

Examining Teenagers' Spontaneous Play in a STEM-Based Out-of-School Time Experience for Refugee-Background Youth

Sarah Braden, Bolaji Bamidele, Sherry Marx, Aryn Dotterer, Lingga Suganda, Raquel Goldrup
sarah.braden@usu.edu, bolaji.bamidele@usu.edu, sherry.marx@usu.edu, aryn.dotterer@usu.edu,
lingga.suganda@gmail.com, rgoldrup8@gmail.com
Utah State University

Tino Nyawelo, Ricardo Gonzalez, Jordan Gerton, John Matthews
tino.nyawelo@utah.edu, ricardo.gonzalez@utah.edu, jordan.gerton@utah.edu, jnm@cosmic.utah.edu
University of Utah

Abstract: This linguistic anthropological case study examines one episode of play involving refugee-background teenagers participating in an informal STEM learning experience. This empirical case shows how the disciplinary practices of cosmic ray detector building were productively interwoven with spontaneous play directed by participating youth. The analysis reveals the need for a greater focus on play, which designers and researchers may initially dismiss as “off-task,” but may in fact be an important component of disciplinary practice. Furthermore, we call for attention to play as a potentially important feature of designing and researching culturally sustaining pedagogies (CSPs) with and for diverse learners in informal STEM learning contexts.

Introduction

In this paper, we examine one scenario of extended play among five teenage boys making jewelry out of tinfoil whilst they are constructing a cosmic ray detector in an afterschool program for refugee-background youth. This spontaneous play had no direct content-based relationship to the disciplinary work students were engaged in. However, we argue that this moment of extended play encouraged students to interact with each other in relationally productive ways. And, we argue that by playing along with the students, instructors legitimized a form of youth-directed play to create a learning context that supported the participation of culturally and linguistically diverse refugee-background teens.

Literature review

Play has long been examined in educational settings for its social dynamics and for the role it has in learning (Goodwin, 1999). Research on play has also addressed impacts on learners' ability to work with peers, problem-solving skills, and use of prior knowledge to support learning (e.g., Taylor & Boyer, 2020). While these studies have addressed play-based learning among elementary school learners, fewer studies have examined the concept amongst older learners. Furthermore, the existing scholarship examines the experiences of learners in designed play opportunities (e.g., the “Physics Playground,” Ba et al., 2021) as well as spontaneously while “tinkering” in a makerspace (McLean & Roswell, 2021). However, within STEM education, less attention has been given to play that researchers deem “off-task” or unrelated to prescribed disciplinary practices. In parallel to research on play, scholarship on creating more equitable informal STEM learning environments has explored the ways in which programs are culturally or linguistically sustaining for youth participants, ways in which programs fail to offer sustainment for students of color, and ways in which youth push back against hegemonic practices that leak from formal contexts into informal ones, to instead claim informal learning spaces as their own and to reshape the values and practices of those spaces (Calabrese-Barton et al., 2022). The CSP movement focuses on humanizing, decolonizing, socially just, and sustaining pedagogies that re-center the values, practices, and lifeways of marginalized students, thereby reversing course on the processes that lead to their marginalization (Paris & Alim, 2017). However, spontaneous play has not been specifically conceptualized within CSPs. Thus, we examine spontaneous play as a practice and suggest how such play might be conceptualized in the design of CSPs in STEM.

Theoretical framework: Identity pathways

As noted above, foundational research on play has focused on both its social functions and its role in structuring conceptual change or disciplinary knowledge development. We take the theoretical position that learning and social identification are inextricable (Wortham, 2006). Thus, in any moment of play, participants enact social roles (local identities, however momentary or enduring they may be) and orient themselves through language and embodied action to particular objects (e.g., components of a cosmic ray detector, or any other materials or tools

in the physical space). In so doing, learners engage in identity work that crafts local personae that both reflect and construct their participation in the learning context. When designers endeavor to craft CSPs that create equity for traditionally marginalized students in STEM, we argue that they are attempting to design learning environments that afford students opportunities to engage in STEM-related identity work as part of a local process of becoming. In such processes of becoming, engaging in or refraining from what might traditionally be labeled “off-task” conversations about dating and other social activities can interweave with students’ physics learning experiences and inform how students develop expertise in the disciplinary work of physics lab exercises (Braden, 2022). To explore and begin to understand how another commonly disregarded practice, play, may be related to designing CSPs with a diverse group of teenagers we ask: How does the students’ jewelry-related play interweave with their detector building activities?

