STEAM Outreach Incorporating K-12 Teachers and Youth Robotics Workshops

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Randy Winzer is a Professor in the Engineering Technology department at Pittsburg State University in Pittsburg, KS; he served as the EET program coordinator from 2002 until 2007. He holds both BS and MS degrees in Engineering Technology and has several years of experience supporting various information technology infrastructure projects; primarily those in support of educational content delivery and K-12 education. The past twenty-one summers Professor Winzer has conducted a STEM outreach effort titled 'Adventures in Robotics' which has had over 1,000 local K-12 participants.

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Abstract

This paper reviews the ongoing Adventures in Robotics (AIR) Program's Summer Youth Workshops and the associated AIR Teacher Workshop at Pittsburg State University (Pittsburg, KS). The summer youth workshops consist of two, week-long sessions providing hands-on STEAM-related activities on the topics of programming, teamwork, brainstorming, robotic basics, and construction techniques (including an age-appropriate introduction to mechatronics). These workshops have been ongoing for 20+ years and provide a STEAM alternative to athletics-related summer camp options in the southeast Kansas region for students 9-13 years of age.

The AIR Teacher Workshop was developed and implemented in 2022 with the support of a sub-award from the Kansas NASA Space Grant Consortium. In the 11-day teacher workshop, area K-12 teachers work with the LEGO Education SPIKE Prime set, a STEAM learning tool designed for grades 6-8, which combines Lego with easy-to-use hardware and a drag-and-drop programming language based on Scratch.

Teachers received hands-on training in a one-day boot camp at the start of the Workshop to familiarize them with the LEGO SPIKE system. Teacher Participants then assisted through the two, week-long summer youth workshops, gaining hands-on teaching experience by mentoring teams of students. This provided a unique hands-on training environment for the teachers, simulating utilization of the AIR workshop materials and LEGO SPIKE system in a classroom environment.

Continued work towards the development of a mobile roadshow version of the AIR workshops will also be presented, as will metrics on student demographics and STEAM topic exposure. The roadshow concept, whereby a subset of the week-long summer program is presented in a four to six-hour format was beta-tested in October of 2022. The intent of the roadshow is to bring robotics educational opportunities to under-represented and economically limited communities. The authors continue to seek funding to implement the concept fully.

Introduction

The intersection of Science, Technology, Engineering, Arts, and Mathematics (STEAM) education is vital for nurturing young minds and fostering future innovators. The Adventures in Robotics (AIR) Program at Pittsburg State University has been a pioneer in immersive summer youth workshops for over two decades. These workshops offer a dynamic blend of activities catering to students aged 9-13, serving as a beacon of STEAM-focused educational enrichment in the southeast Kansas region.

The AIR Program also includes the innovative AIR Teacher Workshop, developed in 2022 with support from the Kansas NASA Space Grant Consortium [1]. This 11-day workshop equips K-12 educators with tools and training to integrate STEAM concepts into their classrooms, utilizing the LEGO Education SPIKE Prime set [2]. Through hands-on training and mentoring during the summer youth workshops, teachers gain valuable teaching experience.

Additionally, the AIR Program is committed to accessibility and inclusivity through ongoing efforts to develop a mobile roadshow version of the workshops [3]. This concept aims to bring robotics educational opportunities to underrepresented communities by condensing the program into a four to six-hour format. Beta-testing in October 2022 highlights the program's dedication to expanding access to STEAM education [3].

This paper provides a comprehensive review of the ongoing AIR Program, focusing on summer youth workshops, the AIR Teacher Workshop, and the mobile roadshow. Metrics on student demographics and STEAM topic exposure underscore the program's impact in fostering STEAM literacy and innovation among young learners. The paper emphasizes the program's commitment to advancing STEAM education and empowering future generations of problem-solvers.

Historical Background

In 2002, a discussion between a faculty member and a department chair sparked a 20-year initiative to promote STEM education. Jim Otter, Chair of the Engineering Technology Department, and Randy Winzer, a faculty member, proposed utilizing the Kansas Technology Center for summer K-12 outreach. Recognizing a lack of academic summer activities, they launched a camp for elementary students, leveraging the KTC facility's resources.

Targeting middle-schoolers aged ten to eleven, they aimed to combat summer learning loss in math through hands-on STEM activities, aligning with the university's motto "by doing learn." Marketing efforts in 2003 included distributing flyers within a 45-minute radius to schools and businesses, focusing on grades 3 through 7. The program's success led to yearly enrollment increases and the addition of sessions like Adventures in Robotics II.

Expanding on this success, Construct Your Future began in 2007, emphasizing construction-related STEM activities. Both programs emphasized collaboration and problem-solving, contributing to participant development. Over 20 years, they've served 1000+ learners, many returning for multiple sessions, inspiring a passion for STEM. A portion of these students have gone on to participate in various robotics competitions (FIRST, FRC, FTC and others) as well as enroll in STEM related fields in college.

Summer Youth Workshops

For over two decades, the AIR Summer Youth Workshops have significantly influenced STEAM education in southeast Kansas. These week-long sessions offer immersive experiences that go beyond traditional academics, fostering creativity, critical thinking, and innovation through programming, teamwork exercises, and mechatronics projects using LEGO robotics kits.

The workshops provide an alternative to athletic summer camps, catering to diverse interests and learning styles. Participants are encouraged to explore technology collaboratively, igniting a passion for STEAM disciplines. Activities range from introductory programming to complex mechatronics projects, challenging students to apply their knowledge in real-world scenarios with LEGO robotics kits. While there's a standard registration fee covering materials and supplies for camp attendees, scholarships are available to support those facing financial constraints who aspire to join.

