table 1. Outline of design workshop schedule and key activities.

	Focus	Activities/Tasks
Day 0 9/07	Planning and preparing for the design sprint	• Select overarching challenge • Get a "decider" (or two) • Recruit design team • Schedule extra experts • Select facilitator • Block days on calendar • Identify design workshop location
Day 1 9/28	Identifying the core challenge and system leverage points	• Introductions to build cohesion • Overview of design sprint and questions • Set long-term goal • Systems mapping and leverage points • Ask the experts • Create guiding "How might we…" statements • Select target population • Initial concept posters for program ***Homework***: *talk to local youth about favorite games and activities*; *talk to local youth-serving professionals about program needs and organizational capacity*
Day 2 10/18	Designing games for health	• Play and analyze existing games • Game design basics • Identify skill/content areas of focus • Creating educational game prototypes • Brainstorming educational games (crazy 8's, storyboarding and concept posters) • Identifying and selecting key components (buy-a-feature) ***Homework***: *present concept posters and storyboards to youth for feedback on questions, concerns, likes/dislikes, and recommendations*
Day 3 10/19	Refining and re-iterating program games	• Brainstorm and re-iterate compelling prototypes • Critique and re-iterate prototypes • Objectives, instructions, and functionality of games • Designing specific game components and features • Play-testing ***Homework***: *show prototypes to stakeholders for feedback*
Day 4 11/6	Finalizing prototypes and soliciting user feedback (part 1)	• Finalize game components, functionalities and features, and program logistics • Decide on names for games and graphics theme • Create final prototypes • Develop questions and protocol for user-testing • Usability testing with local youth ***Homework***: *review feedback and use to modify games*
Day 5 11/8	Finalizing prototypes and soliciting user feedback (part 2)	• Usability testing with adult community stakeholders • Review feedback from adults; compare to feedback from youth • Modify games using stakeholder feedback ***Homework***: *present revised games to youth for feedback*; *begin planning for feasibility testing*

to the adult stakeholders for their insight at the final workshop.

Community Stakeholders' Feedback and Involvement

Between sessions, the MAGC design team was tasked with gathering insight

and feedback from youth and other stakeholders in the community. This ensured user-voice guided the development of program ideas and prototypes based on the community's wants and needs since workshops could not be scheduled during the youth's free time. The TAMU team provided the design team with techniques and example questions to solicit insight and feedback from youth and stakeholders. Solicitation of insight and feedback between sessions did not occur in a typical, formal research fashion, as conducting formal interviews or focus groups was not feasible for the design team. Rather, the design team would meet and talk with stakeholders as they were able; spending various amounts of time soliciting insight and feedback as the team members and stakeholders were able. The design team primarily focused on receiving feedback from youth of all genders in grades 6 - 8, along with slightly older youth that could provide retrospective insight. During the workshops, emphasis was placed on the youth's preferences and needs as the design team worked through HCD strategies to iteratively create, test, and modify the program games.

Final Prototype Production

Through the design sprint process, the design team designed a GBL, TPP program targeting middle school-aged youth (grades 6 - 8, or 11 - 14 years of age) called *Using the Connect* (*UTC*). After the final workshop, the MAGC design team worked with experts in health education and pedagogy, and graduate students from TAMU skilled in graphic design to create content and final prototypes for UTC games and activities. All sexuality education content developed for UTC was centered around the National Health Education Standards (NHES) and the National Sexuality Education Standards (NSES) for youth in grades 6 - 8 (Future of Sex Education Initiative, 2012; The Centers for Disease Control and Prevention, 2019).

Designed as a set of four educational games and one take-home activity, UTC teaches youth sexual health knowledge and skills to prevent teen and unintended pregnancies. Each game focuses on acquiring knowledge or developing skills from the NSES, including core content for understanding the mind and body, positive communication skills, problem solving to make healthy decisions, and accessing credible information (Future of Sex Education Initiative, 2012). UTC also facilitates safe connections between youth and adults in the community through a "take-home" activity. This take-home activity enables youth to engage in two-way conversations with adults to develop safe connections with trusted adults in their community.