Methods

Context

This analysis comes from year two of a three-year ethnography studying the STEM identity development of teens in an afterschool program that specifically serves refugee-background youth. The program involves twice weekly sessions during the school-year, and a 1-week intensive summer experience in which students build and learn to analyze data from cosmic ray detectors and create digital stories about cosmic rays and detector building. The program also hosts twice yearly family and community events in which students share what they are learning with others. The research is guided by a linguistic anthropological framing with the goal of tracing students’ pathways of STEM-identity development over time. Instructional design is informed by culturally sustaining pedagogies (Paris & Alim, 2017) and specifically focuses on relationship-building, power-sharing, student agency, and student-driven inquiry. The jewelry-making episode analyzed in this paper occurred during a detector building session at the end of year two during the summer session. Students were involved in wrapping the scintillator (produces light when struck by a cosmic ray) and light guide (directs the light towards a photomultiplier tube) to create a light tight seal around these components. The wrapping involves delicately cutting, folding, and smoothing multiple pieces of aluminum foil cut to size and taped down with electrical tape, followed by affixing pre-cut thin black plastic sheets and sealing the edges with electrical tape. To complete the detector, students then attached a photomultiplier tube to the light guide so that the light produced from the scintillator as a result of being struck by cosmic rays can be converted into a measurable electrical signal.

Participants

The five students represented in this analysis have the following national and linguistic backgrounds (all names are pseudonyms): Ali (Iraq; Arabic), Fabien (Congo; Swahili), Raphael (Mexico; Spanish), Habte (Ethiopia; Amharic) and Raj (Nepal; Nepali). Three of the students moved to the U.S when they were young through refugee channels, while Habte (refugee parents) and Raphael (unrecognized refugee status) were born in the U.S. Of the 5 boys, Fabien often seemed disengaged and disconnected socially from his peers and program staff. We noticed a shift in Fabien’s engagement in the moment analyzed in this paper. The adults present in the data include the instructor, Ricardo (US - Puerto Rico; Spanish), who recently left a physics PhD program, Jordan, a PhD physicist (US; English), and program support staff (US; English).

Data collection

Audio and video recordings capturing naturalistic conversations, field notes describing communicative practices and episodes of interest related to how students discursively performed or resisted performing expertise in cosmic ray physics, and photos of students engaging in program activities were recorded in every program session by members of the research team who acted as participant-observers.

Data analysis

In this paper, we analyze one 25min jewelry-making episode which occurred during a detector-building session. The episode was initially identified in the broader corpus as an instance that might reveal success in delivering a culturally sustaining science learning experience. Specifically, we identified instances where students engaged in joint activity and conversation that transcended social lines around which the students sometimes organized (e.g., shared national origin, race, or language), and episodes in which students behaved playfully (e.g., laughter, smiling). The episode was transcribed for talk and embodied action using a linguistic anthropological approach (Wortham & Reyes, 2020), with modifications to enable us to examine the simultaneous activity of nine participants. The transcript was then viewed simultaneously with the video and coded in two rounds. The first round of coding traced and categorized the topics of talk and embodied action that students engaged in over the

