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# Engagement in Practice: Collaborating with University Extension on Game Jam Workshops to expose middle school aged learners to basic programming concepts

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**Background & Motivation**

Land Grant Universities have a foundational mission to serve the communities and geographies in which they are embedded. Increasingly, this mission includes cultivating young adults who can contribute to the economic growth of a region and preparing individuals for democratic citizenship in their communities. Scholar practitioners at Iowa State University's School of Education, College of Engineering, and Extension and Outreach Office collaborated to design and evaluate a workshop aimed at addressing these twin imperatives.

As a team we planned a three day game design workshop for middle school students that:

- fosters interest in computer science careers by exposing students to basic programming concepts;
- encourages the development of ethical decision-making capacities by designing games that address contemporary challenges in adolescents' lives; and
- harnesses the motivational affordances of games to encourage students to engage in interest driven learning.

Game Jam workshops are potentially well suited to achieving the goals we note above because of their open-ended nature [3]. Game jams build on the affordances of games, offering youth a playful and agentic perspective on design and problem solving, while exposing them to basic computer science concepts. Game jams are particularly well suited to engage youth in conversations about complex themes and social problems and they provide a space where emerging adults can explore and affirm their social and vocational identities [2]. As such, organizers need to be particularly thoughtful about how they incorporate issues of representation [1,4].

As part of our efforts to engage a wide cross-section of students, the event communications did not focus on the actual products the youth would create but on providing youth with tools to create games-foregrounding agency and students' control over the process. Additionally, we emphasized that participants did not need any prior knowledge to participate.

**Partnership development**

Our workshop grew out of an existing research collaboration at Iowa State University entitled Game2Work aimed at using serious games and gamification to expand pathways to STEM academic majors and careers. Game2Work brings together interdisciplinary researchers from across the institution to develop games, evaluate implementation strategies, and design novel applications for gamification.

The middle school game jam grew out of a project developed by the first author, focused on civic engagement and game design. Game2Work researchers contacted ISU Extension and Outreach who identified a need for programming for middle school aged students that could address organizational priorities around STEM education and career pathways. ISU Extension and Outreach took the lead on logistics and student recruitment, while the authors affiliated with Game2Work developed and facilitated the curriculum. Both groups collaborated on evaluation of the program and developing a strategy for disseminating the curriculum.

**Project design and execution**

We developed a workshop that focuses on identifying place-based challenges youth face in their daily lives as inspiration for game design. Once they identify a problem, participants use storyboards to create a narrative scenario. Youth designers are then introduced to game mechanics in order to implement player

choice into their games. At the end of the workshop, a group of 16 middle school students developed four narrative video games using bitsy where player choice determines the outcome of the game.

Our learning outcomes focused on increasing student awareness and interest in computer science careers, fostering moral and inter-personal development by providing students an opportunity to think about purpose and their role in social change, and encouraging students to use games to explore place-based challenges in their own lives.

*Learning Outcomes and Conceptual Framework*

The conceptual framework links youth development and foundational learning outcomes in computer science and computational thinking through the program activities. As all of our participants are 'middle school aged', and we expect that they would be in the process of exploring potential identities, reflecting on future goals, and experiencing developmentally relevant role confusion [5]. The first set of tasks- identifying a place-based challenge- engages students' values and beliefs by encouraging them to reflect on what they care about. The second set of tasks exposes students to basic computer science concepts through the enactment and development of scenarios they developed around place-based challenges.

In terms of moral and interpersonal development, we were interested in how youth aged 12-15 in a game jam program expressed 1) moral sensitivity, the ability to read a moral situation and determine what role they might play; 2) moral judgment, the ability to solve complex moral problems using reason about duty and consequences; 3) moral motivation, the ability to cultivate self/regulation leading to prioritize ethical goals; and 4) moral action, the ability to intervene and take initiative for others [7].

Our other set of learning outcomes and program objectives, focused on providing middle schoolers to a couple of "big picture" ideas associated with both engineering and computer literacy. We followed the Next Generation Science Standards (NGSS) which set a national agenda for developmentally appropriate engagement in science and engineering learning [6].