The developers aimed to make UTC user-friendly so that it would be "easy-to-use" for organizations. As such, the program comes with a facilitator manual that provides step-by-step instructions for facilitators to reduce training requirements. The manual includes copies of all game instructions and content along with facilitation tips. As the sexuality education content is incorporated into the games, UTC does not utilize didactic teaching, which minimizes the background and experiences required of facilitators.

Usability Testing

Usability testing is a key part of program and product development. Usability testing aims to improve the design of a program or product by identifying areas for improvement (TechSmith, n.d.; U.S. Department of Health and Human Services, 2020). This is done by collecting data as participants attempt to complete tasks associated with participating in the program or using the product (TechSmith, n.d.; U.S. Department of Health and Human Services, 2020).

Sample: Upon finalizing UTC prototypes, MAGC brought together two groups of stakeholders for usability testing of the final prototypes: 1) youth ages 9 - 14 (n = 7; all females), and 2) community youth-serving adults (n = 4; three males and one female). The youth convened on a Tuesday evening afterschool, while the adults convened on a Thursday morning during the first half of their workday. Both sessions took place at the MAGC facility and lasted approximately 2.5 hours.

Process: Both stakeholder groups participated in the program by playing each game and doing the take-home activity, led by a member of the design team. Participants received journals and a list of prompts to confidentially write their thoughts and comments on the games and take-home activity regarding the structure, style, and content of the games. Prompts asked participants to reflect on and document the following: likes, dislikes, questions and points of confusion, recommended changes, clarity of instructions, overall look and feel, and other/miscellaneous. The majority of participants also provided verbal feedback. An observer was present to document observations of user-testing, and write down participants' verbal comments; observation notes were used to triangulate findings.

Analysis: Researchers from TAMU reviewed, coded, and analyzed journal responses and observation notes using an open-coding mechanism to ensure codes reflected the participants' views (Creswell, 2013). After the researchers reviewed and coded all data, they categorized final codes into themes. Key findings and themes were relayed to the design team to use in making program modifications as warranted immediately following usability testing sessions.

3. Results

Through the design sprint process, the MAGC design team designed four games and one take-home activity. See **Appendix** for a description of each game and the take-home activity. Each game and activity went through numerous rounds of iteration, and reached the point of formal "rough draft" prototypes as usability testing was expected to warrant at least some changes. Prototypes comprised all materials necessary to play the games and complete the take-home activity, including: game boards, game/scenario cards, game pieces, instructions, and supplemental information and resources. The design team consulted TAMU to develop content for the games. The TAMU team developed approximately eight to ten sets of content for each game for usability testing. To ensure age- and developmental-appropriateness,

all content and skill-development aspects were developed to align with the NHES and NSES, and be trauma-informed.

Qualitative Findings from Usability Testing

The usability-testing results focus on feedback from youth and adult stakeholders gathered through journal responses and observation notes. Both youth and adults expressed the games were fun, educational, challenging, and engaging overall, though warranted room for improvements. Observations corroborated youth journal responses. Several themes arose regarding the usability of UTC. Researchers and the design team paid particular attention to those warranting revisions and modifications (see Table 2).

Question Cards: All games and the take-home activity included question or scenario cards. Two of the games required one player read the question out loud for another player to answer. Therefore, it was important that question wording not only be clear and concise, but specific in asking for only one answer. Both

Table 2. Key findings and revisions identified through UTC usability testing.