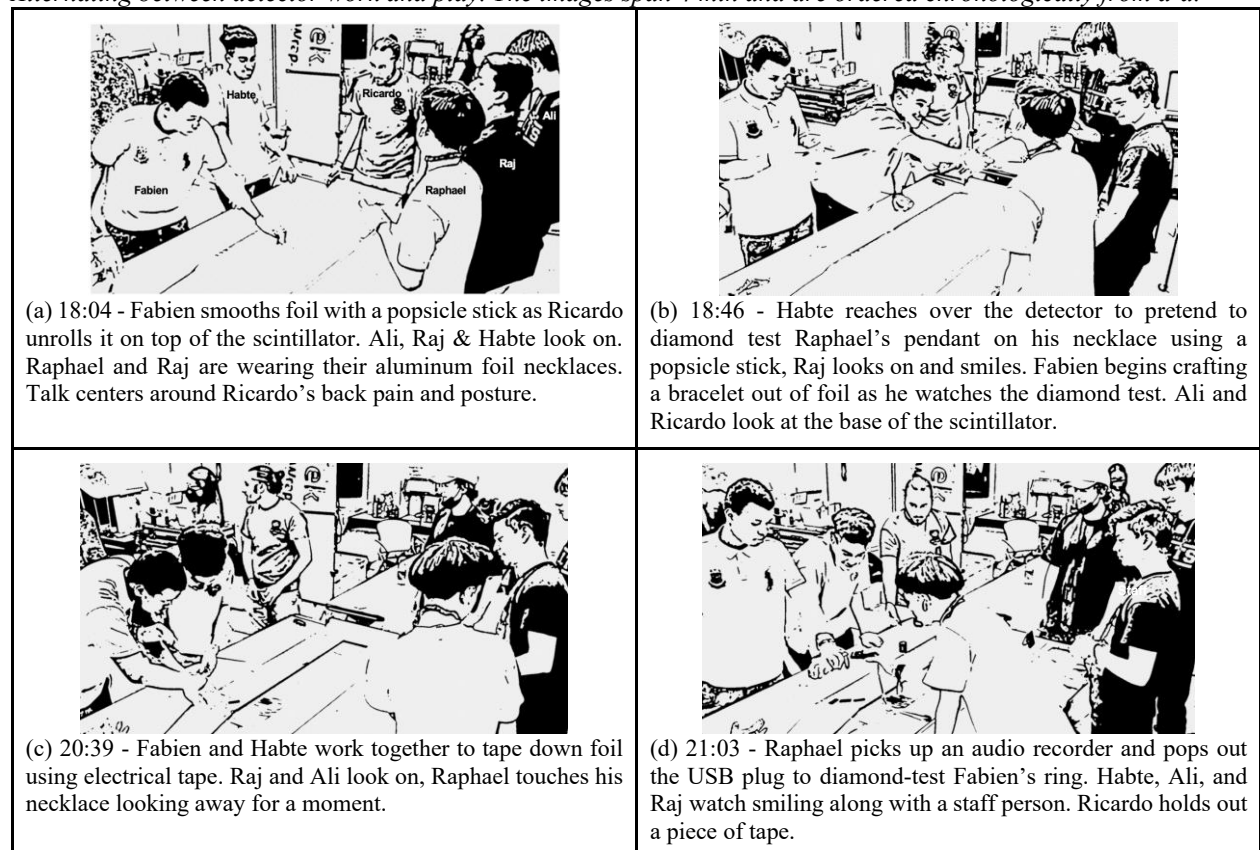
course of the episode (e.g., detector work, jewelry play, shooting play, conversation about psychics, etc.). The second round of coding focused on tagging moments of shift between play and detector work, which allowed us to see student-led changes in orientation, as well as to identify how the adults, the “physics experts,” oriented to the students’ play and detector work. During this phase, still images were made from the video to capture shifts in activity and joint attention to the jewelry and detector. Images were rendered into line drawings using Adobe Photoshop for inclusion in this paper.

Findings: How play interweaves with detector building

We found that all students who participated in the jewelry play alternated between constructing and commenting on the jewelry and wrapping the scintillator with foil. The jewelry play episode begins when Ricardo slides a piece of foil from the bottom of the detector and Raj gently slides the foil away from Ricardo and picks it up. Raj holds up the foil strip and looks at Raphael as if he is going to place the foil on him, but Raphael is not looking and leans forward to smooth the foil on the detector with the proper tool, a popsicle stick. Raj then puts the long strip of foil around his own neck and attaches the two loose ends together, carefully adjusting the strip to widen it slightly onto his shoulders. Fabien and Raphael pretend to shoot each other with popsicle sticks. Ali comments to Raj, “that’s clean,” which is slang for cool new attire. Ali and Raj are smiling and laughing, Habte looks on with a broad smile, briefly gesturing up at the necklace and continuing to smile and laugh. Fabien and Raphael continue alternating between smoothing the foil on the detector and play-shooting at each other with popsicle sticks, sometimes making gunshot noises. Habte then gestures to Raj and says, “diamond test it, bro, that’s glass,” and Raphael turns to Raj to examine the necklace. Raphael places the edge of the popsicle stick on the necklace and makes a sound “dee, dee, dee, dee,” (simulating a beeping sound). An electronic diamond tester often beeps as it is reading the stone to indicate whether or not the gem is a diamond. The boys laugh hard. Ali and Ricardo are then folding the corners of foil around the scintillator. As the episode continues, the boys alternate back and forth between the jewelry play and work on the detector as depicted in Figure 1.

Figure 1

Alternating between detector work and play. The images span 4 min and are ordered chronologically from a-d.