Our workshop allowed students to demonstrate competency in MS-ETS1-1, which relates to the definition of constraints in an engineering problem in order to ensure a successful outcome [6]. Students used Bitsy, an extremely simple game programming engine compared to mainstream tools like Unity and Unreal. Bitsy provided a simple, constrained environment for students to develop in, giving them valuable experience in constrained design and engineering.

We also emphasized proficiency in basic computer literacy topics. For computer literacy, we specifically used standards from the Computer Science Teachers Association (CSTA). CSTA standards are also used in the K-12 environment to map computing outcomes for students. CSTA was used over NGSS for the computer literacy portion as it better fit our emphasis on computer literacy and the flexible design required for game jam programs.

To that end, using Bitsy, students were able to develop both the graphical and mechanical portions of their proposed games. Bitsy provided both typed and "drag and drop" programming environments, so students of all computer literacy skill levels could be included in our workshop. During the workshop, the programming aspects were focused around foundational concepts in programming which could be used in a Bitsy game, like variables and control structures. Students were exposed to variables (CSTA 2-AP-11; [8]) through a required inventory system in their games. Control structures and conditional execution were covered through a requirement of a "locked door" in their game, where progress was halted until a specified interaction took place. Finally, students gained some experience with looping and cyclical control structures. Originally, we were only planning to engage students in simple linear conditionals, but students pushed the mechanics of Bitsy beyond our expectations and created cyclical game loops (returning to game levels multiple times). In addition to mechanical skills, students were also introduced to "soft skills" through the

design/feedback/iteration process we integrated into the workshop, which also adhered to a standard (CSTA 2-IC-22; [8]).

**Workshop Design**

The workshop, entitled "Designing Games for Change" leverages the user-friendly game engine, Bitsy, to make computer science accessible to students with no prior programming experience. The games created in Bitsy have a pixel-art style, with a limited color palette and small resolution, and provide youth with opportunities to experiment with game mechanics, storytelling, and interactive elements.

We organized a 3-day summer camp for 16 participants aged 12-13 years old with the facilitation of the research team. We divided the sessions into five sequential stages: 'Empathize', "Frame your problem", "Illustrate your game", "Make a Prototype", and "Testing" (Table 1).

*Table 1. Summer Game Jam 3-day workshop structure*

| SUMMER JAM<br>3-day workshop structure | | | | | |
|---|---|---|---|---|---|
| **STAGES** | **EMPATHIZE** | **PROBLEM-FRAMING** | **ILLUSTRATE YOUR GAME** | **PROTOTYPE** | **TESTING** |
| **DAY** | Day 1 - Morning | Day 1 - Afternoon | Day 2 - Morning | Day 2 - Afternoon | Day 3 |
| **OBJECTIVE** | Developing self- and social awareness. | Identify pressing social challlenges facing youth. | Define a game concept with a theme and mechanics. | Develop a decision tree process for a narrative game. | Testing an early iteration of the game and presenting to peers. |
| **ACTIVITIES** | Design a Mario Kart circuit for a gamer persona.<br><br>Reflective writing task to generate themes for the game. | Collaborative brainstorming and selection of themes.<br><br>Research on the different themes and how games have addressed them. | Create a front cover for their game including title, description, and illustrations.<br><br>Presentations and peer feedback. | Training in game development using Bitsy.<br><br>Development of a paper prototype identifying scenes, characters, dialogues, objects and branching elments. | Importing real-world images to the game using Pixsy.<br><br>Complete game development and prepare a demo version.<br><br>Final presentations. |

During the Empathize stage, participants learned about self-awareness, self-management, and social awareness through reflective activities and familiar games. In problem-framing, teams identified and voted on pressing social challenges facing youth. The "illustrate your game" stage involved defining a game concept by creating a front cover for the game, including a game title, problem description, player feelings, and illustrations. The prototype stage involved developing a decision tree process for the game and creating an initial iteration. The final stage was testing, where participants learned how to test their early game iteration.