Category	Key Points
Question Cards	• Ensure each card has a single question (i.e., no two-part questions). • Revise "select all that apply" questions. • Not all questions are clear in what the player is being asked to answer. • Content to include: sexual assault, inappropriate behaviors, minor consent, and access to healthcare services.
Instructions	• Always have the card-reader read the answers out loud once the player says their answer. • Make sure instructions are written in a clear, step-by-step manner. • Some instructions are adaptable: make optional adaptations separate from the primary instructions to prevent confusion. • Include a way to "pass" if youth feel uncomfortable or triggered. • Include an informational/instructions card for the take-home activity with a sample script to help the youth get started.
Content and Perceived Benefits	• Content was challenging, but within middle-school-age standards • Participants learned content and skills for healthy behaviors
Design	• Keep instructions separate from game board and materials so the game does not look overwhelming. • Be consistent in colors and graphics used in all games. • Make game boards conducive to playing multiple times.
Language	• Language was sometimes too technical/textbook-y. • Need to include youth-friendly language/answers to be more relatable. • Ensure all questions are written at appropriate reading level. • Include notes about the importance of using medical terminology.
Misc./Other	• Takes time to think and write answers; be considerate of time. • Include resource sheet with definitions of key terms (particularly for communication skills). • Facilitators need to be prepared to step in and respond if youth reveal behaviors or information that require reporting or deviate from the games and content.

youth and adults found it difficult to answer "select all that apply" and two-part questions without having it in front of them to read.

Instructions: When the youth read the instructions for the games, the majority of the time they understood the purpose and successfully completed each game and take-home activity with minimal questions or confusion. Meanwhile, the adults did not always understand the purpose and instructions of games, and struggled to complete the take-home activity and some games. Observation notes indicated the adults appeared to have been overthinking the instructions. Additionally, optional adaptations cut into gameplay time and sometimes created confusion. As the youth feedback was priority and positive, the design team used the adult feedback to review and edit instructions to be clearly written in step-by-step fashion.

Content and Perceived Benefits: The adults expressed concern over content potentially being too difficult for youth and their inability to answer the questions leading to feelings of defeat. The youth did indicate that some questions were difficult or challenging, but answered every question [that arose during gameplay] correctly. After participating in UTC, the youth reported learning about anatomy, mindfulness, characteristics of healthy relationships, local resources, and problem-solving through the games. The adults felt UTC will connect youth to resources, build communication skills, promote critical thinking, and build healthy minds.

Design: Youth and adults both indicated the games looked and felt like real games. The youth recommended keeping bright colors for the color scheme (and using the colors consistently for all games), and the adults recommended using the same graphics across games. Game boards with too much text, graphics, and content was overwhelming for the participants; youth and adults recommended keeping it visually simple and not putting the instructions on the game boards. To increase variability in experience when playing more than once, and flexibility in playing time, participants recommended boards not having a clear "ending" space and be conducive to shorter or longer playing times.

There was one game the youth stated was difficult to play. While they felt the skill and purpose of the game [communication] was important, the youth did not feel the game was adequately designed to teach and practice the communication skills it aimed to. The youth commented on aspects of the game that were important (hands-on, challenging, requires you listen, and helps you with your words and how you communicate) while offering recommendations to re-design the game (work as a group, have quotes or examples to practice and then build off of, and build from person-to-person). Following HCD principles, this game was immediately re-designed using the youth's feedback and the new version was presented to the adult stakeholders for feedback. Adult feedback for the revised communication game was mostly positive, but still warranted room for improvement in the instructions and purpose of the game, which sent the design team back to iteration.

Language: Language was also an important topic regarding usability. As a TPP program, UTC uses medically accurate terminology. However, sometimes the content was so technical that participants weren't sure how to respond or didn't feel it was relatable. Both youth and adults recommended keeping the medically accurate terms, but incorporating youth-friendly language when possible to increase relatability. Adults expressed concern over youth not being able to understand some content, therefore the design team decided to double check reading-level once content was updated. The youth also recommended incorporating notes or content about the importance of using medically accurate terminology.