The inclusive nature of the workshops ensures all participants feel welcome, regardless of background or experience, empowering them to pursue their interests confidently. With an average student age of 10.55, the workshops attract students primarily aged 10 and 11, with participants mainly from Crawford County and its contiguous counties.

Gender information collected from 2022 shows a fairly consistent ratio of male to female participants, with males comprising 72.8% and females 27.1%. These workshops not only facilitate academic exploration but also serve as a catalyst for personal growth and lifelong learning, inspiring a new generation of innovators in southeast Kansas and beyond.

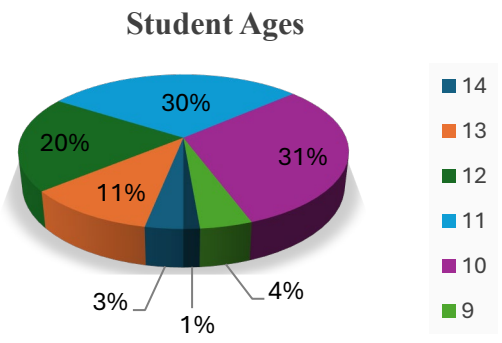

Figure 1 Chart showing the percentage breakdown of AIR student participants by age.

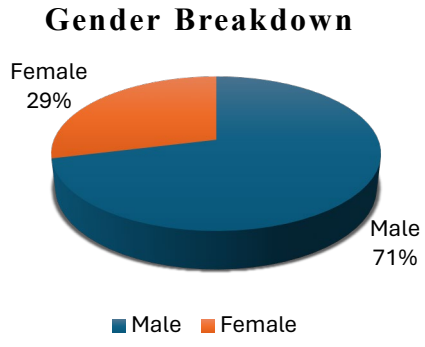

Figure 2 Chart showing the percentage breakdown of AIR student participants by gender.

AIR Teacher Workshop

The AIR Teacher Workshop, introduced in 2022, marks a significant advancement in the AIR Program at Pittsburg State University. Supported by the Kansas NASA Space Grant Consortium [1], this initiative aims to empower K-12 educators in integrating STEAM concepts into their teaching.

This professional development platform provides educators with the skills to effectively use the LEGO SPIKE Prime set, specifically tailored for grades 6-8, as a hands-on learning tool [2]. It features immersive training sessions, beginning with a one-day boot camp to introduce teachers to the LEGO SPIKE system. Through active hands-on mentoring of students during the Summer Youth Workshops, educators gain practical experience, refining their teaching methods and enhancing their understanding of effective instructional strategies. The workshop also fosters a community of practice among educators, encouraging collaboration and ongoing improvement in STEAM education.

Teachers were recruited from continuing education participant lists from Kansas Center for Career and Technical Education (KCCTE) workshops. Participating educators received a $1500 stipend to attend the workshop and 50 hours of STEAM related continuing education units (CEU). In 2023 this was augmented with the addition of a LEGO SPIKE Prime set for each participant, so they could implement the provided lessons and curricula in their classrooms [2]. These provided kits also served as initial seed investments for each of the educators to encourage their school/school district to see the curriculum at work and fund additional robotics kits. All participating educators received certificates verifying completion of 50 hours of STEM related professional development hours.

The educators gained practical experience by mentoring students during the Summer Youth Workshops, refining their teaching techniques and understanding of effective instructional strategies. During their one-day boot camp, teachers received training and discussions on how to assist and teach the workshops, including a review of best practice pedagogy [2]. The workshop fosters a community of practice among educators, promoting collaboration and continuous improvement in STEAM education. Teachers were surveyed 6 and 12 months post-workshop to report on the implementation and use of AIR lessons and curriculum in their classrooms. Over 85% of participating teachers reported using AIR materials to some extent in their classroom, with 45% reporting the use of 50% or more of the provided AIR materials. One educator utilized the provided curriculum and robotics kit to successfully apply for an in-kind grant, enabling her to purchase enough robotics kits for a full class.

The AIR Teacher Workshop underscores the program's commitment to advancing STEAM education by empowering educators to inspire the next generation of innovators and problem-solvers in their classrooms and communities.

Mobile Roadshow Initiative

The AIR Program at Pittsburg State University is pioneering a mobile roadshow initiative to enhance access to its transformative workshops. Recognizing barriers to STEAM education, the program aims to bring robotics opportunities directly to underserved communities [3].

This initiative offers condensed versions of the Summer Youth Workshops in a portable format, making STEAM learning more accessible to communities facing resource limitations or logistical challenges. Beta-tested in October 2022, the roadshow concept reflects the program's commitment to equitable access and community engagement. The roadshow offers the program coordinators opportunities to field test new and updated curriculum modules for program growth and development.

By leveraging partnerships with local organizations and flexible scheduling, the roadshow can reach previously underserved communities, promoting inclusivity in STEAM education. It represents the program's dedication to empowering all learners, regardless of background, to explore and innovate in robotics and STEAM fields.

Conclusion

The AIR Program at Pittsburg State University is a beacon of innovation in STEAM education, fostering lifelong learning for students and educators alike. Through dynamic workshops, participants develop critical skills essential for success in today's world.

Initiatives like the AIR Teacher Workshop equip educators with tools to integrate STEAM concepts effectively, while the mobile roadshow expands access to underserved communities. These efforts reflect the program's commitment to equity and inclusion in STEAM education.

In conclusion, the AIR Program's proactive approach prepares the next generation of innovators for a complex world. By promoting lifelong learning and expanding access, the program ensures that STEAM education remains accessible to all.

Acknowledgments

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