To support youth in developing a better understanding of empathy in game development, we first requested youth to design Mario Kart tracks using the Mario Kart Home Circuit kit. Youth were provided

with a random gamer persona and they had to develop a track that would respond to their characteristics. Then, youth engaged in a reflective individual writing task where they had to complete prompts describing problems experienced by youth, e.g. "If I could change one thing about school, it would be…", "I wish the people around me would…", "I wish teachers knew…", etc. These two activities provided youth with opportunities to think not only about the game mechanics they will be designing but also about the story of the game and how they want players to feel.

The second stage, problem-framing, involved youth thinking together as a group about the challenges they observe among their peers. Participants were asked to write down on a collaborative board ideas about challenges youth face at home, at school, at work, but also challenges they envision for their future or for future generations. Once each team had brainstormed a list of issues, they would rotate to other teams' boards and vote on issues they found most concerning. After all teams had voted on different challenges, teams coalesced around a problem they would attempt to address through a game.

Before participants started exploring game mechanics, teams were encouraged to produce a document where they could state what type of game they wanted to make and what sort of social change or social impact they envisioned as an outcome of their game. Additionally, participants were challenged to create a front cover visual for their game, including a game title, a sub-title describing the problem they had identified, a description of the feelings players would experience, and illustrations that could help players identify the type of game they will be playing. After this stage, youth presented the games to their peers and other staff members and got feedback.

On day 2, we initiated the fourth stage which exposed participants to the game engine. Given Bitsy is a suitable engine for narrative games, we first explored the game mechanics in a series of narrative-oriented video games: Florence, Gone Home, What Remains of Edith Finch and Coffee Talks. Since some of the games were not age-appropriate, we selected some specific scenes from the gameplay to show as video. Once the youth had defined the main ideas for the game mechanics, they were required to create a paper prototype identifying the number of scenes they had to design, characters, dialogues, interactive objects, and how to set up the flow of the game including conditional branching elements.

The rest of the second day teams worked on game development. As a group, we walked through variables and conditions in Bitsy and had students follow along on their own devices. Participants then applied variables and conditions to their own projects based on their storyboards. Teams selected mechanics that implemented the "decision making" part of their game. During the session, we provided personalized mentoring for each team to address emergent issues such as assigning roles to each team member, revising game objectives and discussing the need to drop or add game elements to achieve outlined objectives.

For the last day of the workshop, youth were required to bring photographs or images that represented the problem they described in their communities. They were shown how the images could be imported to Pixsy. This was an opportunity to further connect the game to the youth's lived experiences. At the end of the day, they added the final details to their games and prepared their final presentations including a gameplay demo. Figure 1 describes the development of one of the games, *Listen Up!*, which describes a girl pondering whether to share a bullying situation with her parents. Three of the four groups were able to create playable versions of their games, and the fourth group created a number of elements and demonstrated moral decision-making in their game design.