The sequence of activity in Figure 1 shows how play was interwoven with detector construction. For example, Fabien’s attention alternates between detector work in (a) and (c), and jewelry making and diamond testing in (b)

and (d). Eventually, Raphael, Habte, and Fabien all construct tinfoil jewelry. As scraps of tinfoil are produced from cutting the sheets that they are using to wrap the scintillator and light guide, the boys smooth and wrap the foil on the detector and use the extra bits to make their necklaces and rings. Over the course of approximately 25 minutes, the boys transition back and forth between the jewelry play (including rounds of diamond testing), the work on the detector, and additional conversations that might be deemed “off-topic” in a more formal learning setting such as the difference between a psychic and a side-kick, and how to manage back pain.

Rather than taking away from the experience of detector building, we argue that this moment of extended play allowed the boys to construct practices that they found enjoyable while working on a scientific project. Two of the five students (Ali and Raj) had previously expressed interest in cosmic ray physics and coding. They frequently participated in science conversations with physicists in the program. Ali, Raj, and Habte had also been involved in constructing a detector prior to this one. For Raphael and Fabien, this was their first time participating in detector construction. Interweaving play with detector construction work created a joyful and engaging space for this racially and linguistically diverse group of students where they crossed social lines that were previously present in the afterschool program. Prior to the summer session, we had seen Raj and Ali work together, Habte and Fabien work together with other students from African countries, and Raphael usually worked with another Latinx student who was not present. By engaging in play surrounding jewelry making, students co-created a local version of youth culture that interleaved with their work on the scientific project of cosmic ray detector building. Crucially, rather than shutting down this play, the instructors and staff in the program celebrated the jewelry making by taking photos (Jordan & a staff person) and by validating the play with joint laughter, smiling, and engaging in talk around topics other than detector-making (Ricardo). The students and instructors were nonetheless focused on detector construction and worked steadily to complete the detector with playfulness along the way.

Conclusion & discussion

In offering this analysis, we begin to theorize moments of play as the construction and reproduction of youth culture. When these moments transcend the cultural and linguistic subgroups of the afterschool program, we argue that they reveal important relational work that is part of building an equitable informal STEM learning space. In informal contexts, designers and instructors should have freedom to (re)define the role of play in their programs and to develop strategies to support spontaneous play. Researchers may begin to see play as a sign-post of youth culture in the making in their learning contexts. And, rather than dismissing or shutting down this play as a distraction or unimportant component of the learning context, researchers might instead look to these moments to identify ways to further build spaces for youth culture to thrive as a means of creating inclusion. Such revision may require reimagining what counts as a “disciplinary practice.” More research is needed on the playful practices of teenagers in order to further build the knowledge base on how to design CSPs in STEM.

References

- Braden, S. (2022). The science nerd as the science expert: Enregistering asociality to achieve disciplinary expertise in high school physics. *Linguistics & Education*, 72, 1-13.
- Ba, H., O'Malley, C., Argudo, Y., & Umer, L. (2021). Learning Physics through Embodied Play in a School Setting. In *Design Make Play for Equity, Inclusion, and Agency* (pp. 173-194). Routledge.
- Calabrese-Barton, A., Tan, E., Schenkel, K., & Benavides, A. W. (2022). Towards Justice: Designing for a Rightful Presence as a Lens for Science Teacher Education Research. In *Handbook of Research on Science Teacher Education* (pp. 52-63). Routledge.
- Goodwin, M. (1999). "Playing to Learn." Bridging Educational Research and Practice: 3-5. *Connections*.
- McLean, C. A., & Rowsell, J. (Eds.). (2021). *Maker literacies and maker identities in the digital age: Learning and playing through modes and media*. Routledge.
- Paris, D., & Alim, H. S. (Eds.). (2017). *Culturally sustaining pedagogies: Teaching and learning for justice in a changing world*. Teachers College Press.
- Taylor, M. E., & Boyer, W. (2020). Play-Based Learning: Evidence-Based Research to Improve Children's Learning Experiences in the Kindergarten Classroom. *Early Childhood Education Journal*, 48(2), 127–133. <https://doi.org/10.1007/s10643-019-00989-7>
- Wortham, S. (2006). Learning identity. *The joint emergence of social identification and Social Identification and Academic Learning*. Cambridge University Press.
- Wortham, S., & Reyes, A. (2020). *Discourse analysis beyond the speech event*. Routledge.

Acknowledgements

This research was funded by the National Science Foundation (Award #2005973).