Misc./Other: The remaining feedback was deemed important but without a corresponding theme. First, youth stated it took a little more time to complete games that involved writing answers, though this was not perceived as a negative. Adults agreed and suggested being mindful of the additional time needed in planning and implementing UTC. The youth and adults did not always know the terms used in the games (particularly regarding anatomy). Some participants asked the facilitator for definitions, whereas others were observed looking through game materials for such information. Lastly, adults expressed concern about youth revealing inappropriate information or revealing unhealthy experiences. Regarding this disclosure, the adults stressed facilitators know what information warrants formal reporting to proper authorities, and/or be prepared to get the youth back on track when conversations and behaviors become off-task.

The aforementioned results from usability testing were critical to employing HCD principles in the development of UTC and move the program toward feasibility testing. All results were used to modify prototypes. When re-designing the games, the design team continued to conduct small-scale usability testing with stakeholders until reaching a final design of all program games and the take-home activity to use in feasibility testing of UTC.

4. Discussion

As societal needs change so too must programs and program development processes. While it takes time to develop meaningful programs, developers should be conscious of their momentum and progress to complete the program before too much time has passed, causing the program to be outdated. Program development is, or should be, an iterative process that continuously incorporates user feedback, allows for failure and accepts when ideas do not work, and moves beyond initial ideas likely to be ineffective (Garney et al., 2019; Wilson et al., 2018, 2017). One common method is the development of rapid prototypes used to elicit user feedback to make adaptations early on in the development process (Ferguson, 2018; Hawkins et al., 2017). Such practices avoid unnecessary investment of resources (such as time and money, among others) into programs that are not engaging, are ineffective, or are irrelevant to the intended target population. As discussed and utilized in this study, one method to rapid program development is HCD (Brown & Wyatt, 2010; Vechakul et al., 2015; Wilson et al., 2017).

In embracing HCD, the MAGC design team designed a program comprising four games and one take-home activity over the course of four workshops spanning almost four months. Through the workshops, the team identified the key needs and skills necessary to empower local youth regarding sexual health, which became the central foci of each UTC game. The design team brainstormed ideas for game designs, iterating each game numerous times based on insight and feedback received from stakeholders (Bevan Jones et al., 2018; DeVoe et al., 2014; Thorne et al., 2019).

Throughout the design process, the team identified areas of improvement from stakeholders that may not have otherwise been revealed or addressed by constantly engaging with them to solicit their feedback. As the primary end-user of UTC is youth, the design team prioritized youth responses when conflicts arose with adult feedback. Feedback from adult stakeholders primarily contributed to interest, buy-in, and implementation logistics from organizational and facilitator perspectives. This iterative process allowed designers and developers to make revisions that impacted youth interest and buy-in, clarity of content and instructions, level of engagement, implementation logistics, and relevance of content and skills. Usability testing results revealed strong support for the innovative program.

The HCD process proved to be an effective and efficient process to develop an innovative program. Existing literature on HCD in the health education and promotion field is limited but growing. This study contributes to that literature by describing how HCD was and can be used to develop innovative programs, yielding practical lessons learned for future application of HCD, and noting ways to expand research on the use of HCD.

Limitations

The results of this case study are subject to its limitations. First, the paper presents findings from a small usability test. Only two groups of stakeholders participated in formal prototype testing due to issues with scheduling and availability of stakeholders. Both groups were relatively small with limited diversity, limiting the amount of feedback and representativeness to the larger community. While the data and lessons learned are not generalizable to larger populations, the insights and lessons learned were still important to the program development process to reach a final prototype that was suitable for this community. Additionally, data was not collected from the MAGC design team on the design sprint process. While important lessons learned were gleaned, future research on HCD in program development should consider collecting data from the design team to report on their experience.

5. Lessons Learned

Informal Prototypes

Creating informal prototypes out of available supplies and materials was critical in developing UTC games. Informal prototypes allowed developers to give their ideas substance, which permitted them to actually show the games to

stakeholders for feedback. Rather than trying to explain the games, the stakeholders were able to provide meaningful feedback based on what they saw, felt, and experienced with the prototypes regarding the design, functionality, and possibly look. This feedback then allowed the developers to "go back to the drawing board" early on, so not to waste additional time or resources moving forward with games that were flawed. By keeping prototypes informal, or considering them as a "rough draft", the design team was not tied to prototypes and, thus, able to start over completely as needed. Developers should create informal prototypes beginning as early as possible, and use them as often as possible.

Prototype Iteration and Feedback

Following the creation of prototypes, it is critical that developers iterate prototypes through feedback from end-users and stakeholders (Garcia et al., 2010; Gilliam et al., 2014). For UTC, developers presented prototypes to youth throughout the design sprint and solicited feedback. This allowed the developers to gauge youth interest and buy-in, making modifications along the way to enhance prototypes so they met the desires of the youth. Developers should remember that prototypes serve a purpose to be improved, and seek ways to improve or enhance prototypes until feedback consistently reveals no substantial flaws.

When seeking stakeholder feedback, particularly from end-users, the developers should remember that feedback may not resemble a formal research study. Similar to research studies, the feedback process should be informed, voluntary, consensual, and as representative and inclusive of the intended target population as possible. However, developers should prioritize getting feedback to inform program development versus collecting data similar to a research study. This will allow the developers to solicit feedback until "saturation is met" without concern of receiving feedback on each aspect from all participants (i.e., having complete data from all participants). Developers should value and utilize any and all feedback sought.

End-Users vs. Stakeholders

While meaningful insight can be gleaned from various stakeholders in designing a new product or program, developers should particularly focus on involving end-users in the design process (Bazzano et al., 2017; Gilliam et al., 2014; Thorne et al., 2019). When unable to include the end-users in the initial design process, developers should constantly solicit their insight and feedback along the way to ensure their needs are met and ideas incorporated. In developing UTC, the design team was unable to convene youth for the design workshops; however, they continuously met with youth between sessions to continue gathering insight and feedback from them on ideas and prototypes, and prioritized their feedback over adult stakeholders' on usability-testing of final prototypes. As results demonstrated differences in feedback from youth and adults, this is particularly important for developers to consider and be cognizant of during development processes and seeking feedback.

6. Conclusion

HCD offers an opportunity to bring stakeholders together from various organizations and sectors to identify core needs and leverage points in existing systems, understand the needs of their community, and collaboratively develop promising solutions focused on the core problems. Using HCD allows professionals to brainstorm non-traditional opportunities to fulfill the needs of the end-users. As the health education field continues to evolve, developers are encouraged to not only use HCD, but disseminate how they used HCD principles and lessons learned that will benefit others. Additionally, researchers are encouraged to study implementation of HCD in health program development, and if using HCD leads to more innovative solutions that those developed without using HCD.

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Conflicts of Interest

The authors declare no conflicts of interest regarding the publication of this paper.

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Appendix

Description of UTC Games and Take-Home Activity

All four *UTC* games are designed to be played in a facilitated environment with groups of four to six youth per game. Games do not have to be played in a particular order, and participants do not have to complete all content within one game before playing another game. Games can all be played in one day, or can be broken up and played on different days. Youth should begin with playing each game for 20 - 30 minutes at a time, but can continue playing if they are still interested and engaged in the game. Most games need to be played 3 - 5 times to completely cover all content, and you can keep track of what content is covered each round, then remove those cards for the next round to prevent repeating content.

1. Making Connections (Take-Home Activity)

Objective	**To make safe connections with trusted adults.**
Description of Tasks	Each youth gets a zipper bag with instructions, conversation cards, safety tips, and contact information card. Overview of instructions for youth: 1) Find a trusted adult to connect with. 2) Pick a card and ask the adult the question on the card. Then the adult asks you the second question on the card for a two-way conversation. 3) Write down the adults' contact info on the contact card to connect in the future if needed. 4) Give the adult the card to talk with other youth in the community.
Example Content	**Connection Card** ***Youth to adult***: Tell me about a goal you accomplished. How did you achieve it? How did you feel? ***Adult to youth***: Share with me a goal you have. When do you set that goal? How will you achieve it?

2. The Sum of The Parts (Mind and Body Game)

Objective	**To learn about changes to the mind and body as you grow/develop.**
Description of Tasks	Overview of instructions: 1) Roll picture dice. 2) Draw a card from the deck matching the image on the dice; pass the card to a neighbor to read out loud. 3) Answer the card question correctly. 4) If you answer the question correctly, put one of your PlusPlus building pieces in the middle to build a structure as a group. Topics of card decks: 1) Anatomy and physiology, 2) Mind and emotions, and 3) Social aspects and interactions
Example Content	**Game Card** ***Question for Youth***: What is the opening of the uterus called? ***Correct Answer***: Cervix ***Optional Hints***: 1) Starts with "C", and 2) Sounds like "circus"

3. Tapped In (Accessing Information Game)

Objective	**To identify and practice accessing credible sources of information.**
Description of Tasks	Overview of instructions: 1) Select a playing piece to put on board. 2) Roll numbered dice and move playing piece the number of spaces displayed on numbered dice. 3) Draw a card from the deck matching the colored space the piece landed on; pass the card to a neighbor to read out loud.

Continued

4) Answer the card question correctly.
**If piece landed on a black/Challenge space, complete the Challenge on the card to practice accessing sources of information.
Topics of card decks: 1) Healthcare providers, 2) Schools, 3) Technology, and 4) Community

Example Challenge Card

Content In case you ever need to talk to an adult about sexual health, you should practice so you are comfortable. Pick a question from the list below to ask the teacher. After they answer, discuss how they made you feel comfortable.

- What is contraception?
- What is the most effective way to prevent pregnancy?
- How often should you get tested for STIs?

4. More Than Words (Communication Game)

Objective **To identify and practice using effective communication skills.**

Description of Tasks **Part 1**—Complete puzzles describing 1) communication styles: aggressive, assertive, passive, and passive-aggressive; or 2) communication skills: active listening, empathy, nonverbal communication, and respect.
Part 2—Similar to a board game. Overview of instructions:
1) Roll colored dice and move playing piece on the same colored path.
2) Draw the cards from the space they landed on and identify what communication skills or styles were used, if any. (*Each space contains cards with parts of a script. The script will develop with each move. The final script will vary by paths taken and communication skills and styles used or not used.*)
**Repeat steps 1-2 until reaching a final script.
3) Draw and answer debrief questions.
4) Players rewrite the script in their own words.

Example Content **Example of Content on Puzzle**
***Active Listening*:**

- When you show you understand what someone really means…
- Not just hear the words they say, but interpret them;
- It requires paying attention to their tone, body language, and message.
- Example: "*Your tone seems like you aren't ready to have sex, if that's the case then it's okay. You can tell me.*"

5. Stop • Think • Act (Decision-Making Game)

Objective **To think critically about scenarios and problem solve to make healthy decisions.**

Description of Tasks Similar to a life-size board game. Youth work together as a group to complete. Each youth is assigned a place on the board to begin (and instructions for moving to new sections) based on the number of players. Overview of instructions:

- Player in section 1: Draw and read a scenario card out loud.
- Player(s) in section 2: Identify different decisions for the scenario.
- Player(s) in section 3: Write down the pros and cons for each decision.
- Player(s) in section 4: Identify a local youth-friendly provider that youth could talk to if they were in that situation.
- Player in section 5: Review the aforementioned pieces and decide what the healthiest decision is.
- All participants: Answer discussion questions.

Example Content **Scenario Card**
Hayden has been crushing on Devin for a while. Devin just added Hayden on SnapChat. Their conversations were flirty and harmless at first, but now Devin has been sending Hayden really sexual messages. Hayden has started to feel uncomfortable. What should Hayden do?