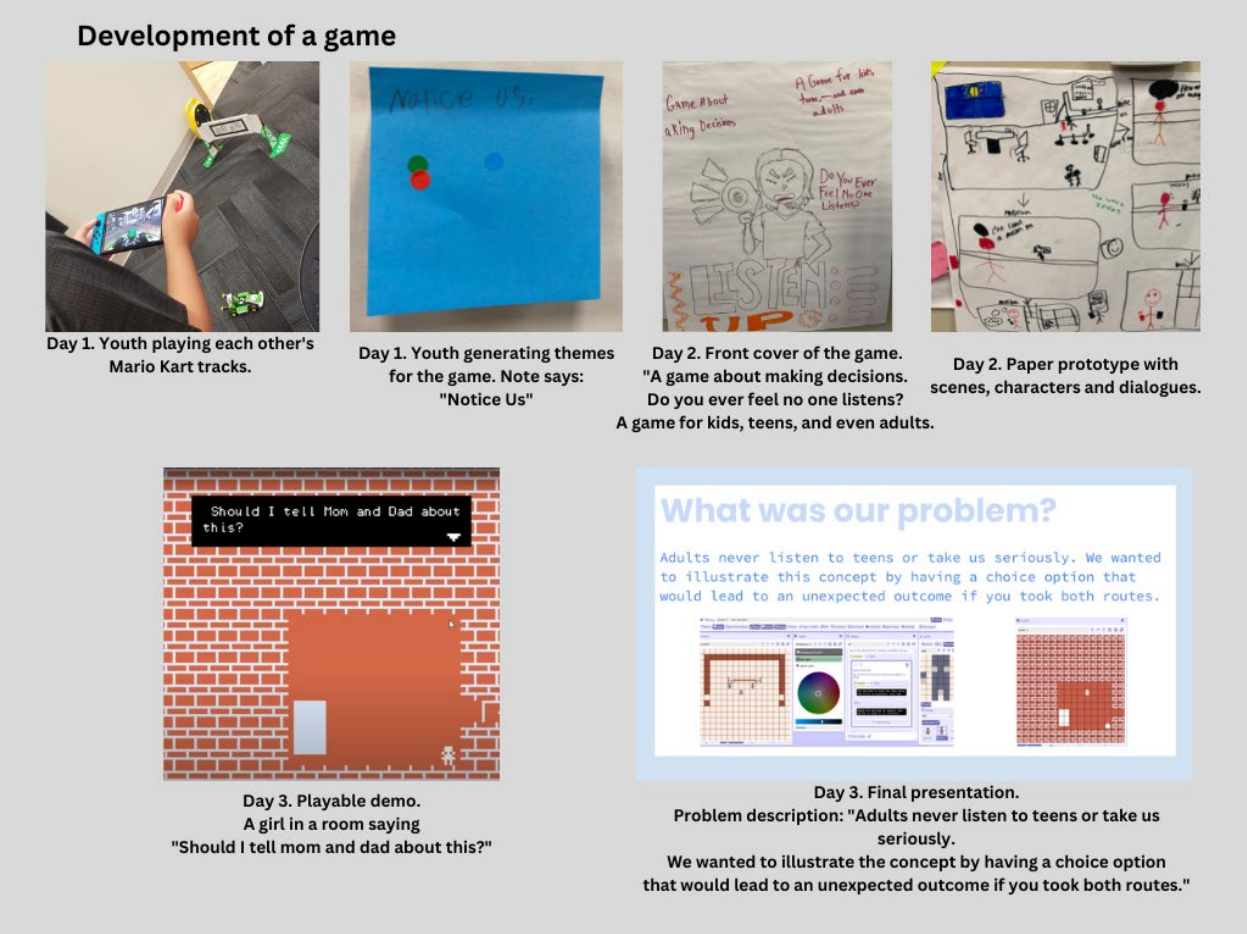


*Figure 2. Illustration of Game Design Workshop through youth produced artifacts.*

**Lessons learned through successes or failures**

For future iterations of this workshop, participants would benefit from an explicit overview of the learning outcomes, objectives they will achieve as part of their participation, and more direct instruction about programming and computer literacy topics. Students had a wide range of experience with programming and algorithms and more experienced students were not as invested in the programming process because of simplicity- more flexibility for self directed learners in the design activities would address this limitation. In our next iteration, we intend to have students work with Twine and an integrated version of Bitsy for Twine that presents a variety of levels of challenge and focuses participants' attention to narrative, identity, and choice.

The four games developed by the youth engage in identifying problematic scenarios such as gaming addiction, bullying, isolation, and high parental expectations thus supporting the place-based nature of the design process. We learned an unexpected lesson from our participants. All four teams chose to create circular decision-making processes in which the player's decisions are irrelevant for the game outcome. Youth took a game mechanic that was meant to provide players with a sense of agency in the design of their narratives to express how little agency they have over their lives. Participants subverted our workshop design through the affordances of branching programming tools. Designing games within the constraints of their youth identities ended up reproducing the challenges they experience everyday through game mechanics.

**Conclusions and next steps**

This study suggests that game jams are potentially fruitful sites for youth focused extension and outreach programming aimed at cultivating democratic citizenship, moral development, and computer science aspirations. Youth in our workshop were capable of using game mechanics to convey powerful messages through the possibilities of actions given to players. This finding is particularly relevant for computer engineering educators who hope to connect programming with creative and self-expression opportunities, which may foster aspirations for careers in computer science and engineering